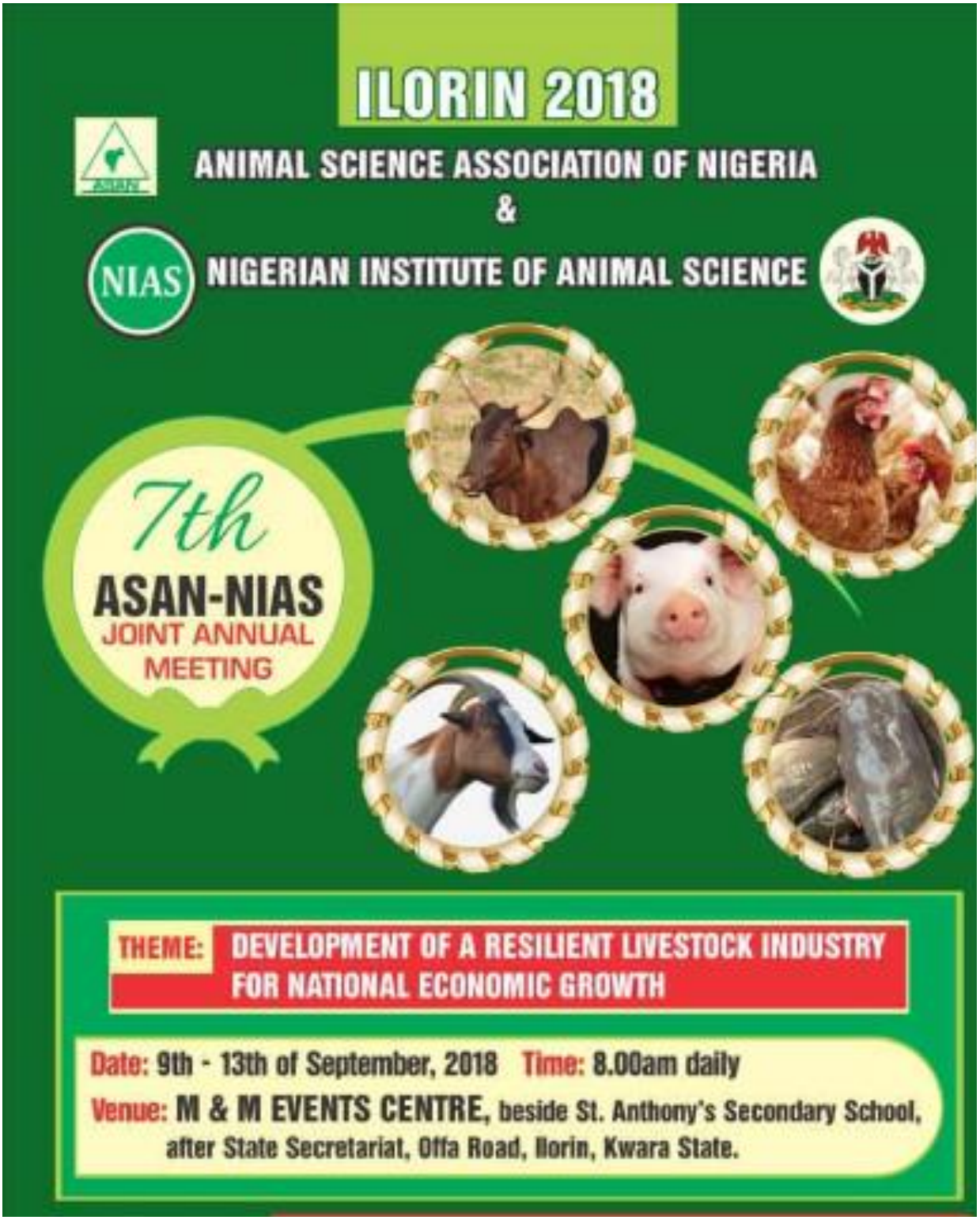

BOOK OF PROCEEDINGS

ANIMAL SCIENCE ASSOCIATION OF NIGERIA (ASAN)

PROCEEDINGS OF THE 23RD ANNUAL CONFERENCE

Theme:

Development of a Resilient Livestock industry for National Economic Growth

Edited by

Atteh, J. O., Belewu, M. A., Fayeye, T. R., Okukpe, K.M, Alli, O. I and Adeyemi, K.D.

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SCHEDULE FOR THE SCIENTIFIC SESSIONS

Scientific Sessions slated for Monday, 10/09/2018: Venue: M.M Event Centre				
Session	**Specialization**	**Manuscript code**	**Chairperson**	**Rapporteurs**
I	Animal breeding, Genetics/Biotechnology	ASAN-NIAS-JAM-AB001-19	Prof. S. O. Oseni	Dr. Sola-Ojo, F. E. Dr. Adesina
II	Mongastric Animal Nutrition and Production 1	ASAN-NIAS-JAM-MN001 to 015	Prof. D. F. Apata	Mr Akanbi Mrs. K. Aliyu
III	Mongastric Animal Nutrition and Production 1I	ASAN-NIAS-JAM-MN016 to 030	Prof. Odunsi	Dr Y. Alabi
IV	Mongastric Animal Nutrition and Production 1II	ASAN-NIAS-JAM-MN031 to 045	Prof. Dafwang, I. I.	Dr. Ogunleye
V	Ruminant Animal Nutrition and Production	ASAN-NIAS-JAM-RN001 to 015	Prof. Adeloye, A. A.	Dr. Ogunbosoye
VI	Micro-livestock Production	ASAN-NIAS-JAM-ML001-014	Prof. A. O. Olorunsanya	Dr. K. D. Adeyemi Dr. Ojo (KWASU)
VII	Animal Physiology and Reproductive Health/ Animal Welfare	ASAN-NIAS-JAM-PR001-012 ASAN-NIAS-JAM-HW001-006	Prof. G.I. Erakpotobor	Dr. K.M. Okukpe
VIII	Animal Product and Processing Technology/ Livestock Economics and Extension	ASAN-NIAS-JAM-PT001-010 ASAN-NIAS-JAM-EE001-007	Dr. Iyanda	Dr. Chimezie, V. O.

Scientific Sessions slated for Wednesday, 12/09/2018: Venue: M.M Event Centre				
Session	**Specialization**	**Manuscript code**	**Chairperson**	**Rapporteurs**
I	Animal breeding, Genetics/Biotechnology II	ASAN-NIAS-JAM-AB020 to 039	Prof. E. A. Salako	Dr. Yusuff, A.T. Mr. DeCampos, J
II	Mongastric Animal Nutrition and Production 1	ASAN-NIAS-JAM-MN046 to 060	Prof. S. A. Bolu	Mr. Fatai Ismail A.
III	Mongastric Animal Nutrition and Production 1I	ASAN-NIAS-JAM-MN061 to 079	Prof. Oyawoye (Landmark)	Dr. J. Olawoye
IV	Ruminant Animal Nutrition and Production	ASAN-NIAS-JAM-RN016 to 029	Prof. O. J. Babayemi	Dr. A.H. Badmos
V	Animal Physiology and Reproductive Health	ASAN-NIAS-JAM-PR013-029	Prof. G.I. Erakpotobor	Dr. I.O. Alli

DETAILS OF MANUSCRIPTS FOR PRESENTATION AT THE 7TH ASAN-NIAS JAM, 1LORIN 2018

	CODE	TITLE OF PAPER	NAMES OF AUTHOR(S)	ADDRESS
		ANIMAL BREEDING AND BIOTECHNOLOGY		
1	ASAN-NIAS-JAM-AB001	Nutrition as it affects reproduction in dairy cows –a review	Achi, N.P., Achi., J.N., Alphonsus, C	National Animal Production Research Institute/Ahmadu Bello University, Shika-Zaria
2	ASAN-NIAS-JAM-AB002	Early growth characteristics of chicken progenies derived from different chickens sires on fulani ecotype dams in southern guinea savanna environment of nigeria	Amao, S.R	Department of Agricultural Education (Animal Sci. Division; Animal Breeding & Genetics Unit), School of Vocational and Technical Education, P.M.B.1010, Emmanuel Alayande College of Education. Oyo. Oyo State. Nigeria
3	ASAN-NIAS-JAM-AB003	Effect of breed and sex on carcass characteristics of turkeys (*Meleagris gallopavo*).	Chana, I.M., Kabir, M., Orunmuyi. O., Musa A. A.	Department of Animal Science, Faculty of Agriculture, Federal University, Gashua
4	ASAN-NIAS-JAM-AB004	Identification of kappa-casein genotype in two indigenous Nigerian cattle	Morenikeji, O.B., Oghate, E.B., Adetunbi, A.J., Ogunshola, O.J., Chineke, C.A.	Department of Animal Production and Health, Federal University of Technology, Akure, Nigeria
5	ASAN-NIAS-JAM-AB005	Relationship among some intrinsic milk related traits in extensively-managed West African dwarf does	Yusuff A. T., Badmos, A. A., Alli, O. I., Fayeye, T. R	Department of Animal Production, University of Ilorin
6	ASAN-NIAS-JAM-AB006	Phenotypic characterization of cephalic traits of West African dwarf goat population in Nigeria	Popoola M.A., Olaniyi T.A. Bello S.M., Raji A.M., Adedeji O.Y., Adekunle O.F.	Federal College of Animal Health and Production Technology, P.M.B 5029, Moor Plantation, Ibadan Department of Animal Science, University of Ibadan
7	ASAN-NIAS-JAM-AB007	Relationship between body weight and linear body measurement in two broiler strains	Abbaya, H.Y., Gadzama, G., Dauda, A., Millam J. J., John, P. A	Department of Animal Production, Adamawa State University, Mubi, P.M.B. 025, Mubi, Nigeria

8	ASAN-NIAS-JAM-AB008	Phenotypic variation among three broiler strains in the Nigerian guinea savannah	Ayorinde, K.L., Sola-Ojo, F. E., Abubakar, I. A.	Department of Animal Production of The University of Ilorin, P.M.B. 1515, Ilorin, Nigeria
9	ASAN-NIAS-JAM-AB009	Associations between polymorphisms of the Yankasa sheep IGF-1 gene and growth traits	Umego, C.M., Kabir, M. Adeyinka, I.A Alao, R.O., Mallam, I., Ibrahim, O.A., Jinadu, L.A.	National Animal Production Research Institute/Ahmadu Bello University, Shika-Zaria
10	ASAN-NIAS-JAM-AB010	Effect of haemoglobin polymorphism on adaptive traits in White Fulani cows	Ajibola, H.O., Popoola, M.A., Awulu, S.J.	Federal College of Animal Health and Production Technology Moor Plantation Ibadan.
11	ASAN-NIAS-JAM-AB011	Effect of season on some reproductive hormones and egg production in two strains of guinea fowls (*Numida meleagris*)	Abubakar, M., Kabir, M., Adeyinka, I. A., Abdullahi, J., Abbaya, H. Y.	Department of Animal Science, Ahmadu Bello University, Zaria, P.M.B. 1045 Zaria, Nigeria National Animal Research Institute (Napri)
12	ASAN-NIAS-JAM-AB012	Phenotypic correlation of body weight and linear body measurement of crosses between Dutch × Dutch and New Zealand White × Chinchilla rabbits (*Oryctolagus cuniculus*)	Mallam, I., Nwagu, B.I., Kabir, M., Achi, N.P., Achi, J.N	Department of Animal Science, Ahmadu Bello University, Zaria.
13	ASAN-NIAS-JAM-AB013	Effect of genotype on semen quality parameters of drakes	Oguntunji, A.O., Oladejo, O.A., Oriye, L.O., Egunjobi, I.M.	Department of Animal Science Fisheries Management, Bowen University, P.M.B. 284, Iwo, Osun State, Nigeria.
14	ASAN-NIAS-JAM-AB014	Polymorphism in insulin-like growth factor 2 gene and its association with body weight of Nigerian indigenous Turkeys	Shobanke, I. A., Akinyemi, M.O., Osaiyuwu, O. H, Fijabi, O.E., Oyewola, K.A., Nwokorie, G.I	Department of Animal Health Production, Oyo State College of Agriculture and Technology, Igboora, Oyo State.
15	ASAN-NIAS-JAM-AB015	Correlation between live body weight and linear body measurements of chickens found in Borno state, Nigeria	Dunya A. M., Alade N. K., Raji A.O., Jibrin A., Lawal M. U., A., Chana I. M.,	Department of Animal Science, Federal University, Gashua.

			Makinde O. J., Maidala A., Lawan A.	
16	ASAN-NIAS-JAM-AB016	Phenotypic correlations and body weights prediction of laying birds fed maize and acha-based diets	Halilu, A., Oko, O. O. K., Ukim, C. I., Henry, A. J.	Department of Animal Science, University of Calabar, Calabar, Nigeria
17	ASAN-NIAS-JAM-AB017	Preliminary Investigation Of Gut Bacteria Found In Ileum Digester Samples of broilers Using 16s RNA Sequence	Otobo, E.; Okpeku M. And Ofongo – Abule, R.T.S.	Poultry Nutrition and Animal Biotechnology Unit, Department of Animal Science; Niger Delta University, Wilberforce Island P.M.B O17 Yenagoa, Bayelsa State –Nigeria
18	ASAN-NIAS-JAM-AB018	Breed and egg weight influence on hatchability and fertility in Sasso, Shika brown chicken and their crosses	Agaviezor, B.O., Ajayi, F.O., Okonkwo, J. C., Briggs, O. O., Chiorlu, O. J., Opara, N. E., Ebede, U.P.,	Animal Science Department, University of Port Harcourt, Port Harcourt, Nigeria
19	ASAN-NIAS-JAM-AB019	Evaluation of the sixth generation of Nigerian heavy-local chicken for productive traits in the derived savannah	Agbo, M. C., Ndofor, H. M., Foleng, Ohagenyi, I. J., Udeh, F. U., Nwosu, C.C.,	Department Of Animal Science, University Of Nigeria, Nsukka, Enugu State
20	ASAN-NIAS-JAM-AB020	Phenotypic correlations and body weights prediction of laying birds fed maize and acha-based diets	Halilu, A., Oko, O. O. K., Henry, A. J. Ukim, C. I.	Department of Animal Science, University of Calabar, Calabar, Nigeria.
21	ASAN-NIAS-JAM-AB021	Traditional and medicinal uses of *Huntaria umbellata* (abere): a review	Haruna, M. A., Odunsi, A. A	Department of Animal Nutrition and Biotechnology, Faculty of Agricultural Sciences, Ladoke Akintola University of Technology, Ogbomoso, Nigeria
22	ASAN-NIAS-JAM-AB022	Growth performance and heterosis for body weight in three Nigerian breeds of sheep	Fatai I.A., Fayeye, T.R., Toye, A. A., Sola-Ojo F.E Yusuf, A. T., Adeyemi, K. D.	Department of Animal Production, University of Ilorin, Ilorin, Kwara State.
23	ASAN-NIAS-JAM-AB024	Modelling the growth curve of Japanese quail under different nutritional environments	Adeyemi, E. A, Dudusola, I. O., Oseni, S. O.	Department of Animal Sciences, Obafemi Awolowo University, Ile Ife. Nigeria

24	ASAN-NIAS-JAM-AB025	The phenotypic variation of a commercial broiler breed as a tool for repeatability estimate and genetic improvement of chicken	Ohagenyi I. J., Eze, U. P., Machebe N. S., Iloh S., Osita, C. O.	Department of Animal Science, University of Nigeria, Nsukka
25	ASAN-NIAS-JAM-AB026	Coat colour pattern differentiated correlations between body weight and body linear measurement of donkeys	John, P.A., Iyiola-Tunji, A.O.,	Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria
26	ASAN-NIAS-JAM-AB028	Discriminant analysis of four strains of broiler chickens	Sola-Ojo F.E., Ibiwoye, D.I.,	Department of Animal Production, Faculty of Agriculture, University of Ilorin
27	ASAN-NIAS-JAM-AB029	Influence of wattle on body weight and linear body measurements red Sokoto does kept semi-intensively in Niger state, Nigeria.	Kolo, P. S., Alemede, I. C., Egena, S. S., Adama, J. Y.	Department of Animal Production, Federal University of Technology, Minna, Niger State, Nigeria
28	ASAN-NIAS-JAM-AB030	Haematology and External Egg Quality Parameters of Three Nigerian Indigenous Chicken Genotypes	Adeyemo, G.O., Bolarinwa M.O. and Ehiabhi, O.	Department of Animal Science, University of Ibadan, Ibadan, Oyo State, Nigeria
29	ASAN-NIAS-JAM-AB031	Genetic progress of the production traits in the Nigerian heavy local chicken ecotype obtained by selection index in the derived savannah zone of Nigeria	Agbo, M. C., Udeh, F. U., Ndofor Foleng, H. M. Ohagenyi, I. J., Nwosu, C. C	Department of Animal Science, University of Nigeria, Nsukka, Enugu State
30	ASAN-NIAS-JAM-AB032	Comparison of White and Black FUNAAB alpha chickens using body weight and selected body morphometric traits	Ideozu, H.M., Oleforuh-Okoleh, V.U., Dike, U.A.	Department of Animal Science, Rivers State University, Nkpolu-Oroworukwo, P.M.B. 5080, Port Harcourt, Rivers State, Nigeria.
31	ASAN-NIAS-JAM-AB033	Heritability estimates for pearl and belgy strains of guinea fowls in northern guinea Savannah zone of Nigeria	Abdullahi, J., Kabir, M., Iyiola-Tunji, A.O., John, P.A Ibe, E.A.	Department of Agricultural Technology, Federal Polytechnic Akanuibiamunwana, Afikpo, Ebonyi State.

32	ASAN-NIAS-JAM-AB034	Polymorphism of ovalyxin-32 gene among six Nigerian chicken populations	Ohagenyi I.J., Oleforuh-Okoleh V.U., Ikeh N. E., Nnajiofor N.W., Udeh F.E., Egom M.A., Ogbu C.C.	Department of Animal Science, University of Nigeria Nsukka
33	ASAN-NIAS-JAM-AB035	Effect of genotype on early growth traits of pure and crossbred chicken progenies under derived Savanna zone of Nigeria	Ojedapo, L.O., Amao, S.R., Akinwale, D.V.,	Department of Animal Nutrition and Biotechnology, P.M.B.4000, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria
34	ASAN-NIAS-JAM-AB036	Relationship between liveweights, linear body measurements and cost prices of small ruminants sold in and around Mubi environs, Adamawa state, Nigeria.	Babale, D.M., Gworgwor, Z., Hussein, U	Department of Animal Production, Adamawa State University, Mubi, Nigeria
35	ASAN-NIAS-JAM-AB037	Comparative morphometric studies on oral cavity in uda sheep and red sokoto goat	Mahmud, M. A, Shaba, P., Usman, A.D., Shehu, S.A., Bello, A., Sidi, S., Aliyu, M.A., Abdulsalam, W.	Department of Animal Health and Production Technology, Niger State College of Agriculture, Mokwa, Niger State, Nigeria
36	ASAN-NIAS-JAM-AB039	Polymorphism in insulin-like growth factor 1 gene and its association with body weight of Nigerian indigenous Turkeys	Oyewola, K.A, Akinyemi, M.O., Osaiyuwu, O. H, Fijabi, O.E., Shobanke, I. A.	Animal Breeding and Genetics Unit, Department of Animal Science, University of Ibadan, Oyo State.
ANIMAL PHYSIOLOGY AND REPRODUCTIVE HEALTH				
37	ASAN-NIAS-JAM-PR001	Blood chemistry of rabbits exposed to dietary kolanut husk meal (KHM)	Ozung, P. O., Anya, M. I., Oko, O. O.K., Eburu, P.O. Jimmy, N. P., Ebitu, C. U	Department of Animal Science, University of Calabar, Calabar, Nigeria
38	ASAN-NIAS-JAM-PR002	Assessment of some semen characteristics and their correlation co-efficient among bull genotype	Adamu, S., Mai, H. M., Mbap, S. T., Adamu, G.,	Department of Animal Production, Faculty of Agriculture And Agricultural Technology, Abubakar

			Adamu, N., Mujitaba, M. A., Yakubu, I.	Tafawa Balewa, University P.M.B 0248, Bauchi Nigeria
39	ASAN-NIAS-JAM-PR003	Response of cockerel strains to transportation density on measured blood parameters in hot humid environmental condition of Nigeria.	Ayoola, M. O., Babalola, A. T.	Department of Animal Science and Fisheries Management, Bowen University Iwo, Osun State Nigeria, P.M.B 284, Osun State, Nigeria
40	ASAN-NIAS-JAM-PR004	Location, breed and gender effect on blood profile of Muturu and Bunaji cattle in Benue and Ogun state	Ochefu, J., Ladokun, A. O., Smith, O. F., Iposu, S. O., Okwelum, N., Omire, O.	Department. of Animal Breeding and Physiology, Federal University of Agriculture, Makurdi
41	ASAN-NIAS-JAM-PR005	Testicular morphometry and qualitative assessment of the ejaculates of Isa white and barred Plymouth rock cocks fed graded levels of dietary salt.	Samuel O. A., Adeniyi D. S.	Department of Animal Production and Health, Federal University of Technology, Akure, Nigeria
42	ASAN-NIAS-JAM-PR006	The effect of dietary salt on fertility, hatchability and hatchling Performance of Artificially Inseminated Commercial Layers' Eggs.	Samuel O. A., Adeniyi D. S.	Department of Animal Production and Health, Federal University of Technology, Akure, Nigeria
43	ASAN-NIAS-JAM-PR007	Effect of honey and vitamin C on the performance of heat-stressed broiler finisher birds	Igwe R.O., Ogunnupebi J.T., Olorunleke S., Aikpitanyi U.K., Nwose R.N., Elechi C.O	Michael Okpara University of Agriculture Umudike, Abia State, Nigeria.
44	ASAN-NIAS-JAM-PR008	Haematological profile of donkeys (*Equus asinus*) as affected by age in North-western Nigeria	Bature, I., Shehu, B. M., Barje, P. P.	Animal Science Department, Federal University Dutsin-Ma, Katsina State.
45	ASAN-NIAS-JAM-PR009	Thermo-physiological responses of broiler chicken fed supplemental	Ijadunola, T. I., Popoola, M. A., Owosibo, A. O., Odetola, O. M., Oladipo, T. A.,	Federal College of Animal Health and Production Technology, P. M. B. 5029, Moor Plantation, Ibadan.

		vitamin E and C to change in diurnal temperature	Adetola, O. O., Lawrence-Azua, O. O., Saka, A. A., Yahaya, M. O., Bolarinwa, M. O.,	
46	ASAN-NIAS-JAM-PR010	Index of reproduction and production performance of doe among small holder goats herd in Bali, Taraba, Nigeria	Waba, Y. E.	Department of Agricultural Technology, Federal Polytechnic Bali Taraba State
47	ASAN-NIAS-JAM-PR011	Influence of aidan (*Tetrapleura tetraptera*) pod meal on haematological and serum chemistry indices of pubertal boars	Ezea, J., Ezike, J.C., Oguike, M.A., Herbert, U.	Department of Animal Breeding and Physiology, Michael Okpara University of Agriculture, Umudike, Abia State
48	ASAN-NIAS-JAM-PR012	Growth performance and gut histomorphometry changes in broiler chicks fed at different post-hatch feeding days	Shittu, M. D., Ojebiyi, O. O., Ojediran, T. K., Ademola, S. G., Mustapha, M. A.	Department of Animal Nutrition And Biotechnology, Lautech Ogbomoso, Nigeria.
49	ASAN-NIAS-JAM-PR013	Survival and biophysical changes of three common species of land snails in Edo and Delta states during a 12-week aestivation	Asagba, E.C., Omoyakhi, J.M., Okhale, O.E.	Department of Animal Science, Faculty of Agriculture, University of Benin, Benin City, Nigeria
50	ASAN-NIAS-JAM-PR014	Influence of *Vernonia amygdalina* flavonoid on performance of cockerels under elevated environmental temperature	Adisa Ekundayo Ojo Olayinka Abosede, Asogwua Nnaemeka Tobechukwu	Department of Animal Production, Fisheries And Aquaculture, Kwara State University, Nigeria
51	ASAN-NIAS-JAM-PR015	Semen characteristics of adult male rabbit fed graded levels of *Moringa oleifera* and *Centrosema pubescens* leaf meals	Wariboko, O. N., Ukanwoko, A. I., George, O.S	Department of Agriculture (Animal Science / Fisheries Option), Faculty of Vocational and Technical Education, Ignatus Ajuru University of Education, Rivers State, Nigeria.

52	ASAN-NIAS-JAM-PR016	Haematological parameters of heteroclarias fingerlings exposed to different temperature levels under laboratory conditions in Minna, Nigeria	Ayanwale A.V., Tsadu S.M. Lamai, S. L., Kolo, R.J., Ojimi, S.O., Kinta M.Jr.	Department of Animal Biology, Federal University of Technology, Minna, Nigeria.
53	ASAN-NIAS-JAM-PR017	Influence of aqueous leaf extract of *Moringa oleifera* lam. On liver and kidney histo – architecture; and liver indices enzymes of growing rabbit bucks	Udofia, E. H., Solomon, I. P., Ekpo, K. O., Essien, U. N.	Farm Project, University of Benin, Benin City, Edo State. Nigeria.
54	ASAN-NIAS-JAM-PR018	Influence of varied photoperiod on the physiology and growth of gilts at finisher stage raised in the humid tropics	Adelowo, Olayinka V., Adebiyi, Olufemi A., Peters, Sunday O.	Animal Production Department, Federal College of Animal Health and Production Technology, P. M. B. 01, N. V. R. I., VOM Plateau State, Nigeria
55	ASAN-NIAS-JAM-PR019	Serum antioxidant status and reproductive performance of rabbit does fed cassia tora leaf meal diets	Daudu, O.M., Chintem, A.M. And Abdulrashid, M.	Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria, Nigeria.
56	ASAN-NIAS-JAM-PR020	Reproductive response of growing rabbit bucks to aqueous leaf extract of *Moringa oleifera* Lam. At early age of sexual maturity.	Udofia, E. H., Solomon, I. P., Essien, U. N., Ekpo, K. O.	Farm Project, University of Benin, Benin City, Edo State. Nigeria.
57	ASAN-NIAS-JAM-PR021	Semen quality of FUNAAB – alpha cocks in a Sudano-sahelian region of Nigeria	Saleh, B., Duwa, H., Mohammed, A. A., Raymond, J. B.,	Department of Animal Science, University Of Maiduguri, P.M.B. 1069, Maiduguri, Borno State
58	ASAN-NIAS-JAM-PR022	Effects of graded levels of black plum (*Vitex doniana*) leave meal on hormone and cholesterol levels of West African dwarf bucks	Okukpe K. M., Lawal M. O., Adeyina A.O., Alli O.I., Aderibigbe T. A., Decampos J.S.	Reproductive Physiology Unit, Department of Animal Production, Faculty of Agriculture

59	ASAN-NIAS-JAM-PR023	Haematology and blood biochemistry of West African dwarf bucks fed graded levels of black plum (*Vitex doniana*) leave meal	Okukpe K. M., Ayangbade S. A., Adeyina A.O., Alli O.I., Decampos J.S., Aderibigbe T. A., Lawal M.O.	Reproductive Physiology Unit, Department of Animal Production, Faculty of Agriculture.
60	ASAN-NIAS-JAM-PR024	Gross anatomy and histopathological parameters of some internal organs of broilers fed cassava grit based diets	Mosobalaje, M. A., Oloko, A. B., Adedoyin, A. A., Adebayo, B. F., Bello, K	Oyo State College of Agriculture, Igboora
61	ASAN-NIAS-JAM-PR025	Effects of feed restriction prior mating on the reproductive parameters in rabbit	Adeyina, A. O., Akanbi, A. S and Ajayi, O. S.	Department of Animal Production, Faculty of Agriculture, University of Ilorin
62	ASAN-NIAS-JAM-PR026	Effect of season on growth performance of bunaji calves in early wet season	Akinlade, J.A., Sola-ojo, F. E., And Abubakar, I. A. .	Department of Animal Production of the University of Ilorin, P.M.B. 1515, Ilorin, Nigeria
63	ASAN-NIAS-JAM-PR027	Effect of *Kigelia africana* Based Diets on Semen Characteristics of Rabbits	Aliyu I. K and Adeyina A.O	Department of Animal Production of the University of Ilorin, P.M.B. 1515, Ilorin, Nigeria
64	ASAN-NIAS-JAM-PR028	Proximate, Composition of *Kigelia africana* Fruit and Leaf Meals	Aliyu I. K and Adeyina A.O	Department of Animal Production of the University of Ilorin, P.M.B. 1515, Ilorin, Nigeria
ANIMAL WEFARE AND HEALTH				
65	ASAN-NIAS-JAM-HW001	Potentials of hot red pepper (*Capsicum annuum* l.) on performance and coccidiosis in broilers	Adedoyin A.A.,	Department of Agricultural Education, Animal Nutrition and Biotechnology Unit, The College of Education, Lanlate, Oyo State, Nigeria
66	ASAN-NIAS-JAM-HW002	Preliminary studies on the prevalent endoparasites associated with ostriches (*Struthio camelus*) in Borgu local government area of Niger state	Fatokun B.O., Edungbola J.A Ajayi, S.R. and Akor S.	Federal College of Wildlife Management, New-Bussa, Niger state

67	ASAN-NIAS-JAM-HW003	Effects of crating on stress and fear responses of growing Broilers fed with *Moringa oliefera* feed meal	Raji, T. B. and Toye, A. A.	Department of Animal Production, Faculty of Agriculture, University of Ilorin
68	ASAN-NIAS-JAM-HW004	Growth performance characteristics, bacterial and oocyst count of egg-type chickens and cockerels given herbal supplement in Western Nigeria	Allinson I.B., Abiola S.S., Adeyemi O.A., Oyekunle M.A., Dipeolu O.O.	Department of Animal Production and Health. College of Animal Science and Livestock Production. Federal University of Agriculture, Abeokuta. Ogun State, Nigeria
69	ASAN-NIAS-JAM-HW005	Tonic immobility, aggressiveness and plumage condition as welfare indicators in locally adapted turkey	Olaniyi T.A., Popoola M.A., Olaniyi O.A., Yahaya M.O., Omotosho M.M., Oladapo R.P. Bolaji A.S.	Department Of Animal Health And Production Technology; Federal College Of Animal Health And Production Technology, Moor Plantation, Ibadan
70	ASAN-NIAS-JAM-HW006	Profile of tick-infested Bunaji cattle in Sabongari local government area of Kaduna state, Nigeria	Adedibu I.I., Olarewaju	Department of Animal Science, Ahmadu Bello University, Zaria, Kaduna State, Nigeria
LIVESTOCK ECONOMICS AND EXTENSION				
71	ASAN-NIAS-JAM-EE001	Growth performance and economics of fattening West African dwarf rams using ammonium sulphate-fortified diets	Akinlade, A. T., Ososanya, T. O., Shehu, S. A.	Department of Animal Science, University of Ibadan, Ibadan, Nigeria
72	ASAN-NIAS-JAM-EE002	Performance and profitability analysis of broilers fed graded levels of baobab (*Adansonia digitata*) pulp meal at the finisher phase	Lawan A., Olugbemi, T. S., Duru, S., Onimisi, P.A., Maidala, A., Makinde, O. J., Adejumo, I.O	Department of Animal Science Faculty of Agriculture Federal University Gashua, Gashua, Yobe State.
73	ASAN-NIAS-JAM-EE003	Influence of seasons on egg production and supply in greater Port Harcourt city, Nigeria	Ingweye, J.N., Meinderts, J.	Department of Animal Science, Faculty of Agriculture, University of Port Harcourt, PM..B 5323 Choba, East-West Road, Port Harcourt, Nigeria.

74	ASAN-NIAS-JAM-EE004	Adoption of improved technologies on pig production among farmers in Ifako-Ijaye, Lagos state	Popoola M.A., Adebisi G.L., Alonge O.G., Bolarinwa M.O., Opeola-Davies B., Adetoro H.A., Jimoh M.A.	Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan.
75	ASAN-NIAS-JAM-EE005	Consumers' Preference and Perception on Meat among Public Servants in Ibadan South West Local Government Area	Ajayi, D.A., Oladipupo, C.O., Abegunrin, O.D., Nden, D.S. and Aladele, S.E.	National Centre for Genetic Resources and Biotechnology, Moor Plantation, Ibadan. Nigeria
76	ASAN-NIAS-JAM-EE006	Fetal losses among pregnant cows slaughtered in Bauchi central abattoir and the effects on cattle population in the state	Luka, J. S., James, L., Oyedapo, F. A. and Okpanachi, U.	Department of Animal Production, Faculty of Agriculture, University of Jos, Plateau State, Nigeria.
77	ASAN-NIAS-JAM-EE007	Perception of Cattle Handlers with Regards to Temperament Traits of Bunaji Cattle	Sunday, H. L., Adedibu, I.I and Iyiola-Tunji, A. O.	Department of Animal Science, Ahmadu Bello University, Zaria, Kaduna State, Nigeria
MICRO-LIVESTOCK PRODUCTION				
78	ASAN-NIAS-JAM-ML001	Performance and economy of weaner rabbits fed diets with different levels of rubber seed cake supplemented with *Pueraria phaseoloides.*	Orimoloye, P.O, Afolabi, K.D., Akinleye, S.B.	Cocoa Research Institute Of Nigeria, Ibadan, Nigeria
79	ASAN-NIAS-JAM-ML002	Effects of sweet potato (*Ipomoea batata*) peel meal (*sppm*) replacement for maize on the growth performance and carcass characteristics of weaner rabbits (*Oryctalagus curniculus*)	Ibrahim, H And Samuel, N.	Department of Animal Production, Faculty of Agriculture, Ibrahim Badamasi Babangida University, Lapai, Niger State, Nigeria

80	ASAN-NIAS-JAM-ML003	Effect of different feeds on the growth performance of *Archachatina marginata*	Raimi, C. O., Olomola R. T.,	Department of Agricultural Technology, Federal Polytechnic, Ado-Ekiti, Ekiti State, Nigeria
81	ASAN-NIAS-JAM-ML004	Response of crossbred weaned rabbits to diets containing fermented – roasted ackee apple seed meal	Ogunbode, A. A., Akinrinade, O.O	Department of Animal Production Technology, Faculty of Animal and Fisheries Technology, Oyo State College Of Agriculture And Technology, Igboora, Nigeria
82	ASAN-NIAS-JAM-ML005	Cost benefit analysis of forages used in rabbit feeding	Ogu, I. E., Okwori, A. I., Ayuba, F	Department of Animal Production, College of Animal Science, Federal University of Agriculture, Makurdi, Benue State, Nigeria
83	ASAN-NIAS-JAM-ML006	Changes in plasma electrolytes and cholesterol of turmeric root (*Curcuma longa*) meal fed to growing rabbits (*Oryctolagus cuniculus*)	George O.S., Wariboko, O. N., Akintola O.A.I	Department of Animal Science, Faculty Of Agriculture, University of Port Harcourt, P.M.B. 5323, Port Harcourt, Rivers State, Nigeria
84	ASAN-NIAS-JAM-ML007	Heamatology, serum analysis, cholesterol status, and physico-chemical evaluation of rabbit fed Africa sunflower leaf meal in their diet.	Fakolade, P. O., Adewole, Y. A., Osunkeye O. J.	Meat Science Laboratory, Department of Animal Science College of Agriculture, Osun State University, Osogbo, Nigeria
85	ASAN-NIAS-JAM-ML008	Effects of mango fruit reject pulp-maize offal mix (MFRP-MO) on the growth performance of Japanese quails	Orayaga, K.T., Apeaule, K.S.	Department of Animal Nutrition, University of Agriculture, P.M.B. 2373, Makurdi, Benue State, Nigeria
86	ASAN-NIAS-JAM-ML009	Carcass and organ characteristics of broiler chicken fed boiled mango kernel composite meal (BMKCM)	Abang, F.B.P., Egahi. J.O., Gbakoron, D.	College of Animal Science, University of Agriculture Makurdi, Makurdi, Nigeria
87	ASAN-NIAS-JAM-ML010	Effects of graded levels of boiled flamboyant seed meal (*Delonix regia*)	Olaiya, O. D., Adelowo, O.V. Bot, M.H., Longs, P.A., Samchi, I.A	Department of Animal Production, Federal College of Animal Health And Production Technology National

		based diet on performance and carcass characteristics of weaned rabbits		Veterinary Research Institute, P. M. B, 01, VOM, Nigeria
88	ASAN-NIAS-JAM-ML011	Performance of weaner rabbits fed sole concentrate, sole forage and their mixtures	Christopher, G. I., Ekpo, J. S., Udofia, I. U.	Department of Animal Science, Akwa Ibom State University, Obio Akpa Campus, Oruk Anam Local Government Area, Akwa Ibom State, Nigeria
89	ASAN-NIAS-JAM-ML012	Haematological indices and carcass characteristics of weaner rabbits fed pawpaw seed meal (PSM)	Amao, E.A, Adeoti, T.M., Azeez, A.A., Fashanu, S.O.	The Oke Ogun Polytechnic Saki, Oyo State. Nigeria
90	ASAN-NIAS-JAM-ML013	Evaluation of performance characteristics of rabbits fed pawpaw seed meal (PSM) based diet	Ayandiran, S.K., Oladokun, A.A., Olaogun, Y.A., Akande, A.A	The Oke Ogun Polytechnic Saki, Oyo State. Nigeria
91	ASAN-NIAS-JAM-ML014	Growth performance and organoleptic indices of weaner rabbits fed two dietary protein levels with or without alligator pepper (*Aframomum melegueta*)	Olatunji, O.I., Olatunbosun O.S., Olaniyan, O.S., Olayiwola O.B., Odunsi, A.A	Department of Animal Nutrition and Biotechnology, Faculty of Agricultural Sciences, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria
MONOGASTRIC NUTRITION AND PRODUCTION				
92	ASAN-NIAS-JAM-MN001	Performance, meat quality characteristics and consumer acceptability of guinea fowl fed varied dietary energy levels	Rafiu T.A., Akinwumi A. O. Adetutu O.I., Opakunle O. D., Oyekale A. K.	Department of Animal Production and Health, Ladoke Akintola University of Technology, P.M.B. 4000,Ogbomoso, Nigeria.
93	ASAN-NIAS-JAM-MN002	Performance and carcass characteristics of broiler chickens administered varying dosages of aqueous extract of tamarind (*Tamarindus indica*) pulp.	Banjo, A.A., Kolo, P.S., Kolo, H.N., Ewa, C., Otu, B., Jibrin, H.	Department of Animal Production, Federal University of Technology, Minna, Niger State.

94	ASAN-NIAS-JAM-MN003	Response of weaner rabbits fed graded levels of desert date (*Balanites aegyptiaca*) and sweet potato (*Ipomoea batatas*) leaf meals.	Wafar, R.J., Iliya, D.S., Tarimbuka, L.I.,	Department of Animal Production and Health, Federal University Wukari, P.M.B. 1020, Taraba State, Nigeria
95	ASAN-NIAS-JAM-MN004	Performance characteristics and haematological indices of broiler chicken fed diets containing fermented leaf (*Hibiscus cannabinus* l.) Seed meal	Odetola, O.M., Akingbade., A.O, Ijadunola, T.I., Adedeji, O.Y., Saka, A.A	Federal College of Animal Health and Production Technology, P.M.B 5029, Moor Plantation, Ibadan, Nigeria.
96	ASAN-NIAS-JAM-MN005	Growth and early laying performance of Japanese quail chicks (*Coturnix coturnix* Japonica) fed diets containing raw and processed pigeon pea seed meal based diets with enzyme (*Vegpro*) supplementation	Akintunde, A. R., Oguntoye, M. A., Adeoye, S. O., Azuaga, C.I.	Department of Animal Science, Taraba State University, Jalingo
97	ASAN-NIAS-JAM-MN006	Performance and carcass characteristics of weaner rabbits fed wild sunflower (*Tithoniadi versifolia*) inclusion in their diet	Fakolade P. O., Adetomiwa A. A.	Meat Science Laboratory, Department Of Animal Science, Osun State University Osogbo, Nigeria.
98	ASAN-NIAS-JAM-MN007	Effect of lemon juice on growth performance of starter broiler chicks	Ndelekwute, E.K., Assam, E.D., Unah, U.L., Elijah, N.A., Umoh, S.U.	Department of Animal Science, University of Uyo, Uyo, Nigeria
99	ASAN-NIAS-JAM-MN008	The performance and serum biochemical indices of weaner pigs fed diets containing varying levels of *Morinda lucida* leaf meal as growth promoter	Akingbade, A. O., Jinadu, K. B., Odetola, O. M., Omole, A. J., Adetola, O. O., Ajayi, F.T.	Federal College of Animal Health and Production Technology, Moor Plantation, P.M.B. 5029, Ibadan, Oyo State, Nigeria.
100	ASAN-NIAS-JAM-MN009	Comparative effect of *Morinda lucida* leaf meal and antibiotic growth promoter on growth performance and serum of broiler chicken	Akingbade, A. O., Jinadu, K. B., Odetola, O. M., Owosibo, A. O., Adekanbi, A. O., Saka, A. A.	Federal College of Animal Health and Production Technology, Moor Plantation, P.M.B. 5029, Ibadan, Oyo State, Nigeria.

101	ASAN-NIAS-JAM-MN010	Productive performance and carcass characteristics of rabbits fed graded levels of moringa (*Moringa oleifera*) leaf meal	Kwari, I.D., Bello, B., Medugu, C.I., Augustine, C.	Department of Animal Science, University of Maiduguri, P.M.B. 1069, Maiduguri, Borno State
102	ASAN-NIAS-JAM-MN011	Effect of graded levels of soymilk residue on growth and meat yield of rabbits	Emmanuel, S. S., Carew, S.N., Attah, S.	Department of Animal Production, University of Agriculture Makurdi, P.M.B 2373 Makurdi. Benue State, Nigeria
103	ASAN-NIAS-JAM-MN012	Effect of graded levels of dried ginger (*Zingiber officinale*) root meal on the performance and carcass parameters of grower rabbit	Emmanuel, B., Ochefu, J.	Department of Animal Breeding And Physiology, Federal University of Agriculture, Makurdi
104	ASAN-NIAS-JAM-MN013	Effects of different processing methods on the chemical composition of sickle pod (*Senna obtusifolia*) leaves	Augustine, C., Igwebuike, J.U., Kwari, I.D., Midau, Abdulrahman, B.S A., Medugu, C.I., Obidah, L.U., Iliya, K	Department of Animal Production, Adamawa State University, Mubi, Adamawa State, Nigeria.
105	ASAN-NIAS-JAM-MN014	Chromatographic and spectrophotometric assay for aflatoxin b_1 of finished poultry feeds in Nigeria.	Okosun, S.E., Tewe, O.O., Oyejide, A., Obasoyo, D.O., Eguaoje S.A.	Department of Animal Science, Faculty of Agriculture, Ambrose Alli University, Ekpoma, Edo State, Nigeria.
106	ASAN-NIAS-JAM-MN015	Effect of feeding cassava grit supplemented with enzyme (*Maxigrain*) on the growth performance characteristics of finishing broiler chickens.	Ajetunmobi, A. W., Eguaoje, S.A., Adeniji, C.A., Omesa, M.T	Adeniran Ogunsanya College of Education, Ijanikin, School of Agriculture, Lagos State University, Epe, Lagos, Devine Fisheries Farm Estate, 12 Junction Ring Road, Redemption Camp Ogun State.
107	ASAN-NIAS-JAM-MN016	A biochemical assay of selected varieties of kidney bean seeds in Nigeria for monogastric animal feed production	Damang, P.J., Tuleun, C. D., O. I. A. Oluremi, O. I. A., Carew, S. N.,	Plateau State College of Agriculture, Garkawa

108	ASAN-NIAS-JAM-MN017	Acute toxicity and hematological conditions of broiler birds fed with raw huracrepitans extract	Nsa, E. E., Ewa, J. E., Archibong, E. E.	Department of Animal Science University of Calabar Calabar
109	ASAN-NIAS-JAM-MN018	Heamatological parameters of broiler chickens fed uncultivated sorrel leaves as dietary fibre source	Maidala, A., Mohammed, M., Ajighjigh, D.T., Zagi, S.P., Makinde, O.J., Lawan, Chana, I.M, Duniya, A.M	Department of Animal Science, Federal University Gashua, P.M.B.1005, Yobe State, Nigeria
110	ASAN-NIAS-JAM-MN019	Proximate and mineral composition of seeds of two roselle (*Hibiscus sabdariffal*) Varieties	Ashom, S. A.,	Department of Animal Health and Production, Plateau State College of Agriculture, P. M. B. 01, Garkawa
111	ASAN-NIAS-JAM-MN020	Effect of processing methods on proximate composition of sweet orange peel meal: a potential livestock feed resource	Oyewole, B.O., Noah, D.O., Ajagbe, D.A	Department of Animal Production, Kogi State University, Anyigba, Kogi State
112	ASAN-NIAS-JAM-MN021	Performance of rabbits fed graded levels of mulberry leaf meal in replacement of soybean meal	Olajide, R., Garus-Alaka, A.W.	Department of Animal Production and Health, Faculty of Agriculture, University Of Africa, Toru-Orua, Bayelsa, State, Nigeria
113	ASAN-NIAS-JAM-MN022	Water quantity requirement and effect on growth performance of large fulani ecotype chicken breeder pullets	Bello, K. O., Irkehore, O. T., Oladigbo, O. S., Oladeji. T. E., Okwelum, N., Famakinde, S. A.	Institute of Food Security, Environmental Resources and Agricultural Research; Federal University of Agriculture, Abeokuta, Nigeria
114	ASAN-NIAS-JAM-MN023	Response of weaner rabbits fed graded levels of desert date (*Balanitesae gyptiaca*) and sweet potato (*Ipomoea batatas*) leaf meals.	Wafar, R. J., Iliya, D.S., Tarimbuka, L.I	Department of Animal Production and Health, Federal University Wukari, P.M.B 1020, Taraba State, Nigeria
115	ASAN-NIAS-JAM-MN024	Growth performance of broilers fed graded levels of full fat palm fruit meal diets with or without enzyme	Enyenihi, G. E., Essien, E., Inyang, U. A.	Department of Animal Science, University of Uyo, Uyo

116	ASAN-NIAS-JAM-MN025	Performance of broiler chickens fed diets containing four varieties of sorghum bicolor Supplemented with maxigrain® enzyme	Daramola, S.T., Sekoni, A.A., Omage, J.J., Duru, S.	Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria, Kaduna State, Nigeria.
117	ASAN-NIAS-JAM-MN026	Growth performance and economics of production of broiler chicks fed graded levels of baobab (adansonia digitata) pulp meal at the starter phase	Lawan A., Olugbemi, T. S., Duru, S., Onimisi, P.A., Maidala, A., Makinde, O. J., Adejumo 1.O.	Department of Animal Science Faculty of Agriculture Federal University Gashua. P.M.B. 1005 Gashuayobe State.
118	ASAN-NIAS-JAM-MN027	Influence of maize grains treated with insecticides on growth performance and liver function tests of chickens	Adejumo I.O., Ologhobo A.D., Maidala A.A., Makinde O.J., Lawan A., Mohammed I.C., Dunyan A.M.	Department of Animal Science, Federal University Gashua, Nigeria;
119	ASAN-NIAS-JAM-MN028	Influence of varied photoperiod on the physiology and growth of gilts at finisher stage raised in the humid tropics	Adelowo, O. V., Adebiyi, O. A., Peters, S. O.	Animal Production Department, Federal College of Animal Health and Production Technology, P. M. B. 01, N. V. R. I., Vom Plateau State, Nigeria
120	ASAN-NIAS-JAM-MN029	Performance evaluation of grower pigs fed graded levels of pineapple (*Ananas comosus*) wine sediment	Nkwocha, G. A., Madubuike, F.N., Ekenyem, B.U., Ndubisi, C.E., Anukam, K.U	Department of Animal Production and Health Technology, Imo State Polytechnic, Umuagwo, Ohaji, P.M.B 1472 ,Owerri, Nigeria.
121	ASAN-NIAS-JAM-MN030	Egg quality parameters of brown egg-type layers fed biscuit dough in place of maize . .	Ojebiyi O.O., Shittu, M.D, Bakare A.M., Farayola O. R	Department of Animal Nutrition and Biotechnology, Department of Animal Health and Production, Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Oyo State Nigeria
122	ASAN-NIAS-JAM-MN031	Effect of Moringa (*Moringa oleifera*) leaf meal on feed utilization and growth of broiler chicken fed growers mash	Abe, O.S., Amusan S.A., Olorundare A.L., Osho O.T., Adeniyi L.[1]	Department of Animal Health and Production Technology, Aquatech College of Agriculture And Technology, Ibadan, Nigeria

123	ASAN-NIAS-JAM-MN032	Effects of varied feeding frequencies on the growth performance and carcass characteristics of grower rabbits in rainy season	Balogun K.B., Ayoola M.A., Ogunsipe M.H.	Department of Agricultural Science, Adeyemi College of Education, Ondo.
124	ASAN-NIAS-JAM-MN033	Evaluation of the growth performance, carcass characteristics and cost of broiler chickens fed commercial and on-farm formulated diets	Halilu, A., Henry, A. J., Oko, O. O. K	Department of Animal Science, University of Calabar, Calabar, Nigeria.
125	ASAN-NIAS-JAM-MN034	Haematology and carcass characteristics of broiler chickens fed graded level of wood charcoal	Ijadunola, T. I., Popoola, M. A., Owosibo, A. O., Odetola, O. M., Oladipo, T. A., Adetola, O. O., Lawrence-Azua, O. O., Saka, A. A., Yahaya, M. O., Bolarinwa, M. O.	Federal College of Animal Health and Production Technology, P.M.B. 5029, Moor Plantation, Ibadan.
126	ASAN-NIAS-JAM-MN035	Growth performance of broiler chickens as influenced by stocking density, protein and energy levels, and season	Ademulegun, T.I., Adeyemo, G.O., Rufus,	Department of Animal Science, University of Ibadan, Ibadan Giwa Polytechnic Owo
127	ASAN-NIAS-JAM-MN036	Proximate and phytochemical analysis of *Moringa oleifera* leaf meal	Bot, M.H., Olaiya, O.D., Gyang, D.C., Garba, S.I., Brengshak, S.B., Andmwadkon, D.D.	Federal College of Animal Health and Production Technology, Nvri, Vom, Plateau State.
128	ASAN-NIAS-JAM-MN037	Effect of enterolobiumcyclocarpum seed meal (ecsm) with and without enzyme supplementation on nutrient digestibility of broiler chicken.	Yahaya, M. O., Popoola, M.A., Awodola-Peters, O,O., Olaniyi, T.A., Saka, A.A., Adetola, O.O	Federal College of Animal Health and Production Technology Moor Plantation Ibadan.
129	ASAN-NIAS-JAM-MN038	Performance characteristics and haematological indices of broiler chicken fed diets containing fermented kenaf (*Hibiscus cannabinus* L.) Seed meal	Odetola, O.M., Akingbade., A.O., Ijadunola, T.I., Adedeji, O.Y., Saka, A.A	Federal College of Animal Health and Production Technology, P.M.B 5029, Moor Plantation, Ibadan, Nigeria

130	ASAN-NIAS-JAM-MN039	Proximate and phytochemical analysis of *Moringa oleifera* leaf meal	Bot, M.H., Olaiya, O.D., Gyang, D.C., Garba, S.I., Brengshak, S.B., Andmwadkon, D.D.	Federal College of Animal Health and Production Technology, Nvri, Vom, Plateau State.
131	ASAN-NIAS-JAM-MN040	Effect of fermented cassava root-leaf meal - blend as a replacement for maize on growth performance of ducks.	Olayemi, W. A., Oso, A.O., Akapo, O. A.	Department of Agricultural Technology, Yaba College of Technology, Lagos
132	ASAN-NIAS-JAM-MN041	Nutrient digestibility of laying quails fed graded levels of yam peel meal (YPM) based diet supplemented with maxigrain® enzyme	Omole, E.B., Fatokun, B.O., Joshua, D.A., Zacheus S.O., Chikezie, J.	[1]department Basic Science,Federal College Of Wildlife Management Forestry Research Institute Of Nigeriap.M.B 268,New Bussa, Niger State.
133	ASAN-NIAS-JAM-MN042	Growth performance and linear body measurements of broilers fed diets containing *Gongronema latifolium* leaf meal	Osita, C. O., Ani, A. O., Ikeh, N.E., Ezemagu, I.E., Omeke, O.P.	Department of Animal Science, University of Nigeria, Nsukka, Nigeria.
134	ASAN-NIAS-JAM-MN043	Performance and nutrient digestibility of broilers chickens fed differently processed rubber seed meal (*Hevea bransiliensis*)	Fatokun, B.O., Omole, E.B.; Joshua, D.A., Chikezie, J., Zacheus S.O.	Department of Animal Production and Health Technology, Federal College of Wildlife Management Forestry Research Institute of Nigeria P.M.B 268, New Bussa, Niger State.
135	ASAN-NIAS-JAM-MN044	Carcass characteristics and relative organs weight of broiler chickens fed maize – yam peels based diets supplemented with xylanase, amylase and protease multi-enzymes	Oguntoye, M.A., Daniel, B., Adamu, F.	Department of Animal Science, Taraba State University Jalingo
136	ASAN-NIAS-JAM-MN045	Effect of replacement of groundnut haulms with lablab (*Lablab purpureus*) leaf meal on growth performance and nutrients digestibility by weaner rabbits	Tamburawa, M. S., Hassan, A.M., Madaki, A.A, Makinde, O J. And Maidala, A.	Department of Animal Science, Faculty of Agric. Kano University of Science and Tech.Wudil, Nigeria

137	ASAN-NIAS-JAM-MN046	Effect of lime (*Citrus aurantifolia* Swingle) on cassava (*Manihot esculentus* Crantz) fermentation for inclusion in fermented liquid feed	Uguru, J.O., Nwanne, I. B., Ukwah, B. N., Nwoadu, O. B., Umoren, E. P., Onu, P N	Department of Animal Science, Ebonyi State University, P M B 053, Abakaliki, Nigeria
138	ASAN-NIAS-JAM-MN047	Growth and production performances of laying guinea fowl (*Numida meleagris*) fed diet containing oyster shell as the main calcium source.	Adams, Y. S., Dairo, F. A. S.	Agricultural Education Department, College of Education (Technical), Lafiagi, Kwara State.
139	ASAN-NIAS-JAM-MN048	Growth response, carcass and sensory quality of broiler chicken served acidified water	Adetola, O. O., Odetola, M. O., Ijadunola, T.I., Yahaya, M.O., Akingbade, A. O.	Federal College of Animal Health and Production Technology, P.M.B 5029, Moor Plantation Ibadan, Oyo State, Nigeria.
140	ASAN-NIAS-JAM-MN049	Title: growth performance and nutrient digestibility of broiler chicken administered aqueous *Moringa oleifera* leaf meal extract at the finisher phase	Adio, S., Alabi, O. J., Malik A. A., Adama T.Z., Ijaiya, A. T.	Department of Animal Production, Federal University of Technologyminna P.M.B. 65, Minna Niger State Nigeria
141	ASAN-NIAS-JAM-MN050	Growth response of Japanese quails (*C oturnix coturnix* Japonica) to graded le vels of ascorbic acid as supplement in the diet s	Makinde, O.J., Babajide, S.E., Mmotugba, S. K., Olaifa, O.P., Mohammed, H.L., Tamburawa Mu'azu S., Isaac S., Maidala, A.,	Department of Animal Science, Federal University, Gashua, Nigeria.
142	ASAN-NIAS-JAM-MN051	Replacement value of feather meal for fishmeal on the performance of guinea cock.	Ahaotu, E.O., Ihiaha, P.O., Osuagwu, C.O., Nwabueze, E.U.,	Department of Animal Production Technology, Imo State Polytechnic Umuagwo, Nigeria.
143	ASAN-NIAS-JAM-MN052	Comparative effects of feeding sorghum sk-5912 versus white sorghum (fara - fara) based diets on haematological parameters and serum biochemical indices of broiler chickens	Lakurbe, O.A., Doma, U.D., Abubakar, M., Bello, K. M.	Department of Animal Science, Federal University, Kashere, Gombe State – Nigeria.

144	ASAN-NIAS-JAM-MN053	Haematology and serum biochemistry of broilers fed diet containing jackfruit juice extract as mineral/vitamins supplement.	Effiong, O. O., Harry, B. J.' Odor, C. O.	University of Calabar, Calabar, Cross River State.
145	ASAN-NIAS-JAM-MN054	Performance and haematological parameters of broilers fed *Ricinus communis* seed meal as feed additive	Forcebray R, A.,	Department of Animal Science, Faculty of Agriculture, Niger Delta University, Amassoma, Bayelsa State.
146	ASAN-NIAS-JAM-MN055	Effect of different number of rope as environmental enrichment on behavioural response of growing pigs	Famakinwa A. A., Adebiyi O.A.	Department of Animal Science, University of Ibadan, Ibadan, Nigeria
147	ASAN-NIAS-JAM-MN057	Evaluation of the growth performance, carcass characteristics and cost of broiler chickens fed commercial and on-farm formulated diets	Halilu, A., Henry, A. J., Oko, O. O. K.,	Department of Animal Science, University of Calabar, Calabar, Nigeria.
148	ASAN-NIAS-JAM-MN058	Haematological indices of young and adult Japanese quail raised in a semi-arid environment of Borno state, Nigeria	Abdulraheem, A. O., Shettima, M. M., Raji, A. O.,	Department of Animal Science, Faculty of Agriculture, University of Maiduguri, P.M.B. 1069, Maiduguri, Borno State.
149	ASAN-NIAS-JAM-MN059	Growth response of growing pigs to diets containing graded levels of cassava plant meal	Adeyemi, M. A., Akinfala, E. O.,	Department of Animal Sciences, Obafemi Awolowo University, Ile-Ife
150	ASAN-NIAS-JAM-MN060	Effect of *Enterolobium cyclocarpum* seed meal (ECSM) with and without enzyme supplementation on nutrient digestibility of broiler chicken.	Yahaya, M.O., Popoola, M.A., Awodola-Peters, O.O., Olaniyi, T.A., Saka, A.A., Adetola, O.O.,	Federal College of Animal Health and Production Technology Moor Plantation Ibadan.
151	ASAN-NIAS-JAM-MN061	Effect of phytogenic plant supplemented goat blood-rumen content mixture based-dietson the growth, haematological indices and serum biochemistry of broiler chicken.	Nwose, R.N., Onu, P. N., Nwenya, J. M. I	Department of Agriculture, Federal University Ndufu-Alike, Ikwo, Ebonyi State.

152	ASAN-NIAS-JAM-MN062	Effect of phytogenic plant supplemented goat blood-rumen content mixture based-dietson the growth, haematological indices and serum biochemistry of broiler chicken.	Nwose, R.N., Onu, P. N., Nwenya, J. M. I.	Department of Agriculture, Federal University Ndufu-Alike, Ikwo, Ebonyi State.
153	ASAN-NIAS-JAM-MN063	Effect of microbial culture from maize steep on performance, biochemical and haematological parameters of broiler chickens	Opowoye, I.O., Ajayi, M.J., Salako, A.O., Atteh, J.O.	Department of Animal Production, University of Ilorin, Kwara State
154	ASAN-NIAS-JAM-MN064	In vitro effects of feed additives on growth of fungi (*Aspergillus parasiticus*)	Salako, A.O, Aderibigbe, T. A., Opowoye, I. O., Atteh, J.O.	Department of Animal Production, University of Ilorin, Kwara State
155	ASAN-NIAS-JAM-MN065	The effects of nutrase – xylan (enzyme) supplementation on the utilization of blood rumen content mixture by broilers	Kolade, I.O., Adeniji, A.A. and Balogun, O.O	Department of Animal Production, Faculty of Agriculture, University of Ilorin, Ilorin, Nigeria.
156	ASAN-NIAS-JAM-MN066	Growth performance of Japanese quails (*Coturnix coturnix* Japonica) fed diets containing varying levels of sweet potato (*Ipomoea batatas*) meal	Agbai, K. N., Omage, J.J., Bawa, G.S.	Department of Animal Science, Ahmadu Bello University, P.M.B. 1046, Zaria
157	ASAN-NIAS-JAM-MN067	Performance of finishing broilers fed dietary levels of groundnut pod	Ajayi, M. A., Nwaodu, O. B. U., Elechi, J., Eziuloh, N. E., Ugwu ,S.O.C.	Departmenkpt of Agricultural Technology, Akanuibiam Federal Polytechnic, Unwana, Ebonyi State, Nigeria
158	ASAN-NIAS-JAM-MN068	Performance and cost benefits of broiler chickens fed maize bran/maize-soya based broiler diets supplemented commercial enzymes.	Samuel C. E., Clement E. N., Sunday N. U., Christiana A. U.,	Department of Animal Science, University of Ibadan, Ibadan

159	ASAN-NIAS-JAM-MN069	Growth performance and haematological characteristics of broiler finisher birds fed high inclusion levels of palm kernel cake (PKC)	Anyanwu, N.J., Obilonu, B.C., Odoemelam, V.U., Etela, I., Kalio, G.A., Ekpe, I.I.,	Department of Animal Science and Technology, Federal University of Technology, Owerri
160	ASAN-NIAS-JAM-MN070	Growth and serum biochemical indices of broiler chickens fed *Parkiabiglobosa* pulp supplemented with exogenous enzyme.	Ademola, S.G., Fadipe E., Togun M.E., Arasi K.K., Akinwumi A.O., Shittu M.D., Oyelekan T.N., Akineseye O.A., Bakare T.O., A, Ilori B.T., Awomoyi B.T., Ajayi O.C., Ogunyemi F.I.	Department of Animal Nutrition and Biotech. Lautech, Ogbomoso
161	ASAN-NIAS-JAM-MN071	Influence of raw and processed sesame seed meals on growth performance of broiler chickens	Ademola S.G., Sarat I., Arasi K.K., Shittu M.D., Akinwumi A.O., Ojewusi R.A., Olaniyi O. F., Oyelekan T.N., Adeoye F.I., Raheem O.D., Nafiu Q.O., Olagunju K.	Department of Animal Nutrition and Biotech. Lautech, Ogbomoso
162	ASAN-NIAS-JAM-MN072	Assessment of two phytogenic leaf meals on egg sensory properties and nutrient digestibility of nera black layer chickens	Adeoye, O., Odunsi, A. A., Olowolaju, E. B., Ajayi, O., Adewoye, J. B., Adekunle, C.O.	Department of Animal Nutrition and Biotechnology, Faculty of Agricultural Sciences, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria
163	ASAN-NIAS-JAM-MN073	Feeding value of defatted cashew kernel reject as protein source in broiler diets	Akande T.O., Abegunde T.O., Gbadamosi F.A.	Department of Animal Sciences, Obafemi Awolowo University, Ile-Ife, Nigeria
164	ASAN-NIAS-JAM-MN074	Egg qualities of laying hens fed diets supplemented with varying levels of copper (II) oxide	Ayoola, T.O, Adu, O.A, Adeniran, C.O. and Gbore, F.A	Department of Animal Production and Health, The Federal University of Technology, Akure, Ondo State, Nigeria

165	ASAN-NIAS-JAM-MN075	Effects of dietary levels of enzyme supplemented rice husk on performance, nutrient retention and microbial gut profile of broilers	Aderibigbe, T.A, Atteh, J.O, Ajayi, M.J, Okukpe, K.M, Opowoye, I.O, and Salako, A.O	Department of Animal Production, University of Ilorin, Ilorin, Nigeria.
166	ASAN-NIAS-JAM-MN076	Effects of dietary protein and energy levels on reproductive performance of guinea hens	Alli, O.I., De Campos, J.S., and Ayorinde, K.L.	Department of Animal Production, University of Ilorin, Ilorin, Nigeria.
167	ASAN-NIAS-JAM-MN077	Effect of feeding frequency on growth performance of pigs	Ogunsipe, M.H., Oladepo, A.D., Balogun, K.B. and Adeyeye, S.A.	Animal Production Unit, Department of Agricultural Science, Adeyemi College of Education, Ondo
168	ASAN-NIAS-JAM-MN079	Comparative effects of ascorbic and baobab fruit pulp meal On perforamnce and haematological status of Broiler chicks in hot-dry season	Adeosun, S.L., Ogundipe, S.O. and [3] Akinyemi, M.	Department of Animal Science, Federal University, Dutsinma Katsina State
ANIMAL PRODUCTS AND PROCESSING TECHNOLOGY				
169	ASAN-NIAS-JAM-PT001	Comparative study on the ready to eat meat productions (*Kilishi, tsuya*, Tsire and *Dambun nama*) in some parts of Kaura-Namoda town of Zamfara state	Hassan A.B., Afolayan G.G., Akyok A.D.,	Department of Science Laboratory Technology School of Science and Technology Federal Polytechnic, Kaura-Namoda Zamfara State.
170	ASAN-NIAS-JAM-PT002	Effect of roselle (*Hibiscus sabdariffa*), ginger (*Zingiber officinale*) and garlic (*Allium sativum*) extracts on meat quality of broiler chicken	Jiya, E. Z., Malik, A. A., Ayanwale, B. A., Okunola, F. A., Alabi, O. J.	Department of Animal Production, Federal University of Technology Minna
171	ASAN-NIAS-JAM-PT003	Growth performance, carcass traits and economics of production of	Ayoola, M. A., Balogun, K. B.	Department of Agricultural Science, Adeyemi College of Education, Ondo

		broilers fed maize replaced with biscuit waste diet		
172	ASAN-NIAS-JAM-PT004	Assessment of consumers preference to different types of meat in Kuje area council of FCT, Nigeria	Mustapha, Y., Jimoh, A., Babandi B., Shehu, B.	Regulatory Affairs Department, Nigerian Institute of Animal Science, Abuja, Nigeria
173	ASAN-NIAS-JAM-PT005	Proximate composition and sensory evaluation of broiler chicken meat fed *Moringa oleifera* seed meal	Akangbe, E. E., Abu, O. A.	Agricultural Biochemistry and Nutrition Unit, Department of Animal Science, University of Ibadan, Ibadan, Nigeria
174	ASAN-NIAS-JAM-PT006	Effect Of Growth Promoters (Zeranol And Estradiol-17β) On Carcass And Sensory Characteristics Of Zero-Grazed White Fulani Bulls	Makinde, O. A., Soyelu, O. T., Aderibigbe, A. O.	Department of Animal Sciences, Obafemi Awolowo University, Ile-Ife, Nigeria
175	ASAN-NIAS-JAM-PT007	Quality assessment of retail meat cuts sold in Akure town, Ondo state, Nigeria	Adetunji, A.O., Afeluyi, S.O., Akintomide, A.A.	Department of Animal Production and Health, The Federal University of Technology, Akure
176	ASAN-NIAS-JAM-PT008	Influence of late quantitative feed restriction on carcass traits, fat deposition, and meat quality in broiler chickens	Adeyemi, K.D., Adegboyega, A.O., Abubakar, S.O., Obamonire, O.S, Ologunde, O.F.	Department of Animal Production, University of Ilorin, Ilorin, Nigeria.
177	ASAN-NIAS-JAM-PT009	pH of beef sausage as affected by time post-mortem on yield and keeping quality of sausage	Oshibanjo D. O., Adesope A. I., Abegunde L.	Department of Animal Production, University of Jos, Jos Plateau
178	ASAN-NIAS-JAM-PT010	Effects of storage conditions on the chemical properties of Japanese quail and chicken eggs	Chimezie V.O., Adeyemi K.D.,Yusuff A.T., Alli, O.I., and Babatunde A.S.	Department of Animal Production, University of Ilorin, Ilorin, Nigeria.

RUMINANT ANIMAL NUTRITION AND PRODUCTION				
179	ASAN-NIAS-JAM-RN001	Effect of stages of growth on dry matter yield and nutrients composition of Centro (*Centrosema mollemart* Exbenth) in the year of establishment in Jos, Nigeria	Akpensuen, T.T., Namo, O.A.T., Okpanachi, U., Andodah, E.O.	Department of Animal Production, Faculty of Agriculture, University of Jos.
180	ASAN-NIAS-JAM-RN002	Olfaction: stress management strategy To improve performance in ruminants – a review	Anya, M.I., Ozung, P.O., Ayuk, A. A., Agube, J. L.	Department of Animal Science, University of Calabar, Calabar, Nigeria
181	ASAN-NIAS-JAM-RN003	In vitro methane gas production and rumen fermentation kinetics of diet containing fermented baobab seed meal	Ikyume, T. T., Bashi, D. T., Atoo, A. F.	Department of Animal Production, College of Animal Science, Federal University of Agriculture, Makurdi, Benue State, Nigeria
182	ASAN-NIAS-JAM-RN004	Growth Performances and Haematological Parameters of West African Dwarf Goats Fed Diets Containing Varying Levels of Fermented Malted Sorghum Sprout	Saka, A. A., Adekunjo, R. K., Ajayi, F. T., Adedeji, O. Y., Odetola, M. O. and Adekanbi, A. O.	Federal College of Animal Health and Production Technology, P. M. B. 5029, Moor Plantation, Ibadan.
183	ASAN-NIAS-JAM-RN005	Accuracy of weight estimation methods in small ruminant	Ma'aruf B.S., Ibrahim T., Sadiqm.S., Umar, H.U., Shu'aibu A.	Department of Animal Science, Faculty of Agriculture, Federal University, Kashere, Gombe State
184	ASAN-NIAS-JAM-RN006	Effect of turmeric and black pepper based diet on haematological and biochemical paramters of west african dwarf does	Belewu M. A. and Oladipo O. A.	Department of Animal Production, University of Ilorin, P. M. B. 1515, Kwara State, Nigeria
185	ASAN-NIAS-JAM-RN007	Effect of turmeric and black pepper based diet on milk yield and milk quality of west african dwarf does	Belewu M. A. and Oladipo O. A.	Department of Animal Production, University of Ilorin, P. M. B. 1515, Kwara State, Nigeria

186	ASAN-NIAS-JAM-RN008	Growth performance and digestibility of rabbits fed bitter leaf (*Vernonia amygdalina*) meal (valm)	Odeyinka, S.M., Ayandiran, S.K., Ganiyu, A.O., Arogundade O.S.	Department of Animal Science, Obafemi Awolowo University, Ile Ife. Osun State. Nigeria.
187	ASAN-NIAS-JAM-RN009	Composition of browse plant species utilized by camels (*Camelus dromedarius*) in semi-arid part of Nigeria.	Shehu, B., Muhammad, B. F., Madigawa, I. L., Madobi, I.S., Mustapha, Y., Babandi. B.	Binyaminu Usman Polytechnic, Hadejia, Nigeria.
188	ASAN-NIAS-JAM-RN010	A Case for Smallholder Organic Goat Farming in Rivers State, Nigeria	Simon, B.P, Ingweye, J.N. and Etela, I.	Department of Animal Science Faculty of Agriculture University of Port Harcourt PMB 5323, Choba, Rivers State
189	ASAN-NIAS-JAM-RN011	Performance of West African dwarf goats fed an ensiled mixture of some non-conventional feedstuffs	Okpanachi, U., David, O.C., Luka, J.S., Agu, C. I,, Akpensuen, T.T., Odah, E.O.,	Department of Animal Production, Faculty of Agriculture, University of Jos, Plateau State.
190	ASAN-NIAS-JAM-RN013	Cattail drying process for animal feed	Sale, N.A., Ratiff, S.N.L., Iyiola, T., Kohn, R. A.,	National Agricultural Extension And Research Liaison Services (Naerls), Ahmadu Bello University, Zaria, Nigeria
191	ASAN-NIAS-JAM-RN014	Growth performance and meat quality evaluation of goats fed urea-treated sugarcane waste and kolanut husk supplemented diets.	Okoruwa, M. I., Adomeh, E. E., Okoh, P. I., Ikhimioya, I.,	Department of Animal Science, Ambrose Alli University, P.M.B. 14, Ekpoma. Edo State, Nigeria
192	ASAN-NIAS-JAM-RN015	Evaluation of nutritional composition of ensiled sugarcane waste with varying levels of rumen digesta in Adamawa state, Nigeria.	Yahya, M.M., Aminu, I.M., Gworgwor, Z.A., Kirfi, A.Y.,	Department of Animal Science And Range Management, Modibbo Adama University of Technology,Yola. Department of Animal Health and Production, Taraba State College of Agriculture, Jalingo

193	ASAN-NIAS-JAM-RN016	Carcass characteristic of west african dwarf bucks fed sole foliage of *Alchornea cordifolia, Aspilia africana Andropogon tectorum.*	Eyoh, G. D., Udo, M.D., Idiong, N. B.	Department of Animal Science, Akwa Ibom State University, P.M.B. 1167, Uyo, Akwa Ibom State
194	ASAN-NIAS-JAM-RN017	Nutrients intake and utilization by west african dwarf goats fed *Azadirachta indica* (neem) leaf meal diets.	Fajemisin, A. N., Ojewande, B.A., Omotoso, O. B., Libhaze, G. A., Osho, I. B.,	Department of Animal Production and Health, Federal University of Technology, P.M.B 704, Akure. Nigeria.
195	ASAN-NIAS-JAM-RN018	In vitro gas volume production of compounded diet containing graded levels of *Aspergillus nigerbiode* graded corn cob	Adedeji, O. Y., Saka, A. A., Ajayi, F. T., Falola, O. O., Oladele-Bukola, M.O.,	Federal College of Animal Health and Production Technology, P. M. B. 5029, Moor Plantation, Ibadan.
196	ASAN-NIAS-JAM-RN019	Effects of phosphorus fertilizer rates on dry matter yield of three lablab varieties	Girgiri, A. Y., Abubakar, M., Kalla, D. J. U., Dass, U. D., Sokoto, M. B.	Department of Animal Science, University of Maiduguri, P. M. B. 1069, Borno State Nigeria
197	ASAN-NIAS-JAM-RN020	Optimization of chloroform quantity for methane inhibition in in vitro gas production experiments	Lawal M., Newbold C. J. N.,	Institute of Biological, Environmental and Rural Sciences, Aberystwyth University
198	ASAN-NIAS-JAM-RN021	The performance of West African dwarf (wad) goats fed graded levels of *Rhizopus oligosporus*-treated rice husk (rotrh)	Belewu, M. A., Ogunbajo, S. A.,	Department of Animal Production, University of Ilorin, Ilorin, Nigeria.
199	ASAN-NIAS-JAM-RN022	Nutrient intake and apparent digestibility of pigeon pea (*Cajanus cajanl*) husk fed to red Sokoto bucks	Yashim, S.M., Achi, N.P., Ali-Balogun, J.K., Ibrahim, A.T.	Department of Animal Science, Ahmadu Bello University,Zaria
200	ASAN-NIAS-JAM-RN023	Intake of fibre by Yankasa rams fed sugarcane waste (SCW) silage	Ashiru, R. M., Ibrahim, U., Dan Abba, U. Y., Ibrahim, J.	Department of Animal Science, Kano University of Science and Technology, Wudil, Nigeria Department of Animal Science, Usmanu Dan Fodio University, Sokoto, Nigeria

201	ASAN-NIAS-JAM-RN024	Botanical composition of native forage species in an established Gamba (*Andropogon gayanus* kunth) pasture in the semi-arid zone of Nigeria	Ibrahim, U., Muhammad, I.R., Ashiru, R. M., Maigandi, S. A., Hassan, A. M., Tamburawa, M. S., Gawuna, S.S., Khaleel, A. G., Zango, M. H., Madaki, S.	Department of Animal Science, Kano University of Science and Technology, Wudil, Nigeria
202	ASAN-NIAS-JAM-RN025	Nutritional potential of composite diets comprising of rumen waste, poultry waste and cassava peels, using in vitro gas production technique.	Inweh, D. A., Ikhatua, U. J., Bamikole, M. A.,	Department of Animal Science, University of Benin, Benin City,Edo State, Nigeria
203	ASAN-NIAS-JAM-RN026	Effect of feeding different ratios of soymilk on Blood parameters of friesian x bunaji dairy calves	Gadzama, I.U., Yashim, S.M., Abdu, S.B., Ndudim, R.K.	National Animal Production Research Institute, Shika-Zaria, Nigeria
204	ASAN-NIAS-JAM-RN027	Assessment of water salinity and microbial status of livestock farm in semi-arid environment.	Asheikh, L.G., Mohammed, G., Abbator. F.I., Chana, Z.M. Kolo, U. M.	Department of Animal Science, University of Maiduguri, P.M.B. 1069, Maiduguri, Borno State, Nigeria.
205	ASAN-NIAS-JAM-RN028	Growth Performance and Nutrient Digestibility of Red Sokoto Bucks Fed Varying Inclusion Levels of Sun Dried Mango (*Mangifera Indica*) Fruit Waste Meals in Rice Offal Based Diets	Ibrahim*, T.A., Turang, S., Abdu, S. B., Hassan, M.R., Adamu, H.Y. and Yashim, S.M.	Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria
206	ASAN-NIAS-JAM-RN029	Performance characteristics and nitrogen metabolism of west african dwarf sheep fed diets containing *Garcinia kola* (bitter kola) seed meal.	Jinadu ,K.B., Akingbade, A.O., Adekanbi, A.O., Olona,J.F., Saka,A.A., Adekunjo,R.K. ,Olagbaju,O.T. and Adedokun,G.A.	Federal College of Animal Health and Production Technology, Ibadan. Nigeria

ANIMAL WELFARE AND HEALTH

Potentials of Hot Red Pepper (*Capsicum annuum L.*) on performance and Coccidiosis in Broilers

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Abstract: A trial was conducted to assess the prophylactic efficacy of Hot Red Pepper (HRP) powder as an additive on performance and coccidiosis in broiler chicken. A Completely Randomized Design (CRD) was used to allot 210 a-day old Hybro-chicks to three treatments with seven replicates of ten birds each. Diet 1 which is a Positive Control (PC) – supplemented with amprolium. Diet 2 was a Negative Control (NC) – without amprolium and HRP, while Diet 3 was supplemented with Hot Red Pepper(HRP) at the level of 1.25%.
Results showed that at the starter phase Average Feed Intake (AFI) and Average Body Weight Gain (ABWG) were higher numerically in diet 1 (PC) – with amprolium and diet 3 (HRP) – Supplemented type compared with diet 2 (NC) – without Amprolium and HRP supplementation. At finisher phase, significantly ($P<0.05$) better feed: gain ratio was reported in birds fed diet 1 (1.96) and in birds fed diet 3 (HRP – Supplementation, 1.98) compared with in birds fed diet 2 (NC – without Amprolium and HRP, 2.12), respectively. Mortality ratio (5.71%) was significantly ($P < 0.05$) higher in diet 2 (NC). Also, the Amprolium, and HRP dietary supplementation had a significant effect on Oocysts shedded Per gram of feaces (OPG) in diet 1 (61.8, 40.6) and diet 3 (70.1, 49.3) compared with diet 2 (83.6, 98.9) for both starter and finisher phases, respectively. Conclusively, hot red pepper supplementation at 1.25% as an anticoccidial feed additive shows some promise and deserves further investigation.

Keywords: Amprolium, Broilers, Hot Red Pepper, Oocysts, Prophylactic

INTRODUCTION

Avian coccidiosis disease (Protozoan) is one of the major threats to poultry industry. This disease caused by seven different species of Eimeria (*E.acervulina, E. tenella, E. maxima, E. necatrix, E. brunetti, E. mitis, E. praecox)* affects the intestinal tract of chickens, producing diarrhea, low weight gain, poor feed to gain ratio, andin severe cases, mortality *(*Williams, 2002*;* Williams *et al.,* 2009*; Pop, L., et al.,* 2015*).* In broiler chickens the most prevalent species are *E. acervulina, E. tenella and E. maxima (*Gyorke *et al*., 2013), of which *E. tenella* and *E. necatrix* are highly pathogenic, causing hemorrhagic diarrhea and being responsible for greatly reduction in weight gain and considerable mortality.
Various alternative strategies have proven their effectiveness in Coccidiosis control with potential stimulatory effects on immunity and performances. Such as usage of feed additives, essential oils and plant extracts (Abbas *et al*., 2012; Zaman*et a*l., 2012). Among them, artemisinin produced by aerial parts of *Artemisia annua* and piperine and capsaicin in hot red pepper (*Capsicum annuum L.*) had been proven to be effective against enteric disorders in poultry. The mode of action of artemisinin most likely implies the production of free radicals due to cleavage of its endoperoxide bridge resulting in the inhibition of the coccidian sarco (Del Cacho*et al*., 2010). Similarly, Adedoyin *et al.* (2017) reported cases of better feed to gain ratio and lower mortality in broilers fed HRP supplemented diets. Also, the control of this disease is based mainly on chemoprevention using coccidiostats additives and more recently on immunization. But with the increasing resistance of avian coccidia to anticoccidial drugs and vaccine efficacy which is variable and the usage may in some circumstances be restricted. Thus, the discovery of novel effective anticoccidial is essential in order to keep in control this devastating disease (Allen et al., 2004; Pop, *et al*., 2015 and Abdelheg, *et al*., 2015). The present study therefore

aimed to test the efficiency of hot red pepper (*Capsicum annuum L.*) on production performances and prevention of coccidiosis in broiler chickens.

MATERIALS AND METHODS

Experimental Diets

The sun-dried hot red pepper (HRP) used in this experiment was obtained from Maya market in Ibarapa Area, Oyo State and was then ground into powder. Diet 1 served as a positive control (PC) (with Amprolium at 60g/100kg diet) diet 2 served as negative control (NC) (without Amprolium and HRP supplementation) and diet 3 was supplemented with 1.25% of hot red pepper (HRP)

Table 1: Nutrients composition of commercial broiler hybrid diets (g/100g)

Nutrients	Starter	Finisher
Dry matter	89.4	89.3
Moisture	10.8	10.5
Crude protein	22.5	20.01
Ether extract	5.1	3.8
Crude fibre	4.3	3.6
Ash	5.0	6.0
Metabolisable Energy Kcal/kg	3000.8	3100.1
Phosphorus	0.45	0.44
Calcium	1.2	1.2
Methionine	0.56	0.52
Lysine	1.2	1.2

Experimental Birds and Management: A total of 210-day old Hybro broiler chicks were used in the present study. Birds were allocated into 3 treatments, each with seven replicates using a Completely Randomized Designed (CRD). Birds were vaccinated against Newcastle disease and infection bursal disease in the 1st, 10th and 21st day. Also, birds fed with positive control (PC) diet 1 were medicated with antibiotics, Amprole-200 and vitalyte as outlined by Olomu (2003). In contrast birds, fed with negative control (NC) diet 2 were provided only with vitalyte, while diet 3 was supplemented with 1.25% hot red pepper (HRP). Birds were raised on deep litter. Feed and water were provided ad libitum. Feed intake, weight gain, feed to gain ratio (FGR) and mortality were recorded weekly and were used as indicators of birds' performance. The duration of the experiment was 56days. Feed to gain ratio (FGR) was calculated as follows:

$$\text{FGR} = \frac{Feedintake}{Bodyweightgain}$$

Parasitological and Immunological Index: On the 28th and 56th days, Oocysts counts were determined in 10gram of excreta collected. Samples were placed in separate airtight storage bags, mixed thoroughly and kept refrigerated. Then, they were firstly ten-fold diluted in a tap water and the resulting solutions were further diluted in saturated NaCl solution at a ratio of 1/10 (floating technique) and oocysts per gram of feaces was determined by duplicate counts of duplicate feacal slurry from each specimen by using McMaster chamber method. The results were presented as the number of Oocysts per gram of excreta (Abdelheg et al., 2015).

Statistical Analysis: Data obtained was subjected to analysis of variance (ANOVA) with SAS software SAS/STAT, 2012). Duncan Multiple range tests (1965) was used to separate subclass means.

Table 2: Performance characteristics of broiler chickens fed experimental diets containing different Additives

	Starter Phase				Finisher Phase			
Diets + Additive	**Av. feed intake g/b/d**	**Av. body weight gain g/b/d**	**Feed: Gain**	**Mortality (%)**	**Av. Feed intake g/b/d**	**Av. Body weight gain g/b/d**	**Feed: Gain**	**Mortality (%)**
Diet 1- PC – with Amprolium)	43.08	32.80	1.31^{ab}	1.42^{b}	84.6	43.14^{a}	1.96^{b}	2.85^{b}
Diet 2-NC- without Amprolium and HRP	42.64	30.01	1.43^{a}	2.85^{a}	73.81	35.03^{ab}	2.12^{a}	5.71^{a}
Diet 3- (HRP) – supplemented type	45.1	33.03	1.36^{ab}	1.42^{b}	88.46	44.61^{a}	1.98^{b}	1.42^{bc}
SEM±	2.08	3.39	0.08	0.19	9.91	1.39	0.20	0.02

abc… means within a column with same superscript do not differ significantly (P>0.05), SEM: standard error means, g/b/d: grams/bird/day; HRP: hot red pepper, PC: positive control, NC: negative control

Table 3: Oocysts Excretion (x10^3) per g of feaces in broiler chickens fed experimental diets containing different Additives

Treatment Phases	**Diet 1 PC-with Amprolium**	**Diet 2 NC-without amprolium and (HRP)**	**Diet 3 HRP-supplemented type**	**SEM±**
Starter	61.7^{b}	83.6^{a}	70.18^{b}	1.9
Finisher	40.6^{bc}	90.1^{a}	43.10^{b}	3.3

abc… means within a raw showing the same superscript do not differ significantly (P>0.05), SEM: standard error means, PC: Positive Control, NC: Negative Control, HRP: Hot red pepper

RESULTS AND DISCUSSION

Both the starter and finisher phases data on Average Feed Intake (AFI), Average Body Weight (ABW), Feed: Gain ratio (FGR) and mortality are presented in Table 2. At the starter phase, birds fed with the diet 1 (Positive Control (PC)- with Amprolium) and diet 3 (hot red pepper -supplemented type) had a numerical higher (P>0.05) AFI and ABWG compared to diet 2 (negative control – without Amprolium and hot red pepper). At finisher phase dietary treatment however, significantly (P<0.05) influenced feed: gain ratio of (1.96) in birds fed diet 1 and (1.98) in birds fed diet 3 (HRP-supplemented type) compared with (2.12) in birds fed diet 2 (NC – without Amprolium and HRP) respectively. The mortality rate (5.71%)(P<0.05) was the highest in the (NC – without Amprolium and HRP). This could be explained that production of enzyme, efficacy and system of birds at starter phase are not yet fully developed to perform some metabolic activities. Pop, L et al. (2015) reported that the pathogenic microbial floral in the small intestine compete with host for nutrients while at the same time inhibiting the binding of the bile acids to the pertinent substances, which resulted to decrease in the digestion of fats and fat-soluble vitamins. This leads to decrease in performance and increase in disease rate. Data from (Table 3) that showed the oocysts excretion per gram of faeces were significantly (P<0.05) higher in birds fed diet 2 (NC – without medication and HRP) compared with others throughout the experimental trail. This might confirm the anticoccidial activity of the used products. However, they do not completely eliminate the parasites from the intestine of those birds fed diets 1 and 3.

CONCLUSION

In this study the prophylactic use of hot red pepper as anticoccidial feed additive shows some promise and deserves further study.

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Effects of Crating on Stress and Fear Responses of Growing Broilers Fed with *Moringa oliefera* Feed Meal

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Abstract: Poultry welfare during transport from sites of production to slaughter processing sites is a matter of concern and loss of birds from stress during crating for transportation can lead to considerable economic loss by the farmer. Knowledge of differential genotype susceptibility could be used in guiding selection of breeds and improvement for crating stress resistance. Physiological stress response and fear levels were evaluated in broiler chickens fed control diets, moringa oleifera supplemented diets for 8 wks. Birds were subjected to 3 hours crating at 8 wks. The fear levels of birds were measured using Open field test (OFT) and tonic immobility reaction (TI).There was significant difference ($P<0.05$) among breeds with Anak and Hubbard breed showing less anxiety, Ross was the most anxious of the breed. This pattern was also followed after the crating treatment. Stress contributed to the observed differences has shown by a reduction in activities of chickens in the 2nd OFT. Significance difference ($P<0.05$) between breeds of broilers in T.I tests shows that Anak and Abor acre are the most fearful compare to Ross the least fearful of the breeds, stress and diet also contributes to the observed differences found in the 2nd T.I test. Significantly difference ($P<0.05$) between breeds was observed in Heterophyl Lymphocyte ratio with Arbor Acre having the lowest, Ross was intermediate while Anak and Hubbard have the highest values. In conclusion, supplementation of broiler diet with M. *oleifera* (2%) did not have a modulatory effect on the physiological stress response of crated birds.

Keywords: Broiler, crating, tonic immobility, fear, stress, H/L ratio.

INTRODUCTION

The welfare of poultry during transport from sites of production to slaughter at processing sites is a matter of concern and loss of birds from stress during crating for transportation can lead to considerable economic loss by the farmer. The adverse effect of these factors on the bird may range from mild distress and aversion to injury and death. It has been reported that 40 per cent of mortalities in "dead on arrival" broilers are a consequence of stress (Bayliss and Hinton, 1990).Breeds may differ in this susceptibility although no scientific proof exists. There is need for base-line information on differential crating stress susceptibility in different breeds of chicken which are faced with crating stress to critically test the validity of the widespread belief that crating stress differs between genotypes. Knowledge of differential genotype susceptibility would then be available for use in guiding selection of breeds and improvement for crating stress resistance. Commercial broiler live haul involves a number of potential stressors, including crating and transportation that can cause increased production of adrenal hormones and affect the welfare of the birds. Crating causes an increase in plasma corticosterone (CORT) levels in both laying hens and broilers (Beuving and Vonder, 1978; Kannan and Mench, 1996). The duration of crating (Kannan and Mench, 1996) and the method of crating (Duncan, 1989) can also influence the stress response shown by the bird. Although catching, crating, and loading are the procedures that are most likely to cause physical injuries, crating and transportation has also been reported to be stressful to broilers. Therefore, the need for attenuating the adverse physiological and behavioural consequences associated with crating and transportation of broiler chickens is recognized within the poultry industry.

Stress response could be measured by Corticosterone concentration level and Heterophy Lympocyte ratio. Duncan (1989), for example, found that birds that were crated and transported on a vehicle for 40 min had higher plasma CORT concentrations than birds that were crated and loaded onto the vehicle but not transported. Further, Cashman *et al*., (1989) reported that fear levels in birds were mainly determined by crating and transportation and not just by catching and loading. The heterophil: lymphocyte ratio (H/L ratio) was used as an index of stress

(Zulkifli *et al.,* 2000a). In addition Gross and Siegel (1983) compared plasma corticosterone concentration and H/L ratio responses to various stressors and concluded that the H/L ratio is a better indicator of stress in poultry. While Open Field reaction and Tonic immobility (TI) reaction of chickens provides a useful behavioural method of estimating their fearfulness (Jones, 1986). Cashman *et al*. (1989) mentioned that both journey duration and waiting time in crates before and during transport increased the duration of tonic immobility.

Supplementations of broiler diets with some feed additives may aid in overcoming any deficiency and enhance tolerance to stresses concomitantly. *Moringa oleifera* can be utilized for broilers to enhance performance and productivity and to increase the immune status of broilers and consequently increase the resistance against diseases, the vital minerals present in Moringa include Calcium, Copper, Iron, Potassium, Magnesium, Manganese and Zinc. It has more than 40 natural anti-oxidants (Fuglie, 2000) which help in alleviating the negative response of stress condition on birds.

Therefore the present study was conducted to investigate the effects of dietary supplementation of moringa oleifera leaf meal on the Corticosterone concentration, H/L ratio and level of fearfulness as indicated by OFT and TI after crating of different breeds of broiler chickens at age of marketing.

MATERIALS AND METHODS

Experimental design: A total of 192 broiler day-old chicks that, is 48 chicks each of four different genotypes (Ross, Anak, Arbor acre and Hubbard) were used for this study, the birds were obtained from a commercial hatcheries. Each strain were randomly distributed into four (4) groups containing 12 chicks each which were labelled and identified A, B, C, and D. The chicks were housed separately by breed in a conventional deep litter cage, thus making four (4) compartments per breed and a total of sixteen (16) compartments.

Each strain was sub-divided into four replicate of 12 chicks each, two replicated groups were fed with control formulated basal diet while the other two groups were fed formulated feed supplemented with *Moringa Oleifera* at 2% level of inclusion in both starter and finisher feed types. Feed and drinking water was available *ad libitum*, the birds were fed with starter mash (1-4 weeks) and finished feed (5-8 weeks).

Processing of *Moringa oleifera* leaves: Fresh samples of the leaves of *Moringa oleifera* were harvested from *Moringa oleifera* tree, stems and branches were cut. Fresh leaves of *Moringa oleifera* were manually removed from the stem and branches, the leaves were air dried under the shade for 10 days. Dried leaves were grounded into fine powder and stored at room temperature; the dried leaves were used in the formulation of the experimental diet.

Apparatus and Procedures: All chicks were examined by the use of three (3) separate tests, including; an Open- field test, a Tonic Immobility test, and Crowding and crating tests.

Open field behaviours were registered in one 5 min session when chickens were 14 days old (2 wks). Between the age of 28 and 35 days (4-5 wks), all birds were tested individually in the Tonic immobility test (1st test). Birds were tested in the Crating test when they were 54 days (8 wks) old.

A repeat of the above tests (2^{nd} OFT test and the 2^{nd} Tonic immobility test) was done when the birds were 7-8 weeks old.

The Open Field apparatus was constructed from Medium Density Fibre-board (MDF). For all tasks, testing order was randomized for each trial. Experiments took place between 09:00 h and 16:00 h.

Open Field Test: The open field consisted of an observation pen measuring 122cm × 122cm × 74cm (width × length × height) of MDF (see Fig 1A).The floor was covered with a black rubber mat, and white chalk lines divided the area equally in a 5 × 5 pattern of squares. After being caught gently and placed in the middle of the open field the, 5 min observation started. After the 5 min observation the bird was immediately returned to its home pen. All tests and observations were performed between 9.00 h and 15.00 h. The sessions were viewed via

a camera hung above the apparatus, allowing the observer to score behaviour from a video screen in an adjacent area.
Latency to cross the first square; total time spent walking, total number of squares crossed and total number of distress calls were recorded using focal sampling continuous recording.

Tonic Immobility Test: The birds were subjected to tonic immobility test at 28 d (1st test) and 49 d (2nd test). Tonic immobility was induced by inverting the chicken on its side and applying lateral manual restraint until the chicken stops struggling. Tonic immobility duration was recorded from the moment the chicken became immobile until the bird righted itself. Tonic immobility test was conducted in separate room within the same building.

Crating test: The birds were subjected to crating test at 54 d (at 07 30h), 10 birds from each genotype group were randomly selected, removed from their flock, carried by the legs in an inverted manner and placed in a plastic crate (0.80m *0.60m* 0.31m). The crates were left stationary for 3 hrs in the other chamber (crates were placed in a single stack) undisturbed. The birds were removed and used for the 2nd OFT test and the 2nd Tonic immobility test immediately after they are taken out from the crate, before they were returned to their home flock.

Blood collection procedure: Three chickens were selected at random from each group genotype after the 2nd OFT test and the 2nd Tonic immobility test. Blood samples (0.3 ml) were collected directly from a puncture of the wing vein into tubes containing EDTA as anticoagulant. Blood samples were capped, placed on ice and delivered to a commercial laboratory as soon as possible after collection had been completed. Samples were transferred to a freezer (−4°F) until Corticosterone, Heterophil Lympocyte ratio determinations were performed.

RESULTS
Significant difference ($P<0.05$) was found between breeds (both in OFT 1and OFT 2) in the latency to cross the first square, number of squares crossed, total time ambulating, number of distress calls (Table 1). Significant difference ($P<0.05$) was found between breeds (both in T.1 1and T.I 2) in tonic immobility time (s) (Table 2). Significant breed effect was found only in the Heterophl Lymphocyte ratio with the Abor acre breed having the lowest and the Anak breed having the highest Heterophl Lymphocyte ratio (Table 3).
The result of this study in the Open Field Tests show that there are differences in the behavioural character exhibited by different breeds of broiler chickens (Table 1) which is in agreement with Buitenhius et al., (2004) who explains that behavior has a genetic component is responsible for the observed differences in open field behavior of different genotypes of chickens.

Stress has a major factor contributed to the observed difference in the second Open Field Test (Table 1) shows a reduction in activities of chickens (latency to cross first square, numbers of squares crossed, total time ambulating and total number of distress calls) which is in accordance with (Marin and Martijena, 1999) explains that short–term stressful stimulation such as loud noise or social separation before placement in the open-field decreases the tendency of chickens to ambulate and escape from the situation.

Tonic immobility test (2nd test) result is consistent with the view that fear behavior responses differs due to stress in tonic immobility test in individual birds (Cockrem, 2007) because chickens under stress are known to have increased arousal, cardiovascular tone and respiration rate. T.I duration was longer (T.I 2nd test) ($P<0.05$) after crating of broilers for 3 hrs irrespective of the diet given (Table 2) suggesting that crating increases the level of fearfulness of broilers. It can be concluded that *Moringa oleifera* (2%) is not a good modulator of stress in chickens although it have a positive effect on their productive performance. Stress affects performance of broiler chickens in ethological tests.

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Table 1. Effects of breed on performance of experimental birds in both Open Field Tests.

TEST	VARIABLES	ROSS	ANACK	ABOR ACRE	HUBBARD
OFT 1	LATENCY (s)	131.54 ± 4.1(46)^{b}	94.05 ± 8.72 (40)^{a}	135.76 ± 6.51 (42)^{b}	110.21 ± 10.89 (38)^{a}
	NO OF SQUARES	7.76 ± 0.51 (46)^{a}	10.63 ± 0.87 (40)^{b}	8.67 ± 0.55 (42)^{ab}	8.63 ± 0.96 (38)^{ab}
	TOTAL TIME Ambul (s)	43.61 ± 2.88(46)^{a}	57.58 ± 5.22(40)^{b}	42.86 ± 2.79 (42)^{a}	48.97 ± 5.78(38)^{ab}
	NO OF DISTRESS CALLS	21.15 ± 1.25(46)^{ab}	23.3 ± 1.29 (46)^{b}	18.11 ± 0.64 (47)^{a}	18.13 ± 1.04 (46)^{a}
OFT 2	LATENCY (s)	149.29 ± 11.61(41)^{c}	118.73 ± 7.75 (40)^{a}	137.49 ± 6.8 (41)^{bc}	133.59 ± 9.15 (41)^{b}
	NO OF SQUARES	6.83 ± 0.59 (40)^{a}	9.6 ± 0.8 (40)^{c}	9.24 ± 0.74 (41)^{bc}	7.9 ± 0.77 (41)^{ab}
	TOTAL TIME Ambul (s)	26.49 ± 2.69 (41)^{a}	34.08 ± 3.5 (40)^{a}	29.8 ± 2.78 (41)^{a}	62.71 ± 5.93 (41)^{b}
	NO OF DISTRESS CALLS	16.68 ± 1.19 (47)^{ab}	17.98 ± 1.01 (47)^{b}	17.87 ± 0.88 (47)^{b}	14.98 ± 0.99 (46)^{a}

a,b,c Means ± SE with different superscript letters are significantly different (P<0.05); but values without superscript are similar (P<0.05).

Latency: Time taken to cross the first square. Ambul- Ambulating (walking). OFT: Open Field Test.

Table 2: Effects of breed on performance of experimental birds in both Tonic Immobility Tests

TESTS	VARIABLES	ROSS	ANAK	ABOR ACRE	HUBBARD
T.I 1	T.I (s)	178.66 ± 4.37 (44)^{c}	154.52 ± 4.61 (44)^{b}	107.4 ± 3.7 (45)^{a}	117.66 ± 5.93 (44)^{a}
	No of induction	1.77 ± 0.11 (44)	1.75 ± 0.11 (44)	1.76 ± 0.11 (45)	1.73 ± 0.11 (44)
T.I. 2	T.I (s)	180.89 ± 5.32 (46)^{c}	161.37 ± 4.35 (46)^{b}	142.7 ± 4.46 (47)^{a}	145.48 ± 4.23 (46)^{a}
	No of induction	1.57 ± 0.24 (46)	1.37 ± 0.08 (46)	1.34 ± 0.08 (47)	1.33 ± 0.08 (46)

a,b,c Means ± SE with different superscript letters are significantly different (P<0.05) but values without superscript are similar (P<0.05).

T.I (s) – Tonic immobility time (s).

Table 3: Effects of breed on hormone and haematological parameters after the stress test

VARIABLES	ROSS	ANACK	ABOR ACRE	HUBBARD
Corticosterone (ng/ml)	111.78 ± 10.17 (12)	114 ± 14.21 (12)	125.63 ± 12.28 (12)	146.11 ± 18.42 (12)
H:Lreading	1.4 ± 0.18 (12)^{ab}	1.61 ± 0.21 (12)^{b}	1.19 ± 0.14 (12)^{a}	1.6 ± 0.16 (12)^{b}

a,b,c Means±SE with different superscript letters are significantly different (P<0.05) but values without superscript are similar (P<0.05).

H: L reading- Heterophl Lmphocyte ratio

Profile of tick-infested *Bunaji* Cattle in Sabongari Local Government Area of Kaduna State, Nigeria

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Abstract: The study was carried out to assess the profile of the tick infested *Bunaji* cattle. Sixty structured questionnaires were administered to *Bunaji* cattle rearers and 40 blood samples collected from the *Bunaji* cows with heavy tick infestation. The cattle graze solely on pastures and were reared under extensive system of management. Majority (91.66%) of the respondents reported ticks infestation as the major parasite. The packed cell volume (PCV), haemoglobin (Hgb), red blood cells (RBC), neutrophil, monocytes, eosinophil, basophils, lymphocytes values were not significantly (P>0.05) in the four zones. There were no significant (P>0.05) differences in the white blood cell (WBC) values of cattles from the three zones. In conclusion, the blood profile of the *Bunaji* cows indicated an immune-competent population.

Keyword: Tick, *Bunaji*, Haematology

INTRODUCTION

Ticks as well as other ectoparasites are among blood sucking parasite that have cause loss of blood, transmission of bacterial, viral, rickettsial and protozoan diseases which could be associated with severe losses to hide and skin, negative effect on milk yield production, weight loss and even death of the affected animals (1). Measures aimed at managing tick infestation to manageable levels will prevent production loss, reduce the use chemical, and reduce the reliance on chemicals by utilizing control with alternative treatments for different herd group (2). Studies on the blood profile of livestock not only have bearing on their physiological status but also have environmental influence (3) hence haematological variables are valuable in selecting genetically immune-competent animals (4,5).

The objective of this study is to know the haematological profile indicative of tick infestation of the White Fulani cattle.

MATERIALS AND METHODS

Study Area: Data was collected from Bassawa district in Sabongari Local Government Area of Kaduna State located between latitude 11^{o} and 12^{o} N and longtitude 7^{o} and 8^{o} E, altitude 640m above sea level (6). Bassawa district was divided into four zones. Zone A- Bassawa, Zone B- Bomo, Zone C- Zango. Zone D- Grace-land.

Data Collection: Sixty structured questionnaires were administered to White Fulani cattle herdmen in the four Zones (15 each). Blood samples were collected through the tail (cocigeal vein) for haemotogical assay from only cows which had visible clinical presentations for tick infestion. Whole blood from 10 cows per zone (40 cows) were collected into 40 Rake containers containing anticoagulants ethylene-diamine-tetra-acetate (EDTA) using 10ml syringe and needle guage 21G x 1½". The packed cell volume (PVC) was determined using Hematocrit centrifugation technique (7). The red blood cell count (RBC) and white blood count (WBC) was carried out manually using the improved Hawksley™ haemocytometer. Haemoglobin concentration (Hgb) was measured spectrophotometrically by cyanmethemoglobin method (8).

Statistical Analysis: Statistical Analysis System (SAS) 9.0 program\was used for the data analysis. Simple descriptive statistics using frequency and percentage was used to analysis the data. Means were compared using Turkey- Kramer HSD

RESULTS AND DISCUSSION

Table 1: Type of Feed

Types of Feed	Frequency	Percentage
Concentrate only	0	0
Forages	60	100
Concentrate and Roughage	0	0
Total	**60**	**100**

Table 2: Management Practice

Management Practice	Frequency	Percentage
Extensive	60	100
Semi-Intensive	0	0
Intensive	0	0
Total	**60**	**100**

Table 3: The Type of Ectoparasite found on the cattle

Ecto-Parasite	Frequency	Percentage
Lice	2	3.33
Tick	55	91.66
Fleas	3	5.00
Total	**60**	**100**

Table 4: Haematological values of the White Fulani cows

Haematological Parameter	Location					Reference Range*
	Zone A	Zone B	Zone C	Zone D		
PCV (%)	32.50±4.48	38.50±8.68	39.37±7.43	36.80±6.03	0.09	24-46%
Hgb (g/dl)	10.90±1.52	12.84±2.96	12.61±2.41	12.33±2.02	0.23	8-18(g/dl)
WBC ($x10^9$/L)	16.41±3.89	10.05±3.94	8.99±3.67	9.47±2.57	0.32	4-12($x10^9$/L)
RBC ($x10^9$/L)	5.74±0.72	6.57±1.38	6.31±1.14	6.20±1.09	0.41	4-15($X10^9$/L)
Total protein	$7.66±1.13^{ab}$	$7.96±1.11^{a}$	$7.53±1.06^{ab}$	$6.18±2.25^{b}$	0.03*	6.0-7.5g/dl
Neutrophil (%)	26.40±10.98	31.80±8.18	31.05±7.33	30.20±12.45	0.57	15-45%
Monocytes (%)	1.90±0.70	1.60±0.67	2.11±0.54	1.90±0.64	0.95	2-7%
Eosinophil (%)	1.20±0.68	1.60±0.58	1.57±0.53	2.40±0.78	0.67	0-20%
Basophils (%)	0.70±0.30	0.80±0.33	0.95±0.35	0.50±0.34	0.07	0-2%
Lymphocytes (%)	58.70±21.48	65.90±7.43	60.63±13.50	56.90±20.79	0.63	45-75%

Significant difference $p<0.05$ using turkey kramer HSD , RBC- Red blood cells; PCV- packed cell volume; Hgb- Haemoglobin; * 14

Table 1 shows the respondents do not give any feed supplements/concentrates but graze solely on pastures as is characterised by the extensive management practices (Table 2) they employ. It has been reported (9) that animals grazing solely on pastures are usually native to the locality and are less likely to have health and animal welfare challenges compared to exotic species because animals are not kept in stifling conditions.

According to the herdsmen, ticks infestation is the major parasite they observe in their flock (Table 3). Tick has also been reported (10) as the major ectoparasite which infects the cattle due to the extensive system of management employed by those who rear cattle which predisposes the animal to tick infestation (11). Ticks still ranks as one of the most economically important parasites of cattle in tropical and subtropical countries (11). Ticks also rank second to insects as vectors of transmissible diseases in man and livestock (12).

The packed cell volume (PCV), haemoglobin (Hgb), red blood cells (RBC), neutrophil, monocytes, eosinophil, basophils, lymphocytes values of the samples in the four zones were not significantly ($P>0.05$) different from

each other and were within the reference clinical range for healthy cattle. This is indicative of a resilient and immune-competent population of cows despite having been infested with ticks. There were no significant ($P>0.05$) differences in the white blood cell (WBC) values as all were within the reference clinical range except the samples from Zone A which was above the normal clinical range which was indicative of an underlying health condition probably due to infection as the cows sampled were heavily infested with ticks (13). The cows in Zone A may be more immune-challenged than the cows in the other zones (13). The total protein values (TP) of the population sampled in the four zones were significantly ($P<0.05$) different (Table 4). The TP values were however within the reference clinical range indicating that the prevailing environmental conditions such management practice, forage the cows grazed on may have been sufficient in supplying the nutritive requirements required and the tick infestation did not affect consumption of feed.

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Tonic Immobility, Aggressiveness and Plumage Condition as Welfare Indicators in Locally Adapted Turkey

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Abstract: Tonic immobility, aggressiveness and plumage condition as welfare indicators in locally adapted turkey raised on-farm was assessed in this study. One hundred and eighty-six locally adapted turkeys were used for the experiment which was conducted for twenty weeks. Data were collected on tonic immobility, aggressiveness and plumage condition of the turkey. These data were subjected to analysis of variance using SAS (2004). Result showed that there was significant ($p<0.05$) effects of age on social aggressiveness of the turkey. There was no significant ($p>0.05$) effect of age on tonic immobility and plumage condition of birds. Also, there was significant ($p<0.05$) effect of sex on social aggressiveness and plumage condition of the turkey. However, there was no significant effect of sex on tonic immobility of the chicken. It is concluded that younger turkey is more aggressive than the older ones, also male turkey were more aggressive than the female turkey. The plumage condition of the male turkey was better than that of the female.
Keywords: Aggressiveness, condition, plumage, tonic immobility, welfare

INTRODUCTION

Turkey *Meleagris gallopavo* provides nutritious food, rich in protein, niacin, and B vitamins (Bender and Bender, 2005). Turkey is one of the domestic species used for meat production. Turkey has a long, dark, fan-shaped tail and glossy bronze wings. They exhibit strong sexual dimorphism. The male is substantially larger than the female, in males, plumage colour may serve as a signal for health status (Hill *et al*., 2005). Turkey production in Nigeria has largely remained at the smallholder level due to various reasons ranging from management problems to lack of incentives.

There are different ways of assessing welfare of animals which include tonic immobility, aggressiveness and plumage condition among others. Tonic immobility is one of the frequently used tests for assessing welfare of animals, it is regarded as a relatively robust measure of underlying fearfulness, particularly in poultry (Campo *et al.*, 2012; Al-Aqil *et al.*, 2013). Behaviors such as increased aggression have been associated with stress in poultry and other animals, though aggression does not necessarily indicate poor welfare in all situations (Broom and Johnson, 1993). Mcglonge *et al*. (1993) found that an animal's social rank within the group can affect stress levels. Gentle and hunter (1991) have indicated that possessive removal of feathers resulted in marked changes of behavior with regards to potential usefulness of fluctuating asymmetry as an indicator of plumage condition; it would be possible that the birds with poor plumage condition might not have been as stress tolerant as those birds with good plumage condition. Thus, this study sought to assess tonic immobility, aggressiveness and plumage condition as welfare indicators in locally adapted turkey

MATERIALS AND METHODS

The study was conducted in turkey farms in Ibadan, Oyo state, Nigeria. One hundred and eighty-six locally adapted turkeys were used for the experiment which was conducted for twenty weeks (5 months). Tonic immobility was induced by placing turkey on its back with the head hanging in a U-shaped wooden cradle, the bird was restrained for 15seconds. A stopwatch was started to record latencies until the bird righted itself (Gudev *et al.*, 2011; Campo and Carnicer, 1994). The plumage condition of the birds was assessed by using three-point

feather-scoring scale from 1=very poor to 3= perfect for 5 body parts: back, tail, neck, breast and wings (Campo and Prieto, 2009). Relative social aggressiveness among the turkey were assessed base on dominant-subordinate relationship as reported by Campo *et al*. (2005)

Data collected were subjected to analysis of variance (ANOVA) using SAS (2004), where significant differences occurred in the means, they were separated using Duncan Multiple Range Test.

RESULTS AND DISCUSSION

Table 1 shows the effect of age on welfare indicator of turkey. Result showed that there was significant ($p<0.05$) effects of age on social aggressiveness of the turkey. The birds were most aggressive at younger age (20weeks old). This could be due to the fact that at younger age, they are not well familiar with one another but the familiarity will increase as they grow older and spend more time with one another. Buchwalder and Huber-Eicher, (2005) report supported the result of this study when they found out that turkeys will increase in aggression when unfamiliar birds are housed together but a marked drop in aggression occur as they become familiar with each time. There was no significant ($p>0.05$) effect of age on tonic immobility and plumage condition of birds.

Table 1: Effect of age on welfare indicator of turkey

Traits	20weeks	28weeks	34weeks	SEM (±)
Aggressiveness	1.78[a]	1.00[c]	1.40[b]	0.04
Tonic Immobility	1.16	1.08	1.09	0.02
Plumage Condition	1.16	1.00	1.06	0.03

[a, b,] means different superscripts along the same rows are significantly different ($p<0.05$)

Table 2 showed effect of sex on welfare indicator of turkey. Results show that there was significant ($p<0.05$) effect of sex on social aggressiveness. It has been reported that sex differences were usually due to differences in hormonal profile, aggressiveness and dominance especially when both sexes are reared together (Ibe and Nwosu, 1999). Millman and Duncan, (2000) also reported that during mating, male broiler breeders often exhibit forced and rough sexual behavior towards females. Aggressive behavior is present in turkey when male and female first interact, and had been found to occur more frequently than aggressive behavior between the males. Another factor that may lead to aggressive behavior is the large body size of the male impeding their mating ability, leading to frustration (Millman *et al*., 2000). Sex also had significant ($p<0.05$) effect on plumage condition of the turkey with male turkey having better plumage condition than female. This could be due to loss of feather during mating by female turkey. The female turkey tends to lose feather in different parts of her body (such as neck, back, breast and wing) when mounted by male in the course of mating which makes the female lose feather more than male turkey. However, sex had no significant effect on tonic immobility of the turkey.

Table 5: Effect of sex on welfare indicators

Traits	Male	Female	SEM (±)
Aggressiveness	1.70[a]	1.46[b]	0.04
Tonic Immobility	1.13	1.12	0.02
Plumage Condition	1.20[a]	1.06[b]	0.03

[a, b] means of different superscripts along the same row significantly different ($p<0.05$)

CONCLUSION

Based on the result of this study, it is concluded that younger turkey is more aggressive than the older ones, also male turkey were more aggressive than the female turkey. The plumage condition of the male turkey was better than that of the female.

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Preliminary Studies on the Prevalent Endoparasites Associated with Ostriches (*Struthio camelus*) in Borgu Local Government Area of Niger State

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Abstract: A five month study which covers both the wet and dry seasons was carried out to investigate the prevalent gastrointestinal parasites associated with Qstriches (Struthio camelus) in Borgu Local Government area of Niger State. Faecal droppings of twenty-five (25) Ostriches were collected from the study area. The samples were collected from twelve (12) Ostriches found in Kainji Lake National Park Head Office, eight (8) were found in KOB Amusement Park, Wawa and five (5) in Emir's Palace all in Borgu Local Government area of Niger State. Samples of freshly pushed out faecal dropping were collected into clean polythene bags very early in the morning throughout the experimental period. The samples were tagged and taken to National Institute of Science Laboratory Technology (NISLT) in Ibadan, Nigeria for examination and identification of worm species in the faecal samples. Analysis of the faecal sample revealed the presence of ova and larva of Ascaridia species, Strongyloides spp, Schistosoma spp, Capillaria spp, Diphyledium spp, Amoebotania spp, and Eimeria spp. This investigation revealed that the most prevalent gastrointestinal parasites of the ostriches in the study area includes Ascaridia species, having a frequency of 42.82%; this is closely followed by the Strongyloides spp with a frequency of 26.19% and Eimeria spp with the least frequency of 1.07%. Isolation and identification of these species of worms in Ostriches in the study area suggests that helminthosis of Ostriches in the study area are caused by these species of helminths.

Keywords: Ostrich; Helminths; Helminthosis; Prevalent; Gastrointestinal.

DESCRIPTION OF THE PROBLEMS

Food crisis that has engulfed Africa and developing countries thus requires a more concerted efforts and focus approach to solve (1). Africa is the only continent in which per capita food production has declined over the last three decades or so while the rates of food self-sufficiency have declined significantly (2). Major food sources in these countries are almost entirely starchy food such as roots, tubers and cereals. These obviously do not and cannot satisfy the protein needs of the populace most especially in the context of the fact that adequate diet must include not only calories but the full range of nutrients that humans need for attainment of food security. This is because protein is essential for muscles, bones, the antibodies that prevent infection, and the many enzymes that regulate all of the body's systems (3). In spite of its centrality in body system stability, protein intake and particularly animal protein consumption in developing countries falls below the recommended rate (1). The necessity of protein supplement food therefore becomes a matter of priority for productive living. Animal proteins found in foods such as eggs, milk, meat, fish, and poultry are considered complete proteins because they contain all of the essential amino acids that bodies need (4). The poultry industry has become one of the most efficient producers of protein for human consumption. Its advantages of relatively shorter time of seven weeks to produce a broiler and five months to produce a laying hen in contrast to what requires to produce beef and pork make it the most sought after in terms of meeting protein needs of the masses. Of all the poultry products, Ostriches continue to attract more attention due to its domestic and economic values. In Nigeria, Ostrich production is not very popular among the poultry producers, probably due to its relative scarcity, high cost of purchase and the need for large expanse of land in raising them. However, it is a very popular venture in countries like Spain, France, Canada, Israel, South Africa, United States of America, Switzerland, Germany, Japan and Holland where they are domesticated for meat, egg and high quality feather (5); the introduction of Ostrich hide as a luxury leather has renewed interest in Ostrich farming. The eggs are good to eat in form of Omelet (a hot dish of egg mixed together and fried often with cheese, meat, vegetable, etc) and one egg is equivalent to two dozens of chicken eggs (5). A fourteen month old ostrich can yield 34 – 41kg of low fat red

meat, which forms an important component of diet of the health conscious. The meat and skin are the greatest products earning and largest returns. The greatest potentials of Ostrich production is however hampered by problems such as poor breeding techniques, limited knowledge on Ostrich production and health management. This work is thus directed at determining the prevalent gastro-intestinal parasites which can negatively affect the survival and productivity in Ostrich.

MATERIAL AND METHODS

Study Area: This study was conducted in Borgu Local Government area of Niger State, which covers a land mass of about 16,200,00km^2 and situated between Latitude 9^o.00' - 11^o 36'N and Longitude 3^o.00' - 43^o 9'E. The study area was bounded to the coast by River Niger (Kainji Lake) to the Northern and Eastern boundaries by Kebbi State and to the West is Republic of Benin. The population of the study area as at 2006 was 171,965 (NPC 2007) most of whom were scattered along the Lake, New Bussa to Dugga (6). The length of the rainy season varies from about 175 – 190 days (5 – 6 months) during which from 1000 – 1250mm rainfall is recorded annually in April reaching its peak in July to August and declined by September. Temperature of the study area is always high during the dry season just before the rain ranging between 25^{o}C – 40^{o}C and it drops in December and January due to harmattan ranging between 14^{o}C – 15^{o}C. The vegetation of the study area may be described broadly as guinea savannah with legumes accounting for 55 – 70% of trees and almost an equal mixture of legumes and small trees, while grasses dominate the herbaceous layer.

Sample Collection, processing and Microscopic examination: The study was conducted on twenty five Ostriches all kept under semi-intensive management system. Freshly passed out faecal samples were collected early in the morning into clean polythene bags between the month of February 2017- June 2017 considering both the dry and wet seasons in the study area. The samples collected were subjected to Wisconsin sugar floatation method; 3g of the sample were tauturated (mixed) with a sheather solution and strained through a sieve. 10mls of the mixture were poured into 15mls test tube and centrifuged for about two to four minutes. They were then removed from the centrifuge and refilled over to the top with the sheater solution. Cover slip was then placed on the meniscus for about five to seven minutes. These cover slips were then removed and placed under the microscope for examination and identification of the worm species. The number of eggs/ova was counted using Stoll's egg counting techniques to count eggs per gram (7).Using Stoll's egg counting technique; the number of eggs counted divided by the weight of the faecal sample (3g in this case) multiplied by 100.

$$\frac{X \times 100}{3g} = \text{Egg Per Gram (EPG)}$$

RESULTS

The result of the diagnostic analysis of one hundred and twenty five faecal samples in Table 1 revealed various species of gastrointestinal parasites found to be associated with the Ostriches (*Struthio camelus)* and Table 2 shows the summary of the diagnostic analysis of the prevalent gastro-intestinal helminth of the ostriches while Figure 1 shows the frequency distribution graph of the prevalent gastro intestinal helminth parasite associated with Ostriches in Borgu Local Government Area of Niger State.

Table 1: Diagnostic analysis of Prevalent Gastro intestinal parasites associated with Ostriches (Struthio camelus) in Borgu LGA, Niger State

Location of Collection of Samples	***Number of Samples Collected***	***Isolated Parasites***	***Number of Parasites Recovered***	***Number of EPG***	***Percentage (%) positive***
KLNP Head Office, Kere area.New-Bussa	60	*Ascaridia spp*	948	32,600	52.84
		Shistosoma spp	174	5,800	9.699
		Strongyloides spp	576	19,200	32.11

		Amaebotania spp	96	3,20	5.35
		TOTAL	1,794	59,800	100.00
KLNP KOB Amusement Park, Wawa	40	*Cappilaria spp*	35	1,166.67	7.77
		Diphyledium spp	80	2,666.67	17.78
		Ascaridia spp	195	6,500.00	43.33
		Strongyloides spp	140	4,666.67	31.11
		TOTAL	450	15,000.01	100.00
Emir's Palace	25	*Ascaridia spp*	788	26,266.67	62.39
		Eimeria spp	50	1,666.67	3.96
		Strongyloides spp	425	14,166.67	33.65
		TOTAL	1,263	42,100.01	100.00

Table 2: Summary of diagnostic analysis showing the prevalent Gastro Intestinal helminth of Ostriches in Borgu LGA, Niger State

Isolated Parasites	***Cumulative Number of different spp of Parasites Isolated***	***Percentage Positive***
Ascaridia spp	1,931	55.10
Shistosoma spp	174	4.96
Strongyloides spp	1,141	32.54
Amaebotania spp	96	2.74
Capillaria spp	35	1.00
Diphyledium sppEimeria spp	80	2.28
	50	1.43
Total	3,507	100.00

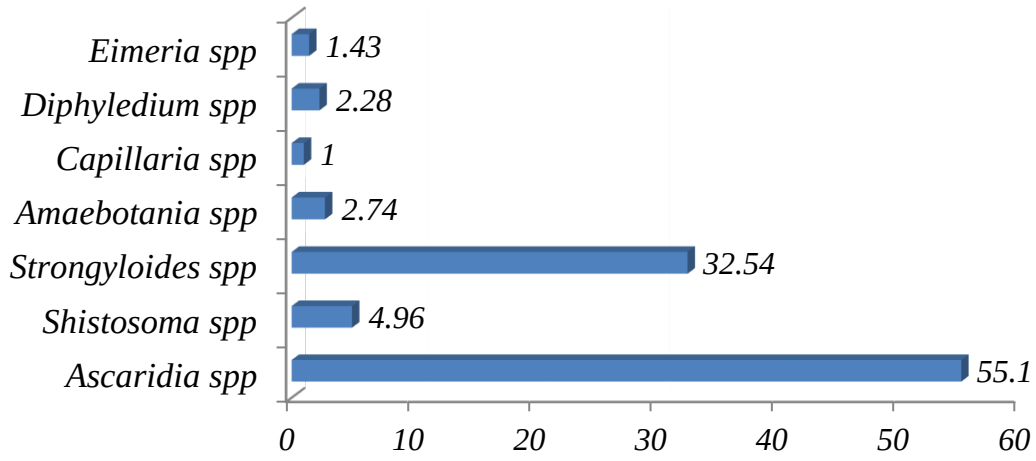

Fig. 1: *Frequency distribution chart of the Gastro Intestinal parasites recovered from the Ostriches in the Study Area*

DISCUSSION

The result of the diagnostic analysis of the faecal sample indicated that *Ascaridia spp* is the most prevalent helminth specie affecting the Ostriches (*Struthio camelus*) in the study area. This is closely followed by *Strongyloides spp* while the least is *Capillaria spp*. This corroborates the findings of (8). It was also revealed from this study that all the Ostriches in the study area harbor infection with variety of helminth parasites. The helminth parasites recorded in the Ostriches in the study area agreed with the reports of (9).This nematode specie is the most likely cause of mortality in chicks and adult Ostriches.

CONCLUSION AND RECOMMENDATIONS

The prevalence of *Ascaridia spp* in the study area is an issue of paramount importance to Ostrich farmers in Borgu Local Government area of Niger State and in Nigeria at large. It is therefore recommended that administration of adequate anti-helmintic agents should be put into practice among Ostrich farmers. Also, hygienic management practices should be encouraged and quarantine of the animals before being introduced into the flock should also be practiced.

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Growth Performance Characteristics, Bacterial and Oocyst Count of Egg-Type Chickens and Cockerels Given Herbal Supplement in Western Nigeria

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Abstract: Organic poultry production which promotes food safety is taking advantage of herbs and their derivatives in improving the performance of poultry birds. This study assessed response of egg type chickens and cockerels to commercial herbal supplement. *In-vivo* experiment was conducted using two hundred and forty day-old Obas Brown strain pullet chicks and one hundred and eighty Obas Black cockerels. Both the pullets and cockerels were divided into four equal treatment groups: Control without herbal supplement but with conventional medication and vaccination (T1); Herbal supplement was given 5 days on weekly basis (T2); Herbal supplement was given 5 days at 2weeks interval (T3); and herbal supplement was given 5 days at 3weeks interval (T4). Treatments 2 to 4 were without conventional medication or vaccination. Each treatment was replicated thrice with 20 pullets and 15 cockerels per replicate, respectively. The cockerel and pullet experiment lasted for 20 weeks. Data were collected on performance characteristics, bacterial and oocyst count. Data generated were subjected to one-way analysis of variance in a completely randomized design. Parameters measured for growth performance, were not significantly ($p>0.05$) different in the layers and cockerels. Bacterial and oocyst counts were also reduced in the excreta of birds in T2 to T4. Treatment 3 particularly recorded lowest bacteria count of $0.71x10^6$cfu/ml for cockerels and 1.4×10^6cfu/ml for pullets by week 20.

Keywords: Herbal-supplement, Growth-performance, Bacterial-count, Oocyst-count, Chickens

INTRODUCTION

Despite the fast growth of commercial chicken production during 1990's, it can be observed that in the first two decade of the 21st century and with two years to the expiration of the first decade, the world is experiencing a continued increase in chicken meat and egg production (Aho, 2002). However, the present poultry industry faces a myriad of management and economical barriers. In order to optimize poultry production levels and protect consumers' safety, various strategies are explored, one of which is the use of herbal medications.

Since ancient times, plants and plant parts have been indispensable sources of medicine for indigenous poultry systems (Okitoi and Mukisira, 2000). In recentyears, advances in identification and chemical characterization of plant compounds which are effective in the treatment of certain diseases have renewed interest in herbal medicines (Khan *et al*., 2012). Some of the herbal preparations have beenreported to possess hepatogenic, hepato-protectiveand growth stimulating properties which tone up the liver resulting in better overall performance and higherprofitability due to increased efficiency of feed utilization (Ather, 1999). Many of the herbal supplements are based on the earlier compilations of various ethno-veterinary medicine systems and are used for their medicinal and non-medicinal properties (Okitoi *et al*., 2007). Since the conventional therapeutic agents are expensive and the capability of small-scale poultry farmers in affording professional veterinary services is limited particularly in the developing countries, the use of herbs and herbal preparations seems to be a popular alternative. Therefore, the objective of this study is to investigate the efficacy of an herbal supplement in poultry production

MATERIALS AND METHODS

Experimental site: The research work was carried out at the poultry unit of TREFAD (Teaching and Research Farms Directorate), Federal University of Agriculture Abeokuta (FUNAAB), Ogun state, Nigeria. Located on latitude7° 15'N, longitude 3° 26' E and its 76m above sea level (Google Earth, 2006). The research site was

located in the Rainforest zone of South-West Nigeria with relative humidity in the rainy season (late March - October) and dry season (November – early March) that ranged between 63 - 96% and 55 – 84%, respectively. It has a mean annual precipitation of 1,037mm and with a mean annual temperature of 34.7°C (Google Earth, 2006).

Experimental birds and management: A total of 240 day-old pullets and 180 day-old cockerels of Oba's brown and Oba's black strain respectively were obtained from Obasanjo Farms Holdings, Nigeria, for the study. The cockerels were raised on deep litter system from 0-20 weeks, while the pullets were also raised on deep litter from 0-20 weeks with nest box provided for egg laying. Feed and water were given *ad libitum*.

Experimental treatments and layout: Superliv®, a liquid herbal mixture produced by Ayurvet India and marketed in Nigeria by Animal Care Konsult was applied in drinking water at the recommended dosage.
Treatment 1; this is the control where no herbal supplementation was given to the birds, but all other conventional vaccinations and medication were given.
Treatment 2; the herbal supplement was given to the birds in this treatment, 5 days in a week (Monday – Friday) at the recommended rate.
Treatment 3; the herbal supplements was given to the birds in this treatment, 5 days (Monday – Friday) every two weeks i.e. fortnightly.
Treatment 4; the birds in this treatment were given the herbal supplements, 5 days every three weeks (Monday – Friday). Treatments 2 to Treatment 4 were not given any medication or vaccination.

Experimental Design: The birds were randomly allotted to the four (4) treatments described above. Biosecurity measures (well-cleaned, hygienic and controlled environmental conditions) were maintained in the experimental house.

Experimental diets (See Table 1)

Data Collection: The following data were collected over the 20 weeks' experimental period

(i) Performance Characteristics
Weight Gain =Final Weight-Initial weight (g/week)
Feed intake =Feed Given-Feed left/number of chicks (g/bird)
Feed Conversion ratio =Amount of Feed Consumed/Weight Gain

(ii) Collection of excreta for Bacterial count
At day old, fourth and eighth week of experiment (starter phase), excreta samples were collected from the experimental birds with sterile swab sticks from three birds per replicate. The bacterial count procedures were carried out at the Microbiology laboratory of the college of Veterinary Medicine, Federal University of Agriculture, Abeokuta.

(iv) Collection of excreta for oocyst count.
A similar procedure in collection of excreta samples for bacteria count was also followed for the collection of excreta samples for the oocyst count. The method used for the oocyst count is known as McMaster method (Thienpont*et al*., 1979) and calculated according to the multiplying method as described by Urquhart *et al*., 1997. These procedures were carried out at the Parasitological laboratory of the College of Veterinary Medicine, Federal University of Agriculture, Abeokuta.

Statistical Analysis: The data obtained in this phase were subjected to analysis of variance as appropriate for a Completely Randomised Design using MINITAB 13.0 statistical package (2006). Significant means ($p < 0.05$) among variables were separated using Duncan's Multiple Range Test (Duncan, 1955).

Table 1: Composition (%) of diets

Ingredients	Chick starter	Growers mash	Layers mash
Maize	40.00	50.00	42.00
Fish meal	2.00	-	2.00
Soybean meal	18.00	12.00	13.10
Palm kernel cake	10.00	-	17.90
Wheat offal	25.00	33.00	15.00
Bone meal	2.00	2.00	2.00
Oyster shell	2.00	2.00	7.00
Lysine	0.25	0.25	0.25
Methionine	0.25	0.25	0.25
*Chick's vit/mineral premix	0.25	-	-
**Grower's vit/mineral Premix	-	0.25	-
***Layer's vit/min. Premix	-	-	0.25
Salt	0.25	0.25	0.25
Total	100.00	100.00	100.00
Calculated analysis (%)			
Crude protein	18.71	15.09	16.47
Ether Extract	5.09	4.95	4.32
Crude fibre	4.56	4.22	5.48
Ash	3.58	3.60	3.49
Calcium	1.62	1.87	3.68
Phosphorus	0.93	0.97	0.97
Lysine	0.73	0.62	0.59
Methionine	0.28	0.24	0.27
Energy (MJ/Kg)	10.32	10.17	10.39

*Vit./Min. Premix contains B_1,1g; B_2, 6g; B_{12}, 0.02g; K_3, 3g; E, 30g; biotin, 0.05g; folic acid, 1.5g; choline chloride, 250g; nicotinic acid, 30g; Ca-Pantothenate, 15g; Co, 0.4g; Cu, 8g; Fe, 32g; I, 0.8g; Zn, 40g; Mn, 64g; Se, 0.16g, BHT, 5g.

**Vit./Min. Premix contains Vit. A, 10 000 000iu; D_3, 2 000 000iu; E, 12 500iu; K, 1.30g; B_1, 1.30; B_2, 4.00g; D Calcium-Pantothenate, 1.30g; B_6, 1.30g; B_{12}, 0.01g; nicotinic acid, 15.00g; folic acid, 0.05g; biotin, 0.02g; Co, 0.20g; Cu, 5.00g; Fe, 25.00g; I, 0.06g; Mn, 48.00g; Se, 0.10g; Zn, 45.00g; choline chloride, 200.00g; BHT, 50.00g.

***Vit./ Min. Premix contains: Vits. A, 10 000 000iu; D_3, 2 000 000iu; E, 13 000iu; K_3, 1 500mg; B_{12}, 10mg; riboflavin, 5 000mg; pyridoxine, 1 300mg; thiamine, 1 300mg; D-Pantothenic acid, 8 000mg; nicotinic acid, 28 000mg; folic acid, 500mg; biotin, 40mg; Cu, 7 000mg, Mn, 48 000mg; Zn, 58 000mg; Fe, 58 000mg; Se, 120mg; I, 60mg; Co, 300mg; choline, 275 000mg; methionine, 20 000mg; BHT, 5 000mg.

RESULTS AND DISCUSSION

Table 2: Effect of herbal supplement on performance characteristics of pullets (0-8 weeks)

Parameters	Herbal Supplement			
	1 (control)	2 (weekly)	3 (2-weeks)	4 (3-weeks)
Average Initial wt(g)	31.56±0.97	30.67 ± 0.67	30.00±0.00	30.22 ± 0.22
Average Final wt (g)	446.15±4.36	447.12±4.93	444.98±15.01	453.74±19.21
Average daily weight gain (g)	7.20±0.22	7.31±0.10	7.12±0.085	7.40± 0.31
Average daily Feed intake (g)	44.50±0.38	45.32±0.69	47.00±2.21	47.19±1.80
FCR	6.20 ±0.23	6.20 ± 0.18	6.72 ±0.25	6.39±0.21
Mortality	1.00 ± 0.22	2.67 ± 2.22	3.03±0.58	3.03±0.58

Table 3: Effect of herbal supplement on performance characteristics of pullets (9-20 weeks)

Parameters	Herbal Supplement			
	1 (control)	2 (weekly)	3 (2-weeks)	4 (3-weeks)
Average Initial wt(g)	446.15±4.36	447.12±4.93	444.98±15.01	453.74±19.21
Average Final wt (g)	1397.25±41.55	1419.44±2.78	1437.67±25.62	1412.01±27.37
Average daily weight gain (g)	12.35±0.54	12.35±0.28	12.66±0.36	12.44±0.11
Average daily Feed intake (g)	82.11±1.50	90.64±1.38	91.47±1.07	86.02±2.88
FCR	6.66±0.19	7.35±0.20	7.24 ±0,24	6.91±0.17
Mortality	0	2.22±2.22	2.22±2.22	0

Figures are mean±SE

Table 4: Effect of herbal supplement on performance characteristics of cockerels (0-8 weeks)

Parameters	Herbal Supplement			
	1 (control)	2 (weekly)	3 (2-weeks)	4 (3-weeks)
Average Initial wt(g)	37.32±1.67	37.76 ± 0.96	35.94 ±0.72	36.44±1.78
Average Final wt (g)	531.70±21.06	523.97±16.52	495.95±11.96	509.16±22.25
Average daily weight gain (g)	8.82±0.41	8.68±0.23	8.21±0.20	8.44±0.42
Average daily Feed intake (g)	45.52±0.39	44.10±0.02	44.25±0.37	45.02±0.45
FCR	5.18±0.22	5.09±0.17	5.39±0.12	5.35±0.21
Mortality	2.00±0.58	0.67±0.33	0.33±0.33	1.33±0.33

Table 5: Effect of herbal supplement on performance characteristics of cockerels (9-20 weeks)

Parameters	Herbal Supplement			
	1 (control)	2 (weekly)	3 (2-weeks)	4 (3-weeks)
Average Initial wt(g)	531.70±21.06	523.97±16.52	495.95±11.96	509.16±22.25
Average Final wt (g)	1751.85±126.58	2022.27±34.34	1807.58±5.46	1890.56±60.37
Average daily weight gain (g)	15.85±1.46	19.46±0.29	17.03±0.22	17.77±0.69
Average daily Feed intake (g)	120.08±2.74	114.72±1.91	118.37±2.69	114.65±3.03
FCR	5.72±0.69	4.37±0.06	5.12±0.12	4.81±0.16
Mortality	3.00± 1.15	4.33±0.33	4.33±0.33	3.00±1.00

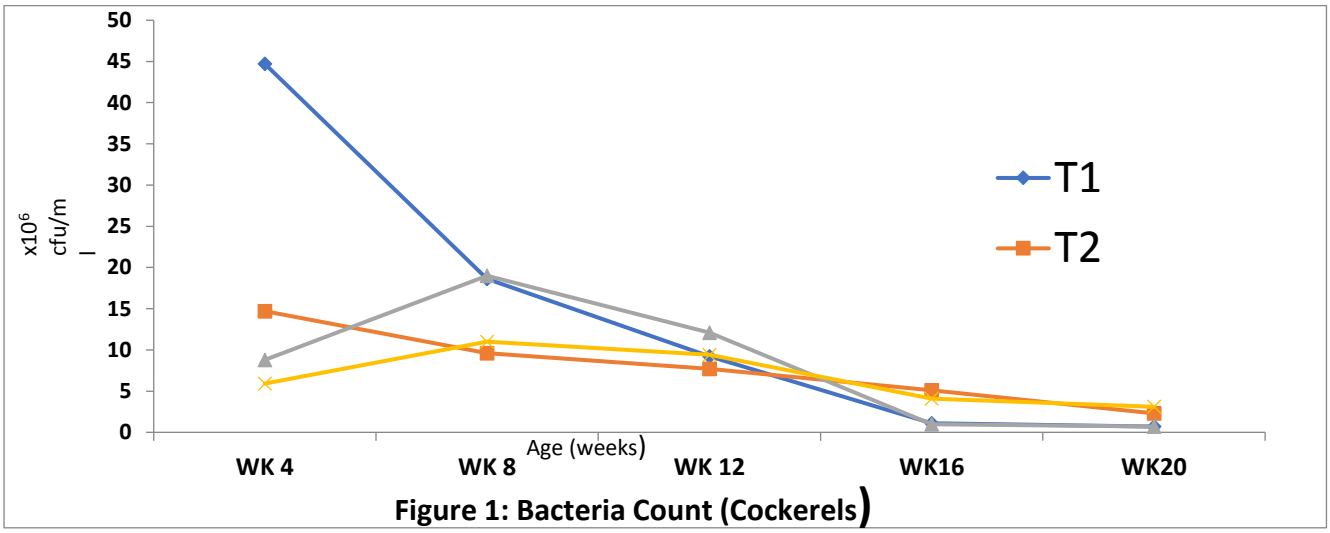

Figure 1: Bacteria Count (Cockerels)

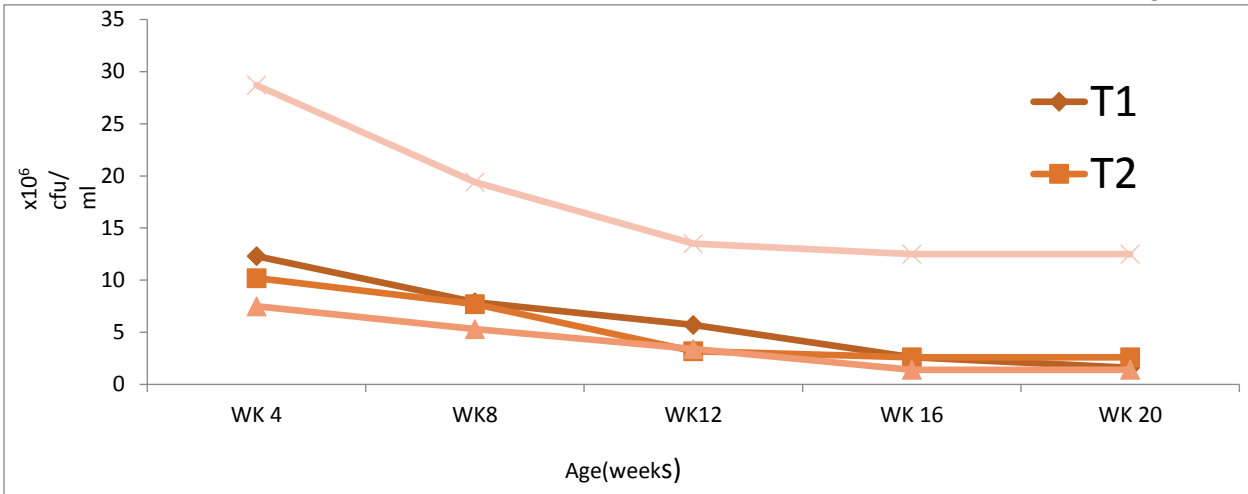

Figure 2: Bacteria Count (Pullets)

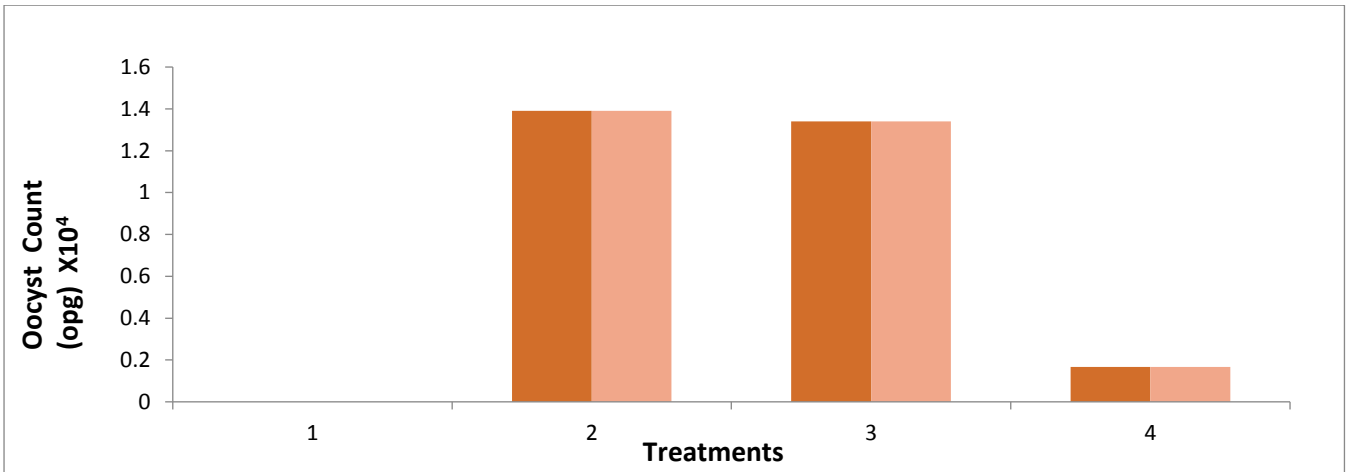

Figure 3: OOCYST Count (8 weeks-Cockerels)

The result of performance of pullet chicks (0-8weeks) given herbal supplement is presented in Table 2. Result obtained for all the parameters are comparable with one another. However, average daily feed intake increased ($p>0.05$) with the use of herbal supplement. Average daily feed intake of 47.19g/bird was recorded for birds on three weeks' interval of herbal supplementation, while the lowest value of 44.50g/bird was obtained in the control group.

The effect of herbal supplement on performance characteristics of cockerels (0-8 weeks) is presented in table 3. The result values obtained are not significantly different ($p > 0.05$) for all the parameters measured. However, the birds that were not given the herbal supplement (control) recorded the highest average daily weight gain of 8.82g while lower values were recorded for the group given the herbal supplement with treatment 3 having the lowest daily weight gain of 8.21g. Results obtained for average daily feed intake and feed conversion ratio did not show any particular trend.

The use of herbal supplement had no significant effect on the performance characteristics of all the treatment groups at the 8th week of age for both pullets and cockerels, this is also in line with the findings of Jibike*et al.* (2011). However, increase in value of the body weight gain and feed intake recorded for the group given herbal supplement was also reported by several authors (Michel *et al.*, 2011, Zaman*et al.* 2011, Chandrakesan*et al.* 2009 and Khan *et al*. 2008) who used herbal mixtures containing some of the herbs present in Superliv(R). The mortality recorded in this study was not significantly affected by the use of the herbal supplement. This is in line with the findings of Jibike*et al.* (2011). The result of oocyst count in this study is similar to that of Nidaulla*et*

al., (2010) who used a herbal complex containing almost the same herbs as in Superliv®. The authors reported a drastic reduction of oocyst count as was recorded in this study especially from week 8 and above. Zaman*et al.,* (2011) also reported a similar result with the used of herbal complex containing *Azadiractaindica* and some other herbs. Michels*et al.,* (2011) also reported the same reduction in oocyst count with the use of *Ecliptaalba*, a major herb contained in Superliv(R).

The bacteria count was reduced for all the groups in this experiment. The reduction of bacteria load in the birds on conventional medication and vaccination programme is in line with the findings of other authors (Ulte*et al*., 2002). This might be due to the effect of the antibiotics (Ulte*et al.,* 2002).

Generally, bacterial and oocyst counts were reduced with the use of herbal complex. The reduced bacteria count both in pullets and cockerels treated with herbal supplement could also be as a result of the antimicrobial effect of Pyrimidine as reported by Prasenjit*et al.,* (2010). Although at week 8 there was slight increase in the number of bacterial count and oocyst count which might be due to the wet season because high infection rate is associated with rainy season. It can be seen that as soon as the dry season approached, bacterial and oocyst counts reduced drastically, probably due to the use of herbal supplement. The result of bacterial count is in line with the findings of other authors (Abass*et al.,* 2012 and Biu*et al.,* 2006).

CONCLUSION

From the findings of this study; the following conclusions could be drawn.

- The herbal supplement tested in this study, did not have any significant effect on the performanceof egg type chickens and cockerels.
- The bacterial and oocyst counts were considerably reduced in all the treatments.

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ANIMAL BREEDING AND GENETICS

Associations between Polymorphisms of the Yankasa Sheep IGF-1 Gene and Growth Traits

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Abstract: A study was conducted at the Small Ruminant Research Programme of National Animal Production Research Institutte (NAPRI) Shika, Zaria, Kaduna State, Nigeria to determine association between polymorphisms of the sheep IGF-1 and growth traits in Yankasa breed of Sheep. A random sample of 140 sheep (70 males and 70 females) was selected for the molecular study. Animals were measured for growth traits namely: birth weight, average daily gain, weaning weight, weight at 6, 8 and 12 months, chest girth and height at withers. Blood samples were collected from the animal's neck region through the jugular veins into 0.5ml EDTA vacutainer tubes and transferred to the laboratory for DNA extraction. Frequencies of alleles were calculated according to Hardy-Weinberg's. Association between genotypes and growth traits were determined through the general linear model (GLM) procedure of the SAS program (Statistical Analysis System, 2000). All growth traits (birth weight, weaning weight, average daily gain, weight at 6 months, weight at 12 months, height at withers and chest girth) with the exception of Body weight (Kg) at 8 months showed significant ($P<0.05$) variations. Sheep with AA and AB genotype were similar in performance across all traits (birth weight, average daily gain, weaning weight, weight at 6 months, weight at 8 months, weight at 12 months and height at withers) with the exception of average daily weight gain (g/day). It was therefore concluded that association between genotype and growth traits showed that the AA and AB genotype were superior to the BB for most measured traits. It is recommended that polymorphism of the IGF-I gene may be a potential molecular marker for growth traits in Yankasa sheep.

INTRODUCTION

The Yankasa is a meat breed in the North and North central Nigeria. The Yankasa is a medium-sized breed of Sheep. The tail is long and thin, the ears moderately long and somewhat droopy. Rams have curved horns and a hairy white mane and ewes are polled (Mason, 1996). They have white coat colour with black patches around the eyes, ears and muzzle.

Insulin-like growth factor-1 (IGF-1) is an important regulator of cell proliferation, differentiation, and apoptosis, has acute insulin-like metabolic effects, and is important for growth and development throughout the body. The level of IGF-1 peaks during puberty and after which it declines with age. Although the IGF-1 serum level is influenced by many factors, such as nutritional status, liver function, and serum levels of sex steroids and insulin, the secretion of this peptide is mainly regulated by growth hormone (GH) (Froesch and Zapf, 1985 cited in Licht *et al*., 2014). It has been estimated that up to 60% of the variance in IGF-1 serum level has a genetic basis (Harrela *et al*., 1996 and Hong *et al*., 1996 cited in Licht *et al*., 2014). Several polymorphisms in the promoter region of the IGF-1-gene have been identified, comprising a variable length cytosine-adenine (CA) repeat sequence (Kato *et al*., 2003). These polymorphisms are thought to influence the transcription rate of IGF-1, which in turn affects serum IGF-1 levels (Fletcher *et al*., 2005). The 192 bp allele is the most common allele and therefore is called the wild type (Fletcher *et al*., 2005; van Turenhout *et al*., 2011).

MATERIALS AND METHODS

Study Location: The research was carried out at the Small Ruminant Research Programme of National Animal Production Research Institutte (NAPRI) Shika, Zaria, Kaduna State, Nigeria. Shika lies between latitude 11^0 12'N, longitude 7^0 33'E and at an altitude of 640m above sea level. The area falls within the Northern Guinea Savannah having an average annual rainfall of 1100mm which starts from late April or early May to mid-October, followed by a dry period (which is divided into early and late dry periods). The early dry period is characterized by cold period and lasts from November to February. The mean temperature is about 24.4^{o}C (14.5-

39.5°C) with the lower humidity of 21% and 72% occurring during the early dry and wet seasons respectively (Institute for Agricultural Research Meteorological unit, 2016).

Experimental Animals and their management: The animals were kept separately at the Experimental Unit of NAPRI and reared under semi-intensive system. The breed was randomly selected among the stock at NAPRI. The ewes that were selected for the study were between two and three years old based on the recommendation of Taiwo *et al*. (1982). All the sheep were maintained on concentrate diets. Supplementary feeding was provided to the advance pregnant and lactating ewes and young lambs. The animals were watered twice, once in morning and again in evening. The sheep were housed during night in sheds covered with asbestos sheets with open sides during winter and in open corrals made by chain link fencing during summer months.

The sheep were fed concentrate supplements (3% of body weight) in the morning at 8:00 am. The concentrates were compounded using cotton seed cake, ground maize grain or maize offals, bone meal, vitamin and mineral premix and salt to make a diet of 18% crude protein (CP) for weaners and 15% CP for yearlings and other adult sheep. Gamba grass (*Andropogon gayanus*) hay was also provided after the concentrates. Nursing ewes and their lambs were kept intensively up to weaning at 90 days while the other sheep in the flock were daily released to graze on improved pastures of *Digitaria smutsii; Bracharia decumbens;* Gamba grass; *Cynodon dactylon and Hyperenia rufa*, between 8:00 am and 4:00 pm. Drinking water was provided *ad libitum*. More feed were allocated to pregnant ewes during the last two month of pregnancy corresponding to 3% of body weight. Routine medication consisted of anti-helminthic, drenching (deworming) was carried out.

Statistical analysis: On the basis of identified genotypes of Yankasa Sheep, the frequency of alleles was calculated according to Hardy-Weinberg's equation (Kubek and Bardun, 1990). This equation is based on the binomial expansion of $(p+q)^2=1$ which gives $p^2+2pq+q^2=1$

Where; p = Dominant allele

q = Recessive allele

Body linear Measurement: Height at wither: Measured by taking the measurements of the circumference of the chest; behind the forelegs.

Chest girth: Measured as a distance from the surface of the platform to the withers of the animal.

Data collection: The Yankasa Sheep was measured for growth traits (birth weight, weight at 6, 8 and 12 months, average daily gain, weaning weight, chest girth and height. Each of the experimental Sheep was scored according to its band for the SNPs either as fast (AA), midway (AB) or slow (BB).

To determine associations, the traits of interest was analyzed using the general linear model (GLM) procedure of the SAS program (Statistical Analysis System, 2000), the following statistical model was used for association of SNP with any measured variable:

$Y_{ij}= \mu + G_i + e_{ij}$

Where:

Y_{ij}= growth parameters,

μ = the overall mean,

G_i= the fixed effect of the i^{th} genotype for IGF-1,

e_{ij}=the random residual error

RESULTS AND DISCUSSION

Table 4.3: Association between IGF-1 genotypes and growth traits in sheep

Traits	AA	AB	BB	SEM	LOS
Birth weight (Kg)	2.35[a]	2.33[a]	1.80[b]	0.25	*
Weaning weight (Kg)	12.42[a]	12.29[a]	11.16[b]	0.50	*
Average Daily Gain (g/day)	0.14[a]	0.11[b]	0.11[b]	0.01	*
Weight at 6 months (Kg)	23.58[a]	22.01[ab]	20.12[b]	1.05	*
Weight at 8 months (Kg)	28.12	28.66	29.09	1.31	NS
Weight at 12 months (Kg)	33.19[a]	32.57[a]	29.01[b]	1.82	*
Height at withers (cm)	58.07[a]	57.51[a]	51.45[b]	2.90	*
Chest Girth (cm)	69.34[a]	68.79[a]	67.25[b]	0.60	*

[ab] means across rows differ significantly (P<0.05); NS: non-significant. SEM: Standard error of means. LOS: Level of significance.

The association between the polymorphic forms of IGF-1 genotypes and growth traits in the Yankasa sheep breed is outlined in Table 1. All growth traits or parameters (birth weight, weaning weight, average daily gain, weight at 6 months, weight at 12 months, height at withers and chest girth) with the exception of Body weight (Kg) at 8 months showed significant (P<0.05) variations. The AA and AB genotypes were mostly similar for birth weight, weaning weight, weight at 6 months, weight at 12 months, height at withers and chest girth and differed significantly (P<0.05) from the BB genotypes. Animals with the AA genotype had the highest birth weight, weaning weight, average daily gain, weights at 6 and 12 months, height at withers and chest girth followed by AB genotyped individuals, BB individuals had the lowest growth characteristics of the studied population.

Observed differences in growth traits due to the various genotypes observed in this study agreed with the findings of Kazemi *et al*. (2011) that polymorphism in 5´ flanking region had a significant effect on growth traits, live weight and carcass weight in Zel sheep and also that of Kurdistani *et al.* (2013) in Kurdish goat, were the polymorphism of *IGF-I* gene was associated with growth traits and yearling fleece weight. But differed from the reports of no significance (P>0.05) reported in Chinese dairy goats for body size, milk yield and birth weight (Deng *et al*., 2010; Wang *et al*., 2011) and Gholibeikifard *et al*. (2013) in Baluchi sheep.

This significant impact of the various genotype on birth weight, weaning weight, average daily gain, weight at 6, 8 and 12 months, height at withers and chest girth in this study supports the assertion that Insulin-like growth factor-1 (IGF-1) is an important regulator of cell proliferation, differentiation, and apoptosis, has acute insulin-like metabolic effects, and is important for growth and development throughout the body. The level of IGF-1 peaks during puberty and after which it declines with age (Licht *et al*., 2014). According to Fletcher *et al.* (2005), the polymorphisms are thought to influence the transcription rate of IGF-1, which in turn affects serum IGF-1 levels which influences growth trait. It is however cautionary to note that Results of studies that evaluated the relationship between the IGF-1 promoter polymorphisms and IGF-1 levels are contradictory; the homozygote 192 bp genotype has been associated with both higher and lower IGF-1 levels compared to the heterozygote and non-carrier genotypes (Fletcher *et al*., 2005 and Euser *et al*., 2011).

CONCLUSION

Association between genotype and growth traits or parameters showed that the AA and AB genotype were superior to the BB for most measured traits.

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Effect of Season on Some Reproductive Hormones and Egg Production in Two Strains of Guinea Fowls (Numida meleagris)

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Abstract: The studywas carried out to investigatethe effect of seasonon luteinizing hormone (LH), progesterone (P_4) and estradiol (E2) and egg production on twostrains (Belgy and Pearl) of guinea fowls. Four seasons were considered; late dry; January-March, early rain; April-June, late rain; July-September and early dry; October-December. A total of ten female guinea fowls per strainwere used for the experiment. Luteinizing hormone, progesterone and estradiol concentrations were determined through Enzyme Linked Immunosorbent Assay (ELISA). There was significant difference ($P<0.05$) on the effect of season on the reproductive hormones and egg production. Season and strain had significantlyaffected($P<0.05$) the reproductive hormones availability and egg production with season three (late rain) and Pearl strainhaving the highestvalues of (LH 5.060 ± 0.213, P_4 1.970 ± 0.085, E2 1.860 ± 0.194, egg number 1675). It was concluded that Pearl strain of guinea fowl had better performance in all seasons of the experiment and therefore recommended to be incorporated in improvement program for egg production of Guinea fowls.

Key words: Guineafowls, Belgy, Pearl, Hormones, andReproduction

INTRODUCTION

One of the major sources of eggs in the rural parts of Nigeria is the guinea fowl. Its attractive plumage and value as a table bird with game-type flavor and high meat to bone ratio has led to its worldwide acceptance (Embury, 2001). However, egg production is seasonal in guinea fowls (Ogwuegbu*et al*., 1988). Sonaiya and Swan (2004) also reported that guinea fowls are seasonal breeders, laying eggs only during rainy season, under free range conditions. This is because successful poultry species instinctively lay and incubate their eggs at a time of the year when newly hatched chicks will have a better supply of high protein and energy food provided by the environment. Saina*etal*, (2005) reported 5±1 months breeding season in Zimbabwe, Southern Africa.The seasonality of production has been recognized as one of the major problems that may hinder large scale commercial guinea fowl production. Factors responsible for this seasonality are however not yet clearly known. Progesterone, estradiol and luteinizing hormone are the most important steroid hormones affecting reproduction in livestock and poultry and have been reported to be positively related to egg production in turkeys (Mashaly*et al.*, 1979). Tanabe *et al.*, (1981) reported a positive correlation between circulatory levels of progesterone and estradiol in egg production in laying hens in a pure-line. The preovulatory rise in plasma progesterone and estradiol precede and stimulate the rise in luteinizing hormone and there is a positive feedback reaction between progesterone, estradiol and luteinizing hormone that induces ovulation (Kanoth and Sharp, 1998). Adeyinka*et al*. (2007) reported a positive correlation between circulatory level of progesterone and egg production in guinea fowls *Numidameleagrisgaleata.* However, this study was aimed at identifying season and strain effect on some reproductive hormones availability and egg production.

MATERIALS AND METHODS

The experiment was conducted at the Department of Animal Science Teaching and Research Farm, Ahmadu Bello University, Zaria, Nigeria. The site is geographically situated between latitude $11^{o}11$'N and longitude 7^{o} and 38'E at an altitude of 686m above sea level (Ovimaps 2015). Annual rainfall in this area ranges from 1102mm to 1904mm per annum which last from late April or earlyMay to October. The mean temperature fluctuates from 31^{o}C maximum during the dry season to 18^{o}C minimum during the wet season. It is located 22km Northeast of Zaria city and in the northern guinea savannah zone of Nigeria as reported by (Kabir 2010). A total of 48 twenty-eight weeks (twenty-four each of Belgy and Pearl) old guinea fowls were used for the study. The parent stock of Belgy were obtained from Maradi, Niger Republic while Pearl from Zaria, Kaduna state. A layer mash of 17%CP and 2710kcla ME/kg and water were offered ad libitum. The eggs collected were recorded in a daily egg record book which was summarized at the end of every season. The data obtained was subjected

to 2x3x4 factorial analysis, with two strains, three hormones and four seasons. Significant differences among means were separated using Duncan Multiple Range Test (SAS, 2004).

RESULT AND DISCUSSION

Least square means and standard errors for the effect of season on hormones availability and egg production are presented in Table 1. Hormones availability and egg number obtained in this study was significantly higher ($P<0.05$) in the late rainy season. This was in line with previous report of having higher hormone availability (progesterone) and collecting highest number in guinea fowls during late rainy season (Adeyinka*et al*. 2007; Jesuyon and Salako, 2013). There was six months of egg production coinciding with raining season. This is similar to the report of (Saina*et. al*, 2005) who reported five months of egg production in guinea fowls kept semi intensively in Zimbabwe and Adeyinka*et al*. 2007 that reported seven months of egg production. It also supported the fact that guinea fowls egg production in Nigeria is restricted to rainy season (Saina*et al*. 2005). The increase in the hormones availability coincides with increase in egg production. This is similar to the earlier report on pheasant (Mashaly*et al*. 2009). The current findings of this study also indicated that level of these hormones is an important factor in egg production in guinea fowls. This result support the suggestions of (Kannoth and Sharp 1998) who noted that the cessation of egg laying induced by stress was associated with low level of these hormones in mainland ducks.

Table 4.9: Least Square Means (± SE) for hormones and season on Belgie and Pearl strains of guinea fowl

Season	Strain	Trait	Mean (± SE)	Egg production
1	Belgie	LH	0.280 ± 0.042^{d}	0
		P_4	0.155 ± 0.022^{c}	
		E2	0.310 ± 0.082^{c}	
	Pearl	LH	0.428 ± 0.064^{d}	0
		P_4	0.220 ± 0.029^{d}	
		E2	0.210 ± 0.031^{c}	
2	Belgie	LH	1.700 ± 0.172^{c}	221
		P_4	0.520 ± 0.076^{b}	
		E2	1.060 ± 0.127^{b}	
	Pearl	LH	2.080 ± 0.36^{c}	376
		P_4	0.540 ± 0.040^{c}	
		E2	0.750 ± 0.101^{b}	
3	Belgie	LH	4.670 ± 0.255^{a}	1552
		P_4	1.390 ± 0.116a	
		E2	2.000 ± 0.209^{a}	
	Pearl	LH	5.060 ± 0.213^{a}	1675
		P_4	1.970 ± 0.085^{a}	
		E2	1.860 ± 0.194^{a}	
4	Belgie	LH	2.206 ± 0.120^{b}	18
		P_4	0.480 ± 0.126^{b}	
		E2	1.390 ± 0.244^{b}	
	Pearl	LH	3.200 ± 0.258^{b}	48
		P_4	1.100 ± 0.146^{b}	
		E2	1.110 ± 0.179^{b}	

LH = luteinizing hormone, P_4 = progesterone, E2 = estradiol. Season 1 = late dry, Season 2 = early rain, Season 3 = late rain, Season 4 = early dry. SE= standard error

Means with the same letters are not significantly different.

CONCLUSION AND RECOMMENDATIONS

Season three (late rain) has higher hormones availability and egg production, as such guinea fowls are confirmed to be seasonal breeders. The findings revealed that Pearl strainhad better reproductive performance and therefore recommended to be incorporated in improvement program for high egg number.

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Comparative Morphometric Studies on Oral Cavity in Uda Sheep and Red Sokoto Goat

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DESCRIPTION OF PROBLEM

Ruminant animals especially the small ruminants are well known with small holders because of their sources of food and forage for hay and pasture are mostly inexpensive feed sources and are considered to have poor quality and have efficient conversion of feed into edible and higher quality meat, milk and hide (skin) (Solaiman, 2007). It is known that environmental diversification of ruminants and their consecutive way of nourishment as well as the sorts of food they feed on, constitute sources of great variety in the structure of their oral cavity (Kobayashi *et al*., 2005). The oral cavity is the first section of the alimentary tract that receives food. It provides the digestive functions of prehension, mastication and salivation. It also plays a role in the respiratory system through oral breathing. The oral cavity consists of accessory structures; the teeth, the tongue and the wall enclosing the oral cavity (Konig *et al.,* 1991). The oral cavity is bordered rostrally by the lips and caudally by the pharynx at the level of the palatoglossal arches. The outer vestibule of the teeth and jaw merge medially and the lips and cheeks laterally. The ramus of mandibule and masseter muscles caudally, inside the dental arches. The palate dorsally and the teeth gums and jaw margin laterally, the tongue margin ventrally. The size can be altered by raising or lowering the tongue and floor of the oral cavity when the mouth is closed (Rajani *et al*., 2010). Many major species effects which include those of growth, resistance to infection, fertility, adaptability, profitability sources of production and semens characteristic have been reported (Chamorro *et al*., 1986; Emura *et al.,* 2000a, 2000b). However, there are scanty reports on species similarities and differences of oral cavity among the small ruminants. Thus, this study is undertaken with the aim of comparing the oral morphometric parameters of the oral cavity in Uda Sheep and Red Sokoto Goat. The results from this study will be useful for clinical comparative anatomists and pathologists.

MATERIALS AND METHODS

The study was conducted in the Anatomy Laboratory, Department of Animal Health and Production Technology, Niger State College of Agriculture, Mokwa, North central, Nigeria. Mokwa is located at latitude $9^0$19˙38" North and longitude $5^0$3'16" East (Google maps, 2018). Twelve (12) heads (Six per species) of apparently healthy adults of Uda Sheep and Red Sokoto goats of both sexes were purchased from local slaughter house in Mokwa town. The samples were collected immediately after the animals were slaughtered and heads were separated from the carcasses for morphomentric studies. The weight, length, thickness and width of the oral cavity in both species were considered for the studies. The weight was measured by using a sensitive electronic weighing balance in gram (g).The length and width were measured with the help of thread and ruler in centimeter (cm) while thickness were measured with the help of a digital vernier caliper in millimeter (mm) respectively. The transverse ridges over the hard palate were noted and counted. The hard palate (Upper Roof) was measured from anterior papilla incisiva part to the soft palate or velum palatinum part (Posterior part of soft palate). The width of hard palate was measured from the following points; Anterior part, Middle part, Caudal part and Narrowest part. Also, the length and width of papillae incisiva and dental pad were measured. The length of buccal floor was measured from rostral prefrenular part to the frenulum linguae, also the width of frenulum linguae, behind incissors, the distance between the frenulum and caruncles over the buccal floor were measured accordingly. The data of parts of the oral cavity obtained were expressed as mean $\pm$ SEM (Standard Error of mean) and subjected to Statistical Package for the Social Science {SPSS} version 17.0. Independent sample t-test at 95% Confidence Interval {CI} was used to determine the level of significant difference in means values of parts of the oral cavities between the two species. Values of ($P \leq 0.05$) were considered significant.

RESULTS AND DISCUSSION

The mean morphometry of Oral Cavity parts are presented in Table 1. The means (± SEMs) of number Width of hard palate at the middle part, Width of papilla incisiva and Length of dental pad were significantly different (P<0.05) between the two species, while other measured parameters were not significantly different (P>0.05) from one another in the two species studied. The present results on mean (± SEM) lengths of transverse ridges of Uda sheep and red Sokoto goats to be 12.00 ± 0.26cm and 11.50 ± 0.43cm respectively are within the ranges reported earlier by Hemran and Ray (2009) in Black Bengal goat and Garole sheep, while the mean numbers of transverse ridges in those breeds of sheep and goats are lower than what were obtained in this present study. This difference could be due to genetic and/or species variations. The present results on the means length of hard palate of Uda sheep and Red Sokoto goats to be 14.43 ± 0.42cm and 11.43 ± 0.43cm respectively are in close range to the mean lengths of 11.80 ± 1.05cm and 12.10 ± 0.08cm in sheep and goats respectively by Snedecor and Cochran (1994). The mean length of Papilla Incissiva in Uda sheep and red sokoto goat obtained in this study are similar to mean the lengths obtained in Black Bengal goat and Garole sheep as reported by Dyce *et.al.*(1996). The present result on mean lengths of dental Pad obtained here are higher than the mean lengths of 6.22 ± 0.58cm, 2.70 ± 0.31cm and 1.51 ± 0.31cm respectively were similar to the reports of Snedecor and Cochram (1994) in Black Bengal goat and Garole sheep. The present result on the mean lengths of rostral prefrenular part in Uda sheep and Red sokoto goat to be 3.17 ± 0.24cm and 2.43 ± 0.21cm respectively are lower than the values of 33.45 ± 1.31cm and 16.05 ± 0.02cm respectively reported by Sarma *et al.* (1995) in sheep and goat. The present results on mean widths of the rostral prefrenular part at frenulum linguae in Uda sheep and Red sokoto goat to be 2.60 ± 0.23cm and 2.22 ± 0.35cm respectively and width of rostral prefrenular part behind the incisors to be 3.55 ± 0.37cm and 2.67 ± 0.09cm respectively are lower than the mean values of 19.06 ± 1.01cm and 22.37 ± 0.97cm respectively obtained in by Sreeranjini *et al.* (2010) in Samba deer. This difference could be due to genetic and/or species variations. The present result on mean distance between frenulum and caruncles of Uda sheep and Red Sokoto goats to be 1.67 ± 0.23cm and 1.05 ± 0.09cm respectively are lower than the mean values of 11.68 ± 2.21cm and 10.55 ± 2.10cm respectively obtained in sheep and goat by Sarma *et al.* (1995). This difference could be due to species or environmental variations. The present result in mean lengths of sublingual Caruncles in Uda sheep and Red sokoto goat to be 0.62 ± 0.09 cm and 0.58 ± 0.07cm respectively are lower than the mean values of 7.40 ± 1.20cm and 4.67 ± 0.40cm respectively obtained in sheep and goat by Mahabady *et al.* (2010).This difference could be due to genetic, species or environmental variations.

Table 1: Mean (± SEM) morphometry of oral cavity parts in Uda sheep and Red Sokoto goat

Parameters		**Uda sheep**	**Red Sokoto Goat**	**Significant level**
Hard palate (upper roof)	Number of Transverse ridges (cm)	12.00 ± 0.26	11.50 ± 0.43	NS
	Length of the hard palate (cm)	14.43 ± 0.42	11.43 ± 0.32	NS
	Width of the hard palate at the anterior part (cm)	2.97 ± 0.15	2.13 ± 0.09	NS
	Width of hard palate at the middle part (cm)	4.10 ± 0.27	3.37 ± 3.16	*
	Width of the hard palate at the caudal part (cm)	4.38 ± 0.27	3.55 ± 0.13	NS
	Width of the hard palate at the narrowest part (cm)	2.88 ± 0.24	2.20 ± 0.12	NS
	Length of papilla incisiva (cm)	0.97 ± 0.06	0.58 ± 0.05	NS
	Width of papilla incisiva (cm)	0.97 ± 0.06	0.60 ± 0.04	*
	Length of dental pad (cm)	3.23 ± 0.23	1.90 ± 0.19	*
	Width of dental pad (cm)	1.25 ± 0.15	0.87 ± 0.07	NS
	Length of median palatine raphae (cm)	10.42 ± 1.07	8.50 ± 0.57	NS
Buccal floor	Length of rostral prefrenular (cm)	3.17 ± 0.24	2.43 ± 0.21	NS
	Width of rostral prefrenular at frenulum linguae (cm)	2.60 ± 0.23	2.22 ± 0.35	NS
	Width of rostral prefrenular behind incisors (cm)	3.55 ± 0.37	2.67 ± 0.09	NS
	Distance between the frenulum and caruncles (cm)	1.67 ± 0.23	1.05 ± 0.09	NS

Length of sublingual caruncles (cm)	0.62 ± 0.09	0.58 ± 0.07	NS
Distance between the median sides of the and right caruncles (cm)	0.88 ± 0.08	0.70 ± 0.11	NS

NS=Not significant, *Significant at α=0.05

CONCLUSION AND APPLICATION

The means (± SEMs) of number Width of hard palate at the middle part, Width of papilla incisiva and Length of dental pad were significantly different (P<0.05) between the two species, while other measured parameters were not significantly different (P>0.05) from one another in the two species studied. The results of this study will be useful for clinical comparative anatomists and pathologists.

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Effect of Genotype on Early Growth Traits of Pure and Crossbred Chicken Progenies Under Derived Savanna Zone of Nigeria

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Abstract: This study was carried out to evaluate the effect of genotype on early growth traits of pure and cross bred chicken progenies. Data were obtained on 181 pure and cross bred chicken progenies of five different strains namely; Naked neck (40), Frizzle feather (55), Rhode Island Red (53), Naked neck x Rhode Island Red cross (9) and Normal feather x Rhode Island Red cross (27). Results were obtained from 0 week to 6 weeks and parameters measured were body weight, body length, chest girth, keel length, shank length, thigh length and wing length. Significant ($P<0.05$) differences were obtained between the variables and the age considered. Naked neck x Rhode Island Red cross had the highest value in body weight and all other growth traits considered at all ages. ranged 43.78 g - 334.67 g, body length ranged 6.50 cm - 12.97 cm, chest girth ranged 9.72 cm - 15.69 cm, keel length ranged 1.00-6.03 cm, shank length ranged 2.00 - 4.41cm, thigh length ranged 3.44-8.64 cm and wing length ranged 4.72 - 22.22 cm than other genetic stocks. It was concluded that Naked neck x Rhode Island Red cross was superior than all other chicken genotypes which can be a bases of improvement of Nigerian local chickens.

Keywords: Genotype, Growth Traits, Purebred Chicken, Crossbred Chicken

DESCRIPTION OF PROBLEM

Several reports have shown that genetic progress can be attained by either selection or cross breeding (1, 2). Crossbreeding of the indigenous stock with commercial exotic birds has also been documented by Amao (3, 4) and (5) to take advantage of artificial selection for productivity in the exotic birds and natural selection for hardiness in the indigenous birds. (6) claimed that good combining ability resulting from a choice of the best performing cross breed could lead to production of birds that will be better in growth rate and efficiency of feed conversion without sacrificing adaptation to the local environment, thereby resulting in reduced cost of production. Genotype can be defined as the genetic makeup of an organism with reference to a single trait, set of traits or an entire complex of traits and the differences in growth traits brought about by some genetic factors cannot be overlooked (7). Growth traits are the quantitative analyses of the structure, shape, and size of an organism and derivation of body weight from body measurements (i.e. morphometric traits) has been reported to be a practical and easy technique, especially among rural poultry breeders with lack of resources (8). (9) reported that morphometric traits such as shank length and diameter were indicators of leg development while body girth was an indicator of breast development. Aside its use as indicator of body weight, morphometric traits can further be used to develop breeding strategies via optimum combination of body measurements (10) to achieve maximum body weight and economic returns. Therefore, the aim of this study is determine the better genotype between the pure and crossbred progenies derived from naked neck, frizzle feather, normal feather, naked neck Rhode Island Red and normal feather Rhode Island Red crossbred.

Materials and Methods

Experimental Site

The experiment was carried out at the poultry unit of Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Oyo state, Nigeria. Ogbomoso is situated in the derived savannah zone of Nigeria and lies on Longitude 4^0 15^1 East of Greenwich Meridian and Latitude 8^0 15^1 North of the equator. The altitude is between 300 and 600m above the sea level while the mean temperature and annual rainfall are 27^0c and 1247mm respectively (11).

Experimental Birds and their Management

The experimental chickens used for the study are the local and exotic breeds. The local strains that were used are the frizzle feather, Naked neck, Normal feather and the Fulani type which were purchased at local markets in Ogbomoso and its environs. The local hens were purchased at 16 – 18 weeks old while the local cocks were purchased at 15 – 17 weeks old. The exotic breed (Rhode Island Red) was procured from Obasanjo farm in Ogun state. The hens and cocks of the exotic breeds were purchased at 15 weeks old. A total number of 85 birds were used for the experiment. The breakdown is 10 hens and 5 cocks of the Naked neck, 12 hens and 4 cocks of the Fulani type, 15 hens and 4 cocks of the normal feather, 15 hens and 5 cocks of the Frizzle feather, 10 hens and 5 cocks of the Rhode Island Red breed. The experimental birds were managed strictly under the intensive management system of production. Each bird was managed strictly under the intensive management system of production and was individually housed in a galvanized battery cage which was being disinfected and properly identified. The experimental birds on arrival were quarantined to forestall any disease outbreak as well as adapting them to their new environment. The birds were dewormed and deloused while in the quarantine house. Vaccination and medication program were carried out at intervals and bio- security measures were put in place.

Feed and Feeding

The birds were fed *ad libitum* with commercial breeders mash containing 17.5% crude protein and 2700kcal/Metabolizable Energy while the hens were given layer mash containing 16% crude protein and 2800 kcal/kg Metabolizable energy and clean and cool water were also supplied *ad-libtum* to the birds.

Mating Technique

The mating technique that was adopted for the experiment is artificial insemination using the hand massage technique. Massaging of the local breeds was carried out at 22 weeks old while massaging of the exotic breeds was carried out at 18 weeks old. Semen was collected from the cocks and immediately inserted into the left vent of the female birds with the use of insemination tube and this was done in the evening. The mating procedures follow:

Normal feather (sire) x Normal feather (dam), Frizzle feather (sire) x Frizzle feather (dam), Rhode Island Red (sire) x Rhode Island Red (dam), Naked Neck (sire) x Rhode Island Red (dam), Normal feather (sire) x Rhode Island Red (dam)

Egg Collection and Incubation

The eggs collected from the inseminated hens were stored at room temperature of 14^0C - 20^0C in an open sided room for seven days. Thereafter, the eggs were taken to the hatchery. Cracked eggs were separated from the eggs that were taken to the hatchery. Incubation was carried out for 21 days and on the 19th day, candling was done to determine the fertile eggs.

Brooding, Feeding and Housing Management

Day old chicks obtained from the hatchery were wing tagged and taken to the brooder unit for 4 weeks. Artificial heat was supplied through charcoal and electric bulb. During brooding stage, the chicks were fed *ad libitum* with commercial chick mash which supplied about 22 % crude protein and 2900 kcal/kg Metabolizable Energy from day old to 6 weeks while clean and cool water was also provided *ad libitum.*

Data Collection

Data was obtained on the progenies generated from the mating of the pure bred birds for the period of 6 weeks. The following measurements were taken on weekly basis: body weight in gram with the aids of sensitive scale, body length, keel length, shank length, thigh length, breast girth, and wing length with the aid of tailor's tape rule in centimeters in according's to the procedures described by (13).

Data Analysis

All data was subjected to one way analysis of variance in a completely randomized design using the procedure of General Linear Model of (14) while significant means were separated with the same procedure of (14). The below model was adopted.

$Y_{ij} = \mu + \beta_i + e_{ij}$

Where,

Y_{ij} = individual observation

μ = overall mean

β_i = fixed effect of the genotype (1,2,3,4,5)

e_{ij} = experimental errors which is evenly distributed

RESULTS AND DISCUSSION

Table 1 shows the mean values of growth as affected by chicken genotypes at day old (week 0), 2, 4 and 6 weeks of age. There are significant ($P < 0.05$) effects between the genotypes in all the variables measured at day old except keel length. Naked neck x Rhode Island Red genotype had the highest values for body weight (43.78 g), body length (6.50 cm), chest girth (9.72 cm) and wing length (4.72 cm) while with the lowest values obtained for body weight (27.00 g), body length (5.53 cm), chest girth (8.46 cm) and wing length (4.31cm) were for frizzle feather genotype. At 2 weeks of age, better values obtained from the Naked neck and Rhode Island Red genotypes for body weight (75.58 g), chest girth (10.92 cm), shank length (2.95 cm) and wing length (12.45 cm) higher than those of other genotypes while the Frizzle feather genotype had the lowest values for body weight (52.44 g), chest girth (10.20 cm), shank length (2.57 cm) and wing length (11.19 cm). Naked neck x Rhode Island Red genotype also had the highest values for body weight (177.00 g), body length (10.92 cm) and chest girth (13.31 cm). The highest body weight (334.67 g), body length (12.97 cm), chest girth (15.69cm), keel length (6.03cm) and thigh length (8.64cm) at 6th week of age were recorded in the Naked neck x Rhode Island Red genotype while the frizzle feather had the lowest values for body weight (214.37 g), body length (11.53 cm), chest girth (14.24 cm), keel length (5.08 cm) and thigh length (7.20 cm) at this age. The result of the present study showed that genotypes had significant effect on growth traits as earlier documented by ( ). The Naked neck and Rhode Island Red cross performed better for all linear body measurements in all weeks. This can be ascribed to the genetic makeup of the progenies which confers better dominance than other genotypes. This finding is similar to the works of (14, 15, 16). These authors claim that variations in the genotypes were due to differences in the genetic constitutions of the chickens. (17) found superior growth traits for crosses between white leghorn and frizzle feather chickens over the crosses between the Naked neck and white leghorn chickens. The frizzle feather had the least performance for all weeks and for all growth traits and this can also be linked to the genetic makeup of the frizzle feather gene. This result is in line with the work of (6) who noticed the least growth traits response for Normal feather for all weeks considered. The better growth traits obtained for Naked neck Rhode Island Red crossbred over the other genotypes were consistent with the reports of (5, 15, 16) that crossbred chickens were superior in respect to growth traits than their counterpart purebred chickens. Generally, all the body parameters increased with respect to genotypes and the ages involved.

Conclusion and Application

It can be concluded from the study that among the pure and crossbred used, Naked neck Rhode Island Red crossbred was better in terms of growth traits than their other counterparts purebreds and crossbred. Based on this study, the Naked neck and Rhode Island Red cross is recommended for growth traits in chicken and also programme that involves exploiting traits due to their very high potential for growth displayed by Naked neck x Rhode Island Red cross.

Table 1: Mean values of growth traits as affected by chicken genotypes at day old, 2, 4 and 6 weeks.

Ages (weeks)	Genotype	N	Body weight (g)	Body length (cm)	Chest girth (cm)	Keel length (cm)	Shank length (cm)	Thigh length (cm)	Wing length (cm)
0	NN	40	31.45±0.85^{d}	5.71±0.09^{c}	8.43±0.12^{d}	1.00±0.00	1.94±0.02^{a}	3.42±0.07^{ab}	4.20±0.10^{d}
	FF	55	27.00±0.54^{e}	5.53±0.09^{d}	8.46±0.90^{c}	1.00±0.00	1.89±0.02^{a}	3.27±0.06^{c}	4.31±0.06^{c}
	RIR	53	41.06±0.67^{b}	6.37±0.10^{b}	9.09±0.11^{b}	1.00±0.00	2.07±0.03^{a}	3.35±0.07^{b}	4.41±0.06^{b}
	NN x RIR	9	43.78±1.45^{a}	6.50±0.12^{a}	9.72±0.09^{a}	1.00±0.00	2.00±0.00^{a}	3.44±0.06^{a}	4.72±0.19^{a}
	NF x RIR	24	34.78±1.30^{c}	5.61±0.09^{c}	9.02±0.11^{b}	1.00±0.00	2.02±0.04^{a}	3.21±0.08^{c}	4.34±0.12^{c}
2	NN	27	62.59±1.70^{d}	7.77±0.09^{c}	10.83±0.13^{ab}	3.13±0.06^{ab}	2.74±0.06^{ab}	4.91±0.08^{ab}	10.44±0.28^{c}
	FF	54	52.44±1.33^{e}	7.85±0.15^{b}	10.20±0.16^{b}	2.74±0.07^{c}	2.57±0.05^{b}	4.51±0.17^{b}	11.19±0.18^{b}
	RIR	50	70.24±1.83^{b}	8.41±0.13^{ab}	10.90±0.23^{a}	2.97±0.05^{b}	2.85±0.03^{ab}	5.00±0.07^{a}	11.24±0.22^{b}
	NN x RIR	9	75.58±3 .85^{a}	8.54±0.17^{a}	10.92±0.50^{a}	3.31±0.11^{a}	2.95±0.07^{a}	4.99±0.12^{a}	12.45±0.31^{a}
	NF x RIR	24	64.38±2.78^{c}	7.76±0.13^{c}	10.81±0.19^{ab}	2.71±0.14^{c}	2.60±0.05^{b}	4.90±0.09^{ab}	11.60±0.27^{ab}
4	NN	25	139.76±22.31^{c}	10.64±0.31^{ab}	13.22±0.39^{ab}	4.55±7.20^{a}	3.56±0.09^{a}	6.05±0.10^{ab}	15.90±0.50^{c}
	FF	51	110.04±13.67^{e}	9.74±0.21^{b}	12.26±0.31^{c}	3.97±0.07^{b}	3.17±0.05^{ab}	5.68±0.10^{c}	15.28±0.24^{d}
	RIR	50	149.92±10.43^{b}	10.55±0.17^{ab}	13.19±0.22^{ab}	4.36±0.09^{ab}	3.56±0.08^{a}	6.41±0.12^{a}	16.60±0.28^{b}
	NN x RIR	8	177.00±12.09^{a}	10.92±0.25^{a}	13.31±0.28^{a}	4.56±0.16^{a}	3.52±0.10^{a}	6.09±0.15^{ab}	17.26±0.31^{a}
	NF x RIR	20	122.70±16.15^{d}	9.80±0.25^{b}	12.40±0.30^{b}	4.29±0.11^{ab}	3.50±0.10^{a}	5.88±0.10^{b}	16.52±0.28^{b}
6	NN	23	239.31±10.20^{c}	12.27±0.22^{b}	13.92±0.54^{c}	5.46±0.14^{b}	4.21±0.12^{ab}	7.90±0.17^{ab}	20.45±0.38^{b}
	FF	51	214.37±7.31^{d}	11.53±0.17^{c}	14.24±2.29^{bc}	5.08±0.9^{c}	3.97±0.07^{ab}	7.20±0.09^{c}	20.10±0.22^{b}
	RIR	50	267.41±9.27^{bc}	12.41±0.16^{ab}	15.27±0.19^{ab}	5.60±0.11^{ab}	4.39±0.7^{a}	7.75±0.12^{b}	21.22±0.30^{ab}
	NN x RIR	8	334.67±23.79^{a}	12.97±0.22^{a}	15.69±0.38^{a}	6.03±0.16^{a}	4.41±0.12^{a}	8.64±0.21^{a}	22.22±0.38^{a}
	NF x RIR	17	283.65±12.62^{b}	12.15±0.26^{bc}	14.54±0.26^{b}	5.44±0.11^{ab}	4.16±0.11^{ab}	7.22±0.28^{c}	21.05±0.30^{ab}

^{abcdef}Means along the same column at each age with different superscripts are significantly ($P < 0.05$) different.
N = Number of observation, NN= Naked Neck, FF= Frizzle Feather, RIR= Rhode Island Red, NF= Normal Feather, NN x RIR = Naked neck Rhode Island Red crossbred, NF x RIR = Normal Feather Rhode Island Red crossbred.

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Effect of Breed and Sex on Carcass Characteristics of Turkeys (*Meleagris gallopavo*)

Abstract: Aim: This study was conducted to assess the effect of breed and sex on carcass characteristics of Turkey. The result of carcass shows that there were significant (P<0.05) difference in all the traits measured between and within the breed except thigh which has no significance (P>0.05) difference by the breed and sex. For the organs Norfolk also have the higher values.

Study Design and Duration: The study conducted at 20 weeks during which the carcass characteristics were measured in 100 Turkeys using completely randomized design.

Methodology: At twenty (20) weeks, 20 birds were selected from each breed which comprised of 10 males and 10 females on the basis of average weight. They were weighed, slaughtered and eviscerated for carcass evaluation. The parameters that were measured are (LVWT) = live weight, (DRS WT) =dressed weight, (CACWT) = carcass weight, (THI WT)=thigh weight, (BRE WT)=breast weight, (WIN WT)=wing weight, (BACK WT)=back weight, (DRTC WT)=drumstick weight and (NECK WT)=neck weight.

Results: Results obtained from carcass analysis shows that there were significant (P<0.05) differences in all the traits measured (which are neck length, thigh length, shank length, body length, chest girth and wing length) between the two breeds and also the same exist within the same breed except thigh which has no significance (P>.05) difference by the breed and sex.

Conclusion: From the study conducted, results showed that, there were significant effect (P<0.05) of sex at 20 weeks on carcass traits, it showed that, the Norfolk breed demonstrated higher carcass weight than the Mammoth breed.

Keywords: Turkey, Carcass, Norfolk, Mammoth

INTRODUCTION:

Turkey has been found to contribute to the economic and social life of Nigerians in that they are used during festive period (Smith, 1990). Despite the increase in demand for turkey consumption, there are no large scales commercial turkey farms in Nigeria to meet the ever increasing demand (Ogah, 2011). Today, with the vast majority of poultry products being marketed in cut-up parts, yield of high value items such as breast and shank have become critical to processors (Young *et al.*, 2001). Watts and Kennett (1995) reported that demand for high quality parts have driven poultry industry to change their marketing practices to cut-up parts in response to consumer's needs. It has been reported that genetic variation in carcass traits and body shape in turkey has received little attention (Nestor *et al*., 2001). Variation in body weight within a flock can be attributed to genetic variation and environmental factors that impinge on individuals (Ayorinde and Oke, 1995). In comparing between body parts of two strains of Nicholas and hybrid toms turkey, Barbour and Lilburn (1996) had reported heavier weight of pectoral's major and tibia, plus associated muscles, as well as higher relative weights of pectoral's major in the hybrid toms at 72 and 82 days. Development of muscles and bones were studied by Brenoe and Kolstand (2000) during the period of 4-12 weeks old in two commercial strains of turkeys (BUT-9 and Nicholas) of both sexes. The authors reported that meat proportion increased and bone percentage decreased significantly throughout the experimental period for both strains and sexes. BUT-9 tended to have a higher percentage of meat than Nicholas, while Nicholas strain of turkey showed lower bone percentage than BUT-9. The objective of the study was to determine the effect of breed and sex on body weight and carcass characteristics of turkey.

MATERIALS AND METHODS:

Experimental site: This research was carried out at Poultry Unit of the Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria. Zaria is Located within the Northern Guinea Savannah Zone of Nigeria, on the latitude $11^0 9'$ 45" N and longitude 7^0 38' 8" E, at an altitude of 610m above sea level (Ovimaps, 2012).

Source of experimental birds: Day old Poults of two breeds of Turkey were purchased from ZARTECH Farms Ltd, Ibadan, Oyo State of Nigeria. A total of 100 day old Poults of Turkey comprising of 50 Norfolk-black and 50 Mammoth-bronze were used for this study.

Management of experimental birds: Before the arrival of the chicks, the brooding room was cleared, disinfected and fumigated. On arrival, the birds were brooded with the aid of kerosene stove and electric bulbs as sources of heat. The birds were allowed *ad libitum* access to feed and water. The experiment lasted for 20 weeks

Experimental design: The study was 2-way factorial arrangement with breed and sex in 2 × 2 factorial in Completely Randomized Design (CRD), each breed was replicated five times with ten birds per replicate.

Carcass Evaluation: At the end of twenty (20) weeks, 20 birds were selected from each breed which comprised of 10 males and 10 females on the basis of average weight and were weighed, slaughtered and eviscerated for carcass evaluation. The birds were fasted for 12 hours before slaughtering, bled and slaughtered weight was taken in kg. The birds were defeathered manually using hot water and eviscerated. The live weight and carcass weight were recorded. The dressing percentage was calculated.

Statistical Analysis: The data generated were subjected to General Linear Model (GLM) procedure of SAS (2002). Difference among the breeds in terms of body weight and carcass traits were compared using Duncan Multiple Range Test (DMRT) (Duncan, 1955).

Model for the experiment:

$Y_{ijk} = \mu + B_i + S_j + (B \times S)_{ij} + e_{ijk}$

Where: Y_{ijk}= Observations, μ = Overall population mean,

B_i = the effect of i^{th} breed (i = Norfolk-black, Mammoth-bronze)

S_j = the effect of j^{th} sex (k= male, female), $B \times S_{ij}$ = interaction of breed and sex

e_{ijk} = random error term

RESULTS AND DISCUSSION

Table 1: Effect of breed on traits of Turkeys at 20 weeks

Traits (g)	NORFOLK	MAMMOTH	SEM	LOS
LVWT	3666.67[a]	3283.33[b]	85.80	*
CACWT	3200.00[a]	2850.00[b]	80.79	*
DRSWT	2583.33	2458.33	63.74	NS
THIG WT	335.00	294.67	25.36	NS
BRE WT	549.50	493.17	34.51	NS
WIN WT	312.17	304.00	20.57	NS
BACK WT	402.83	390.83	25.86	NS
DRTC WT	343.67	327.33	18.64	NS
NECK WT	219.50	209.17	14.61	NS

LVWT = live weight, DRS WT =dressed weight, CACWT = carcass weight,THI WT=thigh weight, BRE WT=breast weight, WIN WT=wing weight, BACK WT=back weight, DRTC WT=drumstick weight and NECK WT=neck weight

Table 2: Effects of sex on traits of Turkeys at 20 weeks

Traits	Male	Female	SEM	LOS
LVWT	4166.67[a]	2783.33[b]	85.80	*
CACWT	3566.67[a]	2483.33[b]	80.79	*
DRSWT	2925.00[a]	2116.67[b]	63.74	*
THIG WT	353.00[a]	276.67[b]	25.36	*
BRE WT	563.83	478.83	34.51	NS
WIN WT	348.33[a]	267.83[b]	20.57	*
BACK WT	443.00[a]	350.00[b]	25.86	*
DRTC WT	383.00[a]	288.00[b]	18.64	*

NECK WT	247.67[a]	181.00[b]	14.61	*

LVWT = live weight, DRS WT =dressed weight, CACWT = carcass weight,THI WT=thigh weight, BRE WT=breast weight, WIN WT=wing weight, BACK WT=back weight, DRTC WT=drumstick weight and NECK WT=neck weight

Table 3: Effect of breed and sex on traits of Turkeys at 20 weeks

	NORFOLK		MAMMOTH			
Traits	Male	Female	Male	Female	SEM	LOS
LVWT	4533.33[a]	2800.00[c]	3800.00[b]	2766.67[cd]	121.34	*
CACWT	3900.00[a]	2500.00[c]	3233.33[b]	2466.67[cd]	114.26	*
DRSWT	3133.33[a]	2033.33[cd]	2716.67[b]	2200.00[c]	90.14	*
THIG WT	371.00	321.00	335.00	354.33	30.21	NS
BRE WT	576.33[a]	522.67[a]	551.33[a]	435.00[b]	48.80	*
WIN WT	340.00[a]	284.33[b]	356.67[a]	251.33[b]	29.09	*
BACKWT	442.67[a]	339.00[b]	443.33[a]	361.00[b]	36.58	*
DRTC WT	392.00[a]	295.33[b]	374.00[a]	280.67[b]	26.37	*
NECK WT	258.67[a]	180.33[b]	236.67[a]	181.67[b]	20.67	*

LVWT = live weight, DRS WT =dressed weight, CACWT = carcass weight,THI WT=thigh weight, BRE WT=breast weight, WIN WT=wing weight, BACK WT=back weight, DRTC WT=drumstick weight and NECK WT=neck weight

The result shows the main effect of breed on carcass traits of Turkey at 20 weeks age, (Table 1) The results shows that the live weight and carcass weight were significantly affected ($P<0.05$) by the breed while the dressed weight, thigh, breast, wing, back, drumstick and neck were not significantly affected ($P>0.05$) by the breed at 20 weeks of age. Barbour and Lilburn (1996) compared important carcass parts of the two strains of Nicholas and hybrid toms, they found breed was significantly affected ($P<0.05$) live weight and carcass weight. Breed and feeding strategies may influence carcass quality and composition, which in turn may be utilized to meet different market demands (Brenoe and Kolstad, 2000). Nestor *et al.* (2001) mentioned that genetic variation in carcass traits and body shape in turkey has received little attention. A turkey's skeleton comprises about 5 % of its total body weight with strong well developed muscles running the length of the leg (Stu Keck, 2004).

The sex measured (Table 2) Sex significantly ($P<0.05$) affected all the parameters measured. Male Turkey of all breed showed remarkable and better carcass yield than their female counterparts for all the traits except for breast. The values obtained for the dressed weight agrees with the findings of Joseph *et al.* (1992) where dressed weight of male birds was reported to be significantly higher than that of female. The carcass weight obtained for the male was higher than that of the female as well. These findings correspond with the report of Theerachai (2009) where male birds was reported to have higher proportion of total carcass and also consistent with that of Garcia *et al.* (1993) strengthening the argument for inherent genetic differences. They reported sexual dimorphism at slaughter and carcass yield of the chicken used in their study. These result revealed that males generally had higher values for slaughter weight, weight after bleeding, slaughter weight after defeathering, carcass weight and other organ weights measured in this study which is in accordance with the report of Cahaner *et al.* (1993). This phenomenon known as sexual dimorphism has been revealed by several reports to usually favour male compared to female especially in poultry (Ilori *et al.*, 2010; Peters *et al.*, 2010). Fayeye *et al.* (2006) attributed this difference to genetic effect of sex which arises from the male physiological activities. Adedeji *et al.*, (2004) stated that the aggressiveness of males over the females especially when reared together put the females at a disadvantage for feed and water.

At 20 weeks age (Table 3) The results shows the interaction effect of breed and sex on carcass traits of Turkey at 20 weeks of age, the result shows that the live weight, dressed weight, carcass weight, breast, wing, back, drumstick and neck were significantly affected ($P<0.05$) by sex across and within the breed except the thigh which has not significantly affected ($P>0.05$) by sex within and across the breed. The male of Norfolk have the

best carcass traits followed by male of Mammoth and there females. This is in accordance with Karima and Fathy (2005) who reported significant breed differences in live body weight and other carcass parameters. This is also in agreement with the findings of Musa *et al*. (2006) who found Males compared to females showed higher live weight and carcass weight, breast, back, drumstics, neck and wing. The superior average male performance among the more economically important traits is as a result of sexual dimorphism caused by the faster growth and muscle laying activity of the male hormone. Development of muscles and bones were studied by Brenoe and Kolstad (2000) using 4-12 wk old two commercial strains of turkeys (BUT-9 and Nicholas) of both sexes. Their results indicated that meat proportion increased and bone percentage decreased significantly throughout the experimental period for both strains and sexes.

CONCLUSIONS

From the results obtained in this study, the significant effect ($P<0.05$) of sex at 20 weeks age on carcass traits showed the Norfolk breed demonstrate higher carcass weight than the Mammoth breed. The male of Norfolk have the best carcass traits followed by male of Mammoth and there females. For marketing purposes, the farmers need to know which breed can grow fast and give highest carcass weight, dressed weight and other primal cuts, in this study Norfolk was better.

RECOMMENDATIONS

From this study Norfolk breed was recommended to the farmers because it had high carcass weight and hardy. For breeding purpose the male of Norfolk and female of Mammoth and vice versa may be crossed to monitor the growth of offspring.

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Estimation of Live Weight Using Litter Size, Parity and Body Measurements in Yankasa Ewes

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Abstract: Data from forty-eight (48) Yankasa ewes were used to study the relationship between litter size and parity in estimate of live weight using body measurements at different ages in Yankasa ewes. The data were collected at the College of Agriculture and Animal Science, Ahmadu Bello University, Mando Road, Kaduna State, Nigeria. Traits recorded were Litter Size (LS), Parity (P), Body Length (BL), Height-At-wither (HAW), Chest Girth (CG), Body Condition Score (BCS). The data were analysed using the General Linear Model of SAS. The average height-at-withers, body length, chest girth, litter size, body condition score and body weight recorded were 69.0 $\pm$ 2.34cm, 66.0 $\pm$ 3.40cm,77.6±3.40, 1.46 $\pm$ 0.04, 2.67 $\pm$ 0.10 and 32`0 $\pm$ 0.24kg respectively. The correlation coefficients recorded for the measured traits ranged between 0.21 and 0.89 and were significant ($P < 0.01$). The coefficient of determination (R^2) were significantly higher for both Y_1 (Weight at 1 – 2years) and Y_2 (Weight at 3-4years), but Y_2 was observed to have the highest R^2 value (93.22%). Weight equations showed that body weight can be predicted using combination of linear body measurements. This study also indicated that body measurements and body weight showed significant and positive correlations and the tendency to show some progress with progressing litter size and parity of the ewes. These characters could be improved by conditioning the environment and the system of management.

Keywords: Litter size (LS), parity (P), body weight (BW), body measurement (BM), and Yankasa Ewes.

INTRODUCTION

It is important to increase the efficiency of sheep production (output) by improving reproductive traits, quantity and quality of growth traits, milk yield and other traits that are important economically (Vatankha *et al.*, 2008). Body conformation and growth rate of animals are important criteria for selection of breeding animals in meat producing species. In many livestock species, conformation traits have been included in the genetic evaluation procedures and selection programmes (Mandal *et al.*, 2008). Body dimensions or linear measurements have been used as indicators of body size and weight and live body weight can be predicted from body measurement (Valdez *et al.*, 1997, Varade and Ali, 1999, Atta and El-Khidir, 2004, Afolayan et al., 2006).

Litter size was positively correlated with parity (Awemu *et al*., 1999, Akpa *et al.*, 2004and Abubakar *et al.*, 2014). Parity has been reported to have significant effect on body weight, body measurements, and other reproductive traits in different studies of Sheep in various breeds (Yadzi *et al.*, 1998; Vatankha *et al.*, 2008, Jafaroghi *et al.*, 2010; and Mohammed *et al.*, 2010). The productivity of domestic ruminants are closely linked to their Live Weight and Body Condition Score (Robinson, 1990). Mellado *et al.*, (1996) reported that infertility increased in both bucks and does as body score decreased.

Yankasa sheep are the most widely distributed and most numerous sheep breed in Nigeria (Oni, 2002). Nigeria has about 22.3 million sheep (FDLPCS, 1991), it is estimated that Yankasa sheep constitute 60% of the total national flock and very popular among sheep farmers (Afolayan, 1996). It is a medium sized breed, with long and thin tail and moderately long and somewhat droopy ears. Rams have curved horns and hairy, white mane and ewes are polled. They have white coat colour with black patches around the eyes, ears and muzzle (FAO, 2006). The aim of this study is to estimate live weight using litter size parity and body measurements in Yankasa ewes.

MATERIALS AND METHODS

Experimental site: The research was conducted at the Teaching and Research farm of the College of Agriculture and Animal Science, Division of Agricultural Colleges, Ahmadu Bello University, Mando road, Kaduna. The College is on Latitude $10^0$35'N and longitude 7^0.25' – 26.41^{0}E, Kaduna State Nigeria. The rainfall in this area varies between 1096mm – 1544mm per annum and raining season last for 150-200 days and dry season stars from October to early April. The mean annual temperature is 34^{0}C with the hottest month being March to April (40^{0}C) and the coolest period (16^{0}C), which is between December and January, during severe harmattan (NIMET, 2014).

Experimental Animals and their Management: A total of forty-eight (48) Yankasa ewes range between twelve and forty-eight months of age were used for this study. The ewes were managed under semi-intensive system. The animals were released for grazing in the morning at about 8.00am and were kraaled overnight. Supplementary feeding was done using crop residues such as groundnut haulm, bean pods and maize offals. Mineral blocks and water were also provided. The animals also receive routine inspection; deworming, vaccination and treatment of ecto-parasites were carried out. All the animals were identified using ear tags.

Data Collection: Data were collected over a period of four (4) months (September to December). Body weight, height-at-withers, chest girth and body condition score (BSC) were recorded fortnightly in the morning before the animals were released for grazing. Litter size, parity and age of each animal were also recorded. Age of the animals was determined using dentition formula as per Wilson and Durkin (1984). Body weight of the animals were measured using weighing scale and values recorded in (Kg), height-at-withers was measured as the distance from the surface of a platform to the withers, while body length was measured as the distance from external occipital protuberance to the base of the tail and chest girth representing the circumference of the chest. These traits were measured using measuring tape and figures recorded in (Cm). Body Condition Score (BCS) was assessed using the 5-point scale (1 = very thin to 5 = obese) as described by Aumont *et al.*, (1994) and Thompson and Meyer (2002). The ewes' lumbar vertebrae, loin and rump areas were palpated, examined and then scored. Amount of fat deposit was determined by the use of fingertip pressure which is exerted on the back bone, pin bone and hip bone.

Statistical Analysis: The population average and standard deviations were calculated based on the means of SAS (2001). The variance analysis and multiple comparison were analyzed by the General Linear Model (GLM) of SAS (2001). Significant differences were separated using Duncan Multiple Range test (SAS) (2001). Correlation and regression were computed using SAS (2001). The data were analyzed using the following model:

$Y_{ijk} = P_j + L_k + W_l + E_{ijkl}$
Y_{ijkl} = any observation
μ = the overall mean
P_i = effect of parity of ewe
L_j = effect of litter size of ewe
W_k = effect of weight of ewe and
E_{ijk} = residual error

RESULTS AND DISCUSSION

The descriptive statistics; mean ± S.E minimum and maximum values for Height-At-Wither (HAW), Body Length (BL), Chest Girth (CG) and Body Weight (BW) are presented in Table 1. The average values for HAW, BL, CG, and BW. For first, second, third, and fourth parities were 65.0 ± 1.10, 60.1 ± 1.67, 70.0 ± 1.89cm, 20.0 ± 1.04kg, 69.0 ± 2.34, 66.0 ± 3.40, 77.6 ± 2.04cm, 32.0 ± 6.23kg, 68.8 ± 1.03, 68.0 ± 0.91, 78.5 ± 1.04cm, 31.5 ± 0.65 kg and 68.0 ± 2.00, 68.5 ± 6.50, 79.5 ± 0.50 cm, 32.0 ± 3.00 kg respectively. The coefficient of variation (cv) for body measurements ranged from 2.5 to 11.5. BW, HAW, BL, and CG seemed to increase with progressing parities of the ewes. This agrees with the report of Yadzi *et al.*, (1998), Jafaroghu *et al*., (2010), Mohammed *et al.*, (2010) and Abubakar *et al*., (2014) that parity has significant effect on live weight and body measurements increased with progressing parity of the does. The values for BW, HAW, BL and CG obtained in this study were within the ranges reported in the same breed by Afolayan *et al.*, 2006, Fasae *et al.*, (2005) and Umar *et al*., (2015).

Table 1: Descriptive Statistics of Parity on Height-at-withers, body length, chest girth and body weight in Yankasa Ewes

Parity	No 48	Variable	Means S.E.	Min.	Max.	C.V
1	08	HAW (Cm)	65.0 ± 1.10	61.0	70.0	5.0
		BL (Cm)	60.1 ± 1.67	52.0	63.0	7.3
		CG (Cm)	70.0 ± 1.69	61.0	75.0	6.4
		WT (Kg)	20.0 ± 1.04	16.0	23.0	14.0
2	13	HAW (Cm)	69.0 ± 2.34	62.0	75.0	7.6
		BL (Cm)	66.0 ± 3.40	55.0	74.0	11.5
		CG (Cm)	77.6 ± 2.94	70.0	86.0	8.5

		WT(Cm)	32.0 ± 6.23	20.0	35.0	23.0
3	15	HAW(Cm)	68.8 ± 1.03	67.0	71.0	3.0
		BL (Cm)	68.0 ± 0.91	66.0	70.0	2.7
		CG(Cm)	78.5 ± 1.04	76.0	81.0	2.5
		WT (Kg)	31.5 ± 0.65	30.0	33.0	4.1
4	12	HAW (Cm)	68.0 ± 2.00	66.0	70.0	4.6
		BL(Cm)	68.5 ± 6.50	62.0	75.0	4.2
		CG(Cm)	79.5 ± 0.50	79.0	80.0	0.9
		WT (Kg)	32.0 ± 3.00	29.0	35.0	13.3

HAW: height-at-withers, BL: body length, CG: Chet girth, WT: body weight, Min: Minimum, Max: maximum, N: number of observation, Cv: Coefficient of variation

Table 2: Prediction of weight traits using combination of linear body measurements in yankasa ewes

Traits	Prediction equation	LOS	R^2 Value
Litter Size	$Y_1 = -106.84 + 0.075 (X_1) – 0.07 (X_2) + 1.19 (X_3) – 0.60 (BCS)$	**	84.10%
Parity	$Y_2 = -52.44 + 0.63 (X_1) + 0.66 (X_2) – 0.18 (X_3) + 3.43 (BCS)$	**	93.22%

X_1: Height – at withers, X_2: Body length, X_3: Chest girth, BCS: BCS condition Score,
LOS: Level of Significance

The estimates of body weight traits in Yankasa ewes using linear body measurements are presented in Table 2. The coefficient of determination (R^2) were significantly ($p < 0.01$) higher for both Y_1 (weight at 1-2years) and Y_2 (weight at 3-4years) respectively. Y_2 was observed to have the highest R^2 value (93.22%). The coefficient of determination (R^2) indicated that the body measurements succeed to describe more variation in live weight. These high R^2 values obtained from litter size (84.10%) and parity (93.22%) in this study accounted for the highest variation of body weight by combination of HAW, BL, CG and BCS in predicting live weight than using individual variable. This agrees with the report of Lawrence and Fowler (1997) that the coefficient of determination of multiple regression of heart girth and any other linear measurement on body weight was slightly higher than that of simple regression of heart girth on body weight. It is also in agreement with the findings of Atta and Elkhindir (2004) that used combination of heart girth, wither height and scapuloischial length for prediction of live weight of Nilotic sheep. These results are also supported by the findings of Mohammed and Amin, (1996), Topel and Macit (2004).

CONCLUSION

The results of this study showed that body weight, body measurements, and body condition score had significant and positive correlations and the tendency to show some progress with progressing parity of the ewes. These characters could be improved by conditioning the environments for better production. It also indicated that litter size and parity may be useful as selection criteria for improving performance traits in a situation where weight measurements might not be feasible, especially by as small holder farmers that do not have access to the weighing materials.

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Influence of Breed and Egg Weight on Fertility and Hatchibility of Sasso, Shika Brown Chicken and Their Crosses

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Abstract: The effect of breed and egg weight on hatchability and fertility in Sasso, Shika brown and their crosses was studied using one thousand, one hundred and seven (1107) eggs comprising 509 Sasso eggs (46 light, 285 medium, 178 heavy) 392 Shika brown egg (141 light, 97 medium, 154 heavy) and 205 Sasso x Shika brown cross (19 light, 145 medium, 42 heavy). Data on number of fertile eggs, number of fertile eggs hatched, fertile eggs not hatched, eggs not fertile, chicks dead in shell, deformed chicks and total number of eggs were collected and analyzed by SAS (2001) using analysis of variance (ANOVA). The results revealed a significant ($p<0.05$) effect of breed on the number of fertile eggs, number of fertile eggs hatched, fertile but not hatched eggs, eggs not fertile, dead in shell chicks, deformed chicks and total number of eggs. For number of fertile eggs hatched, Sasso had the highest mean number of fertile eggs hatched (19.55). Sasso had the highest number of eggs not fertile (35.55). The number of deformed chicks was highest in Shika brown (0.66). Total number of eggs was highest in Sasso (56.55). The highest value of fertile eggs hatched was observed in medium weight eggs of Sasso (41.00). Furthermore, the highest number of eggs not fertile was observed in medium weight eggs of Sasso (50.00). In conclusion, it is observed in this study that fertility and hatchability in chicken is affected by the breed and the weight of the egg.

Keywords: Single Nucleotide Polymorphism, Hatchability, fertility, Sasso, Shika brown

INTRODUCTION

Domestic chickens (*Gallus gallus* domestica) are non-descriptive and heterozygous birds that are different in size, colour, shape and production ability depending on their genetic makeup. In Nigeria the population of local chickens' accounts for 80% (Ajayi and Agaviezor, 2012) and are of great importance to man both nutritionally, culturally and economically (Peters *et al*., 2008). Selection for production traits in the poultry industry (broiler and layer) has resulted in a rapid improvement in animal performance. For broilers, the main selection pressure has been on growth rate, feed efficiency, and carcass traits, and in layers, the focus has been to increase egg production and quality (Fulton, 2012). However, although several traits have been genetically improved, phenotypic and genetic variations still exist among chicken populations due to differences in selection practices imposed by different breeding programs; therefore, improvements are required in this regard (Rönnegård and Valdar, 2011). In poultry production, different factors ranging from environmental to genetic factors do affect egg production, fertility and hatchability of the eggs. Some of such factors include storage time, position of the eggs, relative humidity, temperature and feed variation (Mussaddeq*et al*., 2002; Al-Bashan and Al-Harbi, 2010). However genetic factors such as breed type, genetic makeup of the embryo, shell quality, egg size and disease also affect fertility and hatchability (King'ori, 2011). The productive value of animals is determined by its ability to meet production demand and the production potential of domestic fowl is controlled by several parameters including those related to its reproductive potential (fertility and hatchability of eggs). This study was therefore designed to assess the influence of breed and egg weight on hatchability and fertility in Sasso, Shika Brown and their crosses in the South - South region of Nigeria.

MATERIALS AND METHODS

This study was carried out at the University of Port Harcourt Demonstration Farm, Choba, Port Harcourt, Nigeria. Ten(10) males and 100 females of Sasso and 5 males and 50 females of Shika brown donated by African Chicken Genetic Gains (ACGG) for capacity building were artificially inseminated (Sasso males to Sasso

females, Shika brown males to Shika brown females and Sasso males to Shika brown females) to generate a total of one thousand, one hundred and seven (1107) eggs comprising 509 Sasso eggs (46 light, 285 medium, 178 heavy) 392 Shika brown egg (141 light, 97 medium, 154 heavy) and 205 Sasso x Shika brown cross (19 light, 145 medium, 42 heavy) were used for this study. The egg weights were classified as light <50g, medium 50 – 59g and heavy 60- 69g. The eggs were collected, weighed and sent to the hatchery. Data on number of fertile eggs, number of fertile eggs hatched, fertile eggs not hatched, eggs not fertile, chicks dead in shell, deformed chicks and total number of eggs were collected and analyzed using SPSS version 16 in a 3 x 3 Factorial experimental design. Significant means were separated at $p<0.05$ using Duncan Multiple Range Test of the same package.

RESULTS

Table 1 shows the effect of breed on fertility and hatchability parameters of the chickens studied. The results revealed a significant ($p<0.05$) effect of breed on the number of fertile eggs, number of fertile eggs hatched, fertile but not hatched eggs, eggs not fertile, chicks dead in shell, deformed chicks and total number of eggs. Sasso and Shika Brown had more number of fertile eggs as compared to Sasso x Shika Brown cross. For fertile number of eggs hatched, Sasso had the highest mean number of fertile eggs hatched (19.55). This was followed by Shika brown (14.88) and the least value was seen in Sasso x Shika brown cross (8.22). Also, considering fertile but not hatched eggs, the highest value was seen in Shika brown (8.77). This was followed by the Sasso and Sasso x Shika brown cross having the same value of 1.44. Sasso had the highest number of eggs not fertile (35.55). This was followed by Shika brown (19.88) and the least was observed in Sasso x Shika brown (13.22). Chicks dead in shell also varied significantly. The highest number was observed in Shika brown (1.77). Sasso had 1.11 and the least was observed in Sasso x Shika brown cross (0.33). The number of deformed chicks was highest in Shika brown (0.66). Sasso and Sasso x Shika cross had no deformed chicks. Total number of eggs was highest in Sasso (56.55) and was followed by Shika brown (43.55) and the least was observed Sasso x Shika brown cross (22.88).

Table 1: Effect of breed on hatchability and fertility of Sasso, Shika brown and their cross

Breeds	Number of fertile eggs	Number of fertile eggs hatched	Number of fertile eggs not hatched	Number of eggs not fertile	Number of chicks dead in shell	Number of deformed chicks	Total number of eggs
Sasso	21.00[a]	19.55[a]	1.44[b]	35.55[a]	1.11[b]	0.00[b]	56.55[a]
Shika brown	23.66[a]	14.88[b]	8.77[a]	19.88[b]	1.77[a]	0.66[a]	43.55[b]
Sasso x Shika brown	9.66[b]	8.22[c]	1.44[b]	13.22[c]	0.33[c]	0.00[b]	22.88[c]
Standard Error	0.00	0.30	0.30	0.36	0.21	0.11	0.36

a, b, c: Means in the same column having different superscripts are significantly different ($p<0.05$)

Table 2 shows the effect of egg weight on fertility and hatchability parameters of the chickens studied. There was also a significant ($p<0.05$) effect of egg weight on the number of fertile eggs, fertile number of eggs hatched, fertile but not hatched eggs, eggs not fertile, deformed chickens and total number of eggs. Number of chicks dead in shell were not however significant. Shika brown had the highest number of fertile eggs and the least was observed in Sasso. Fertile numbers of eggs hatched were highest among medium weight (28.55). This was followed by the heavy weight eggs with a value of 13.66 and the least was observed among the light weight eggs (9.33). For fertile but not hatched eggs, the light weight eggs had the highest value of 4.88. This was closely followed by the heavy weight eggs with a value of 4.00. The least was seen in the medium weight eggs with a value of 2.77. However, there was no statistical difference ($p>0.05$) between the light and heavy size eggs. For eggs not fertile, the highest significant value was observed in heavy weight eggs (27.88). This was followed by the medium weight eggs having a value of 27.22 and the least was seen in the light weight eggs (13.55). Chicks dead in shell were not significantly affected by egg weight. However, the medium and heavy weight eggs had equal value of 1.11 as compared to the light size egg with a value of 1.00. For deformed chicks, the highest

significant number was seen in the light weight eggs with a value of 0.66. There were no deformed chicks in the medium and heavy weight eggs. For the total number of eggs hatched, the medium weight eggs had the highest value of 58.55. This was followed by the heavy weight eggs with a value of 41.55. The least was observed in the light weight eggs with a value of 22.88.

Table 2: Effect of egg weight on fertility and hatchability of eggs

Egg size	Number of fertile eggs	Number of fertile eggs hatched	Number of fertile eggs not hatched	Number of eggs not fertile	Number of chicks dead in shell	Number of deformed chicks	Total number of eggs
Light	9.33[c]	4.44[c]	4.88[a]	13.55[b]	1.00	0.66[a]	22.88[c]
Medium	31.33[a]	28.55[a]	2.77[b]	27.22[a]	1.11	0.00[b]	58.55[a]
Heavy	13.66[b]	9.66[b]	4.00[a]	27.88[a]	1.11	0.00[b]	41.55[b]
Least Square Mean	0.00	0.30	0.30	0.36	0.21	0.11	0.36

a, b, c: Means in the same column having different superscripts are significantly different (p<0.05)

DISCUSSION

The results of this study show that difference in breeds has a significant effect on different hatchability parameters. The findings of this study is thus in line with the fact that hatchability and fertility performance of eggs depends on genetic factors (Islam *et al.*, 2002). Fertility and hatchability are interrelated heritable traits and they vary among breeds, variants and individuals within breeds and variants. However, Ashart *et al.* (2003) reported that there was no significant difference (p>0.05) in the fertility between Lyallpur silver black and Rhode Island Red interaction but between the hatches, significant (p<0.05) differences were observed. From this study, higher hatchability results were achieved in medium egg weight. This shows that jumbo size eggs and light weight eggs should not be set in the hatchery. However, maximum fertility was observed in the light weight eggs. Similarly, Hassan *et al.*, (2005) reported that medium size eggs yield at least 75% hatchability compared to 50% and70% hatchability of small and large eggs respectively. However, in contrast Dewilt and Schwalbach (2004) observed that large eggs recorded higher percent hatchability in New Hampshire and Red Rhode Island chicken breeds. Another study also showed that large size eggs of indigenous Venda chickens had a higher hatchability than medium and small size eggs (Mbajiorgu, 2011). A negative correlation between egg size and hatchability in crossbred chicken was observed and heavier eggs resulted in low hatchability than medium size eggs (Farooq*et al*., 2001). Similarly, Wondmeneh *et al*. (2011) reported that medium size eggs of Potchefstroom keokeok chicks had the highest hatchability than large and small eggs size group. The results of this study is also supported by that of Durmus*et al.*, (2010) who reported that fertility, late embryonic mortality (dead in shell), and hatchability differs between genotypes.

CONCLUSION

In conclusion, genetic and non-genetic factors influenced hatchability and fertility in Sasso, Shika brown and Sasso x Shika brown cross. A significant effect of breeds and egg weight on fertility and hatchability parameters was observed. The use of Sasso and Shika brown as pure breeds as well as medium weight eggs should be encouraged for better percentage of fertility and hatchability. However, understanding these factors and how they affect chickens reproductive or productive traits will help to develop practices to regulate hen productive performance at a profitable level.

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Relationship among some Intrinsic Milk Related Traits in Extensively-Managed West African Dwarf Does

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Abstract: Scrutiny of milk production traits is a necessity towards identifying dairy potentiality of West African Dwarf does. Mammary gland morphometric characteristic of lactating extensively managed West African Dwarf (WAD) does (n = 330) was examined based on age, lactation length (LL) and kids' number. Udder traits (length-UL; width- UW and circumference - UC) and teat traits (Length –TL; diameter- TD and distance between teats -DBT) were examined. Data obtained were subjected to Pearson correlation. The result revealed a nonsignificant influence of kids' number on all the traits while a significant ($P<0.05$) but negative correlation coefficient (-0.198) was observed between UC and LL. A strong association was obtained among all the udder traits (UC, UL, UW) and between DBT and udder traits (UC: r = 0.544; UL: r = 0.667 ; UW: r = 0.588). This study concluded that age and lactation length of lactating WAD does had minimal influence on teat and udder characteristics but a selection priority for UL has greater tendency to accompany increase in other mammary gland parts.

Keywords: Lactation, Morphology, Relationship, Teat, Udder

Description of Problem

A conglomerate of factors is known to influence the quality and quantity of milk obtainable from livestock. Genetic make-up, for instance, has been reported among the factors that affect the milk yield and composition in various ruminant species (1; 2). Similarly, a positive correlation was indicated to exist between lactation yield and some of the udder morphometric characteristics of ruminant species (3; 4). Therefore**,** identification of potential dairy animals are usually based on actual yield test and some physical characteristics which are considered to be indicative of yield ability (5). Udder and teat physiological and conformational characteristics are vital to lactation, and are often considered in addition to other factors when dairy animals are selected. Shape and size of the udder and teat, for instance, have been shown to be related to milk yield of some species of ruminants (6). Ease of milking was also documented (7) to have strong association with the morphology of the mammary gland and its attachments. Therefore, morphometric characteristics of the physiological apparatus for milk production and ejection is one the most important considerable factors if WAD goats are to be selected for dairy purpose. There is however a dearth of information on these dairy production traits in WAD goats. Thus, the present study was aimed at examining the influence of doe age, lactation length and kids' number on udder and teat morphology of semi-intensively managed lactating West African Dwarf does. This would eventually assist in designing selection criteria for potential dairy candidates in WAD goats.

Materials and Methods

Experimental Sites: The study was conducted in the agrarian communities in Ilorin south and Ilorin East Local Government Areas, Kwara State Nigeria. This comprised of Aleniboro, Sentu, Ile-Apa, Oke-ose and Lajiki.

Experimental Animals: Three hundred and thirty extensively managed lactating West African Dwarf does within the age range of 1 – 10 years were used for the study. The goats were grouped into five age ranges (1 – 2yrs; 2 - 4yrs; 4 - 6yrs; 6 - 8yrs; 8 - 10yrs) using dentition (8) and production history obtained from the owners of the animals.

Data Collection: Flexible tape rule was used for measuring udder and teat morphometric parameters as described by (9). The parameters measured were: Udder width (UW) - distance between the widest part of the udder measured from the rear end; Udder length (UL) - length from rear to the front attachment of udder along with its sole, where the udder blends smoothly with the body; Udder circumference (UC) – this was measured at maximum diameter of udder; Teat length (TL) – distance from attachment of teat with udder to the end of

teats; Right and left Teat diameter (TD) – distance between the middle of teats and its side and; Distance between teats (DBT) - distance between sphincters of the right and left teats.

Data analysis: Relationship between the variable was analyzed using Pearson's correlation of SPSS Version 17.

RESULTS AND DISCUSSION

Pearson's correlation coefficients among the milk related specific factors (Age of the does, lactation length and litter size) and morphology of udder and teat in lactating WAD does are presented in Table 1. Age of the dam has no significant ($P > 0.05$) correlation with all the udder morphometric measurements (length, width and circumference) of the examined WAD does. There was a significantly ($P < 0.05$) positive relationship between the age of the does and the length of the teats on both left and right positions. The length of the left teat (LTL) had a highly significant ($P < 0.01$) correlation with the age of the does when compared to the right teat (RTL). A negative correlation coefficient (-0.198) was however observed between the lactation length (LL) and udder circumference (UC). The number of kids suckling the does had no relationship with all the udder and teat measurements. The udder width (UW) of the goats had highly significant and positive relationship with udder length (UL: 0.438), udder circumference (UC: 0.872) and distance between teats (DBL: 0.588). The RTL had a significant relationship with udder width. Udder length had a highly significant relationship ($P < 0.01$) with udder circumference and were also highly correlated ($P < 0.01$) with distance between teats (DBT). RTL and LTL were both significantly correlated with UL (RTL: 0.184; LTL: 0.187) while only RTL had a highly positive correlation coefficient (0.225) with UC. The relationship between RTL an LTL as well as RTD and LTD were observed to be positive and highly correlated, while LTL was negatively correlated with both RTD and LTD. A significantly negative correlation coefficient (- 0.185) was also observed between LTD and DBT.

Non-significant association observed between the age of the goats and udder measurements was also reported for Black and Meriz goats by (1), while the positive correlation coefficient between teat length and age of the goats contradicts their findings. This result suggests that as the animal ages the teat length increases. The negative relationship between the udder circumference and length of lactation is suggestive of gradual involution of mammary gland as lactation declines (10). Involution is likely induced when the kids suckling the mammary glands are becoming independent of dams' care. This result could also be associated with possible inhibition of galactopoietic hormones as a result physiological adjustment during pregnancy (11) which was inevitable among the animals used for the study because of their management system. A generally strong interrelationship among all the udder related measurements negates the findings of (4) who observed a different trend between the traits except for width and circumference of the udder.

Table 1: Correlation matrix among milk related specific factors and morphology of udder and teat

	AGE	LL	LS	UW	UL	UC	RTL	LTL	RTD	LTD
UW	-0.058; 0.507	-0.121; 0.166	0.088; 0.318	-				-		
UL	0.046; 0.602	0.010; 0.912	0.075; 0.390	0.438**; 0.000	-					
UC	0.133; 0.129	-0.198*; 0.023	-0.011; 0.900	0.872**; 0.000	0.364**; 0.000	-				
RTL	0.283*; 0.006	-0.009; 0.915	-0.048; 0.581	0.192*; 0.027	0.184*; 0.035	0.225**; 0.010	-			
LTL	0.283**; 0.001	0.004; 0.963	-0.026; 0.763	0.092; 0.295	0.187*; 0.031	0.148; 0.091	0.793**; 0.000	-		
RTD	-0.097; 0.271	-0.026; 0.768	-0.029; 0.740	-0.019; 0.829	0.014; 0.873	-0.026; 0.767	-0.113; 0.198	-0.215*; 0.013		
LTD	-0.091; 0.298	-0.066; 0.454	-0.040; 0.645	-0.076; 0.386	0.084; 0.338	-0.093; 0.287	-0.060; 0.492	-0.186*; 0.032	0.852**; 0.000	
DBT	-0.028; 0.001	0.102; 0.243	0.000; 0.996	0.588**; 0.000	0.667**; 0.000	0.544**; 0.000	0.103; 0.240	0.084; 0.337	-0.092; 0.293	-0.185*; 0.033

* indicates that correlation coefficient is significant at 0.05 level (2 tailed - 5%); ** indicates that correlation coefficient is highly significant at 0.001 level (2 tailed - 1%);

The strong association between the diameter as well as length of the right teat and their corresponding left teat measurements is an indication that the two teats are frequently being suckled and that the prevalence of weak teat which is a major defect in dairy (12) is not a popular attribute among WAD goats. None of the udder attachment (teats) is weak among the experimented goats. Differences in the level of aggressiveness of the offspring during suckling could result into differences in the size and shape of the teats. The negative association recorded between the diameter and the length of the teat suggests that the longer the teat the less the diameter. A relatively strong association between distance between the teats and each of the udder related measurements (UC, UD and UW) of the goats conforms to the findings of (4). The report by (13) also indicated a significant correlation coefficient between udder length and teat size in one of the breeds that were investigated which corroborates the current finding. This association depicts that the more superior the width, length or circumference of the udder the farther apart the teats or attachments.

Conclusion and Application

Few of the udder and teat characteristics of lactating WAD does are minimally influenced by the length of lactation and age of the does rather than number of suckling kids. It is concluded that selection for udder length would not only accompany increase in other udder traits but also a number of other teat characteristics that are required for efficient milking.

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Relationship between Liveweights, Linear Body Measurements And Cost Prices Of Goats Sold In And Around Mubi Environs, Adamawa State, Nigeria

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Abstract: This study was conducted to investigate the relationship between body length (BL), heights at withers (HW), girth circumference (GC), Height at rump (HR), abdominal circumference (AC) neck length (NL), neck circumference (NC) with live weights and cost prices of animals. Data obtained were subjected to Correlation and Regression Analysis using SAS package. It was found that length of animal (LA), girth circumference (GC) and neck circumference (NC) were highly and positively correlated ($P<0.01$) with weight while heights at rump (HR) and abdominal circumference (AC) were correlated with with weight of the animals ($P<0.05$). However, there was no significant ($P>0.05$) correlation between height at wither (HW) and neck length (NL) with weight. The R^2 value was 92.23%, all their F-ratios were highly significant at ($P<0.01$), confirming the significance of these variables on the prices of the animals. It could be concluded that the price of goat breeds is subject to the weight. The price of goats in an open market can best be predicted from a combination of leg length and loin girth. Body conditions and market demand mainly determined goat and sheep price estimation in the areas.

Keywords: Live weight, linear body measurements, Cost prices, Small ruminants.

INTRODUCTION

The marketing of small ruminants has not made headway because of the basic problem of unequal bargaining powers of various links in the marketing chain (Adamu, 2002). There is therefore a call for structural reorganization of the Marketing system (Lamidi *et al*., 2012). The reliability of single measurements such as wither heights, body length, heart girth, rump height and width in the estimation of weight at both traditional and institutional levels have become widely necessary (Adejoro *et al*., 2010). Others have used it as indicators of breed origin and relationship within species (Jewel, 2003). Body dimensions in different livestock species have been studied by many scientists. Therefore the assessments of the powers of body measurements in the estimation of weights and the accuracy of body weights in the estimation of size have been reported (Adejoro *et al*., 2010). The ability of the producers and buyers to relate the live animal measurements to live weights, growth characteristics, meat and milk production is essential for optimum production and value based trading system (Afolayan *et al*. 2006; Samuel and Salako, 2008; Adewumi and Adewole, 2012). According to Akpa *et al.* (2011), growth is the sum total of increase in size of different structural body components measured from gain in body weight and linear body measurements.

Body dimensions have been used in estimating body weight and appropriate pricing of meat animals (Eghahi *et al.*, 2011). The authors further stated that body measurements on most farms in the tropics help farmers who lack weighing scales and the education to understand how to manipulate them. It is used in estimating weight and market value in terms of cost of the animals.

The research was therefore carried out to determine linear body measurements of goats sold in Mubi and its environs, determine live weights of goats sold in the study area and their prices and to determine the relationships between linear body measurements, live weights and prices of the animals.

MATERIALS AND METHODS

Experimental site: The research was carried out in ruminants markets in and around Mubi, Adamawa State, Nigeria. The experinmental site is as described by Saidu and Gadiga, 2004 and Adebayo, 2004

Parameters Determined: Body parameters measured were body length (BL), heights at withers (HW), girth circumference (GC), Height at rump (HR), abdominal circumference (AC) neck length (NL), neck circumference (NC) with live weights and cost prices of animals.

Live weight of each animal was determined by suspending the animal on a spring balance and weight of each animal taken and recorded.

Price of each animal was determined by watching the buyers and sellers bargain until reaching at the final price of the animal.

In determining body measurements, body length (BL) was measured using tape rule as the distance from the occipital protuberance to the base of the tail.

Height at wither was obtained by using platform upon which each animal was placed. It was measured as the distance from the surface of the platform to the withers using a meter rule.

Girth circumference was determined by taking the measurement of the circumference of the chest with a tape.

Height at rump was measured as the distance from the surface of the platform to the rump using a measuring rule.

Neck length was the distance from the lower jaw to the point of the shoulder using tape rule.

Neck circumference was gotten by measuring the distance round the neck below the lower jaw using the tape rule.

Data analysis: Data obtained were subjected to Correlation and Regression Analysis using SAS (2001) package.

RESULTS AND DISCUSSION

The correlation relationships between the linear body measurements and live weight of goats are presented in Table 1. It was found that length of animal (LA), girth circumference (GC) and neck circumference (NC) had highly positive significant correlation with weight ($P<0.01$) while heights at rump (HR) and abdominal circumference (AC) had significant correlation with weight ($P<0.01$) of the animals. However, there was no significant correlation between height at wither (HW) and neck length (NL) with weight ($P>0.05$).

The regression analysis of linear body measurements for goats is presented in Table 2. The R^2 value was 92.23% while the F-ratio, 10.74 was highly significant ($P<0.001$). Variables like heights at withers (HW), neck length (NL) and neck circumference (NC) were also highly significant ($P<0.001$). This confirms the relationship of the variables on live weights and prices of the animals.

The regression results between linear body measurements and prices of animals showed a very highly (<0.001) significant relationships between all linear body measurements and prices of goats. All their F-ratios are highly significant at ($P<0.01$), confirming the significance of these variables on the prices of the animals.

Alemayehu and Tikabo (2010) found a very high correlation relationship between girth circumference (GC), animal length (AL) and height at withers (HW) with live weight of animal. They found R^2 of 63% for goats. They concluded that the higher correlation coefficient of body weight with a given body dimension demonstrate that on the basis of the dimensions of various measurements, the body weight could be predicted more accurately. That girth circumference is the best used for live weight estimation at farm conditions especially under smallholder farmers.

It is reported by Ramesh *et al*. (2011) that estimation of price in small ruminants while marketing is mainly based on the body condition and market demand. That body condition is judged by healthiness of animals, body configuration and average weight according to size and height.

Therefore, important criteria were related to physical appearance consisting of body size, apparent health and body conformation. Agajiye (2010) stated that in marketing of small ruminants, smallholders use visual observations and other proxy methods for estimation of weights and prices. By visual observation, they consider body condition and healthiness. Others are age of animals and temperament. Therefore smallholders are encouraged to improve body condition of their animals in order to attract higher premium prices for their animals.

The price of sheep and goat breeds is subjected to the weight. The price of sheep and goats in an open market can best be predicted from a combination of leg length and loin girth. Body conditions and market demand mainly determined goat and sheep price estimation in the areas.

Table 1: Correlation Relationships between Live Weights and Body Measurements of goats

HW	GC	L. Animal	HR	AC	NL	NC	LVW
HW							
GC	0.074***						
L. An	0.188**	0.04ns					
HR	0.372**	0.023ns	0.562**				
AC	0.221**	0.164**	0.703**	0.411**			
NL	-0.032ns	0.126**	0.228**	0.140**	0.193**		
NC	0.127**	0.040ns	0.745**	0.436**	0.713**	0.172**	
LVW	0.247**	0.012ns	0.401**	0.278**	0.364**	0.228**	0.442**

** Significant at 5% ns=Not significant

HW=Height at withers, GC=Girth circumference, LA=Length of animal, HR=Height at rump, AC=Abdominal circumference, NL=Neck length and NC=Neck circumference and LVW=Live weight.

Table 2: Regression Result for Goats

Parameters	Coefficient	Standard Error	t-value	Significance
Constant	-6582.83	8020.20	-0.821	***
HW	-83.59	361.04	0.232	***
GC	-194.50	199.58	-975	***
HR	616.92	693.55	890	***
NL	626.65	392.32	-1.597	***
NC	599.15	430.28	1.392	***
AC	-635.95	323.35	-1.967	***
Fore leg length	249.08	1347.76	0.185	***
Hind leg length	-775.71	1076.50	-0.721	***
AL	859.10	647.27	1.327	***
WT. ANIM	453.35	168.39	2.692	***
R^2	92.23			
F	10.74***			

Dependent variable: Price

CONCLUSION AND RECOMMENDATIONS

From the findings of this research, it could be concluded that the prices of goat breeds are subject to the weights. The prices of goats in an open market can best be predicted from a combination of leg length and loin girth. Body conditions and market demand mainly determined goat price estimations in the areas. It is recommended that in the absence of weighing scales, rules could be used to estimate weights through body measurements for better pricing of small ruminants.

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Genetic Progress of the Production Traits in the Nigerian Heavy Local Chicken Ecotype Obtained by Selection Index in the Derived Savannah Zone of Nigeria

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Abstract: A multiple selection programme was designed and carried out to determine the genetic response of productive traits of the Nigerian heavy local chicken ecotype (NHLCE) using selection index from fourth to sixth generations. A random breeding population consisting of 270 NHLCE pullets (23 weeks old, point of lay) that had been subjected to three generations (G_1, G_2 and G_3) of index selection was used for the study. The parameters measured included Body Weight at First Egg (BWFE), Average Egg Weight (AEW), and Total Egg Number (TEN). The hens were housed individually in cages after brooding, rearing and fed layers' ration G_4 and G_5: 110g/hen/day; G6: 125g/hen/day. A control population was established to monitor for environmental (rE) effects and estimate genetic responses. Selection differential was negative on the average for BWFE due to the negative value of its economic weight, while selection intensity for TEN, AEW and BWFE recorded were 2.12, 1.42 and 2.38 respectively. Direct selection responses namely expected, predicted and realized genetic gains were all positive for all the traits selected. Expected average genetic gain per generation for BWFE, TEN and AEW were 66.2g, 4.19 and 1.01g respectively. For gain in index traits due to selection on index score, a mean value of 1.96 eggs was recorded for TEN, 0.14g for AEW and 11.65g for BWFE. The ratio for realized to expected genetic gains were all positive across the three generations with values of 0.96 for BWFE, 1.42g for AEW and 1.62 for TEN.

Keywords: Genetic gain, production traits, heavy ecotype chicken, selection index and derived savannah.

INTRODUCTION

The local chickens of Nigeria for convenience can be classified into light and heavy ecotype on the basis of body weight and size. The light ecotype represents the chicken type from the swamp; rainforest and derived savannah agro-ecological zones, whose mature body weight ranges from 0.68 – 1.5kg and the heavy ecotype are those of the guinea savannah, sahel savannah and some montane regions, whose mature body weight ranges from 0.9 – 2.5kg. These ecotypes have lived and produced for several years in the Nigerian environment under natural selection. Thus, it is expected that they are adapted to their environment and may carry some genes favorable to the poultry industry in the future [1].

The local chickens play major roles through their contributions to food security, household income, employment and quick funds in emergencies [2], [3], [4]. Hence the desire for the development of Nigerian breed of egg chicken, integration and commercialization into the production systems through selection for productive traits.

MATERIALS AND METHODS

Study location: The study was conducted at the Department of Animal Science Teaching and Research Farm, University of Nigeria Nsukka. Nsukka lies in the derived Savannah region, and is located on longitudes 7^0 24^1E and latitudes 5^0 22^1N [5] with annual rainfall range of 986 – 2098mm. The climate is of humid tropical setting with relative humidity range of 56.01 – 100%. The average diurnal minimum temperature ranges between 20.99 – 37^OC [6], [7]. Nsukka is characterized by two seasons of the year. The rainy season extends from April – October while the dry season spans from November – April with no sharp demarcation.

Management of Experimental Animals: Artificial insemination technique was used to generate the foundation stock. Six (6) heavy local chicken ecotype cocks and sixty (60) hens were randomly selected from the reference population and housed in a battery cage system in the Teaching and Research farm of the Department of Animal Science, University of Nigeria Nsukka, in a mating ratio of one cock to ten hens (1:10). The cocks (sires) and hens (dams) were identified with sire and dam numbers using tags: sire identification was 1,2,3,4,5 and 6, while dams were in groups of ten as group A, B, C, D, E and F. semen was collected according to the massage technique [8] from each of the cocks and diluted or extended using sodium citrate dehydrate. The dams were artificial inseminated according to dam group to produce generation four (G_4). Fertile eggs were collected and hatched to produce the day old chicks. The management system adopted was as described by [9] from day-old (o – 8weeks), (9 – 22weeks) and (23 – 39weeks) of age. Formulated rations were fed according to each growth phases. The layer's ration contained 16.5% crude protein and 2,600 Kcal ME/kg at the rate of 110g/hen/day in

G_4 and G_5 generations. The layer's ration was fed 125g/hen/day in G_6 due to improvement in body weight. Water was given *ad libutum*, while routine vaccinations were administered at each growth phase.

Data Collection and Measurement: A simplified linear selection index according to [10] in the relative economic weights and heritability of the traits was constructed and used as weighing factors for phenotypic values. All hens belonging to the G_4 generation were subjected to selection using a selection index incorporating, BWFE, AEW and TEN. The phenotypic performance of each hen in these traits was represented in the index as X_1, X_2, and X_3 for BFWE, AEW, TEN respectively. The index score (1) for each hen became a univarite character (trait) subjectable to selection. The index score (1) thus enabled the ranking of the hens for the purpose of selection and a hen which attained the index score or above the score was select for the next generation.

The general form of the index is given as

$$I = \sum bix_i = \sum aih_1^2 X_1^1 + a_2h_2^2X_1^1 \pm - - - - aihiX_i^1$$

Where $bi = aih_i^2$

$ai =$ the relative economic weight of the trait in the index

$h_i^2 =$ heritability estimate of the trait in the index

Xi = standardized phenotypic value of the ith trait in the index BWFE, AEW & TEN

$I =$ Index

The standardized variable xi was obtained according to [11]

$asxi = \frac{xi - \bar{x}i}{\sigma xi}$ (Stanfield, 1969).

Where $xi =$ Record of the performance of an individual in the trait of the index

$\bar{x}i =$ mean of the performance of the whole population in the ith trait of the index

$\sigma xi =$ population phenotyphic standard deviation for the ith trait

RESULTS AND DISCUSSION

Table 1 shows the comparison of BWFE, AEW, TEN in G_4, G_5 and G_6 using selection index. The results indicated superiority of the selected populations over the whole and control populations in TEN and AEW while in BWFE trait maintained different trends across the three generations. The G_6 selected and whole populations had the highest values for BWFE for all generations. The table shows significant difference ($P \leq 0.05$) between generations in TEN, AEW and BWFE for selected and whole populations specifically selected G_5 and G_6 AEW were significantly superior ($P \leq 0.05$) to selected G_4 and G_5 whole populations while G_4 and G_6 control populations in AEW were similar but significantly inferior (($P \leq 0.05$) to selected G_4 and G_6 whole populations.

The results indicated significant differences ($p \leq 0.05$) from the base population (G_3) to the selected populations G_4, G_5 and G_6 for all the traits measured. The body weight (g) at first egg for all generations increased from G_4: (1331.16 ± 8.45), G_5: (1355.01 ± 10.22) and G_6: (1441.99 ± 10.12). The total egg number of G_4, G_5 and G_6 values were (89.86 ± 0.36), $(93.86 \pm 0.36)$and (94.97 ± 0.51) respectively. This study showed improvement from the values of (82.92 ± 0.146), $(89.73 \pm 0.089)$and (88.91 ± 0.112) reported by [12], for G_1, G_2, and G_3 populations who also worked with the same Nigerian heavy local chicken ecotype after three generations of index selection. Also similar improvements were recorded in average egg weight. While the present study had 43.52 ± 0.08g, 44.50.15g and 45.06 ± 0.12g respectively, [12] reported 41.94 ± 0.07g, 43.84 ± 0.08g and 43.19 ± 1.20g, respectively, for G_1, G_2, and G_3 generations.

Table 1: Comparison of BWFE (g), AEW (g) and TEN in G4, G5 and G6 generation using selection index

Traits	Gen.	Selected	(Gj – Gi)	Whole	(Gj – Gi)	Control	(Gj – Gi)
	G_4	1331.16 ± 8.45[a]		1344.03 ± 8.09[b]		1264.90 ± 10.41	
			(23.85)		(31.08)		(42.98)
BWFE	G_5	1355 ± 10.22[a]		1366.95 ± 8.70[ab]		1264 ± 10.41[c]	
			(86.98)		100.70)		(42.98)
	G_6	1441.99 ± 10.12[ab]		1452.65± 10.24[a]		1371 ± 10.42[b]	
	G_4	43.52 ± 0.08[a]		42.93 ± 0.25[b]		42.51 ± 0.16	
			(1.03)		(3.27)		(0.96)
AEW	G_5	44.55 ± 0.15[a]		44.37 ± 0.13[a]		43.47 ± 0.23[b]	

			(1.12)		(-1.16)		(0.09)
	G_6	45.06 ± 0.12[a]		43.47 ± 0.23[a]		43.56 ± 0.28[b]	
	G^4	89.98 ± 0.81[a]		84.22 ± 0.35[b]		80.20 ± 0.56[b]	
			(3.88)		(0.95)		(4.18)
TEN	G^5	93.86 ± 0.36[a]		85.87 ± 1.44[b]		84.38 ± 0.91[b]	
			(1.12)		(1.65)		(2.39)
	G^6	94.98 ± 0.51[a]		85.38 ± 1.25[b]		86.77 ± 0.81[b]	

a,b: means within the same row with different superscripts are significantly different ($P \leq 0.05$), BWFE = Body Weight at First Egg, AEW = Average Egg Weight, TEN = Total Egg Number, Gj = Observation for jth generation, Gi = Observation for the ith generation, (Gj-Gi) = Difference increase (+) or decrease (-) between jth and ith generations (i = 4,5 and j = 5,6)

Table 2 presents the generational progress in index selected traits for G_4, G_5 and G_6 populations. The selection differentials (ΔS) for TEN trait increased in a positive direction leading to progressive increases in cumulative selection differentials, while for AEW it presented decreasing trends though positive across the generations. The positive selection differentials (ΔS) obtained for TEN and AEW across the three generations followed from the superiority of the selected populations over the whole populations in mean values for these traits. The phenotypic standard deviations were also positive and maintained increasing trends in TEN and AEW throughout the generations among individuals in each generation. The selection intensity factor per generation for TEN were highest than for AEW and least for BWFE with negative values. This showed that the multiple trait selection index used for this study applied greater pressure on egg number, than on egg weight and least on BWFE. The low selection intensity (negative) values for BWFE of G_4, G_5 and G_6 generations may have been responsible for the very low and negative values obtained in selection differential values recorded in G_4, G_5 and G_6 BWFE across the generations for this trait.

Table 2: Selection differential(ΔS), Cumulative selection differential($CUM\Delta S$), Phenotypic Standard Deviation ($\sigma\rho$) and selection intensity (i) for index selected traits across G4, G5 and G6 generations

Trait	Gen.	ΔS(g)	$CUM\Delta S$(g)	$\sigma\rho$	I
	G_4	-12.87	-12.87	21.41	-0.601
BWFE	G_5	-11.94	-24.81	23.02	-0.519
	G_6	-10.66	-29.97	27.10	-0.393
Average/Gen		-11.82	-22.55	23.84	-0.504
	G_4	0.59	0.59	0.65	0.908
AEW	G_5	0.18	0.77	0.35	0.514
	G_6	0.37	1.14	1.40	0.562
Average/Gen		0.38	0.83	0.60	0.661
	G_4	4.19	4.19	1.98	2.12
TEN	G_5	6.09	10.28	4.32	1.42
	G_6	9.11	19.39	3.82	2.38
Average/Gen		6.46	11.29	3.37	1.97

BWFE = Body Weight at First Egg, AEW = Average Egg Weight, TEN = Total Egg Number, G_4,G_5,G_6 = Generation four, five and six, ΔS = Selection differential, $CUM\Delta S$ = Cumulative selection differential, $\sigma\rho$ = Phenotypic Standard deviation, i = Selection intensity

CONCLUSION

The increase in BWFE from G4 to G6 (1331.16±8.45 to 1441.95±10.12), AEW I43.52±0.08 to 45.06±0.12) and TEN (89.98± 0.08 to 94.98 ± 0.51) indicated that there was genetic improvement in the performance of the hens. And selection index is a strong tool for genetic improvement of productive traits.

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Polymorphism of Ovalyxin-32 Gene in three Nigerian Chicken Strains

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Abstract: Ovocalyxin-32 (OCX-32) is a matrix protein found within the outer layers of the eggshell and in the cuticle. Numerous reports in the literature have identified association between variants in the gene encoding this protein OCX-32 and various eggshell quality traits. Thus, OCX-32 is a candidate gene for selection for eggshell traits in commercial poultry populations. Sequencing of exon 1 and 2 of the OCX-32 gene in three strains (naked neck, NN, frizzled feathered, FF and normal feathered, NF) of Nigerian chickens revealed 2 SNPs. One novel and known SNPs were found in the normal feathered strain while one of the SNPs was reported earlier to be in complete linkage equilibrium in both exons 2. A total of 3 variant haplotypes of OCX-32 were inferred in the study. One out of the three strains had three haplotypes. Allele (T) was not found in NN and FF strains. A total of 21 variants of proteins were detected among three chicken strains in Nigeria. The study reveals low heterozygosity within two Nigerian chicken strains and the presence of Hardy- Weinberg equilibrium. High heterozygosity within the normal feathered and commercial broiler chicken indicates selection pressure for certain variants during the breeding program. Natural selection or long term and high pressure selection favoured some allelic frequency that resulted in enormous differences between the Nigerian chicken strains.

Keywords: OCX 32, SNPs, Heterozygosity, Nigerian, Chicken Strains

DESCRIPTION OF PROBLEM

The Nigerian local chicken exhibits diversity in morphological characteristics. They show heterogeneity in phenotypic characteristics[1]. Major genes of frizzling and naked neck are important as they enhance the thermoregulatory activities of the birds. Several factors which may be genetic or environmental influence egg quality in chicken[2].

Out of the 24-25h required for egg formation, it takes 20h to develop the eggshell, a complex biomineral structure that encloses the internal contents, serves as a barrier against penetration of microbial agents, physically protects the developing embryo, mineral reserve for the avian embryo, and allows for water and gas exchange between the external environment and the embryo[3]. Not only does the shell provide a protective shelter for the avian embryo, it also serves to retain egg contents from the point of lay through processing and transport to the domestic or other food establishments. Ovocalyxin-32 (OCX-32), a 32-kDa protein is present at high levels in the uterine fluid during the terminal phase of eggshell formation and is localized predominantly in the outer eggshell[4]. The timing of OCX-32 secretion into the chicken uterine fluid suggests that it may play a role in the process of mineral deposition and in the completion of the eggshell[5]. SNPs in the intron region of the OCX-32 gene were associated with the thickness of the mammillary layer[6]. Low egg production strains of Taiwanese country chickens expressed more transcripts of the OCX-32 compared with high strains at egg-laying stages and suggested that the OCX-32 gene is a potential molecular marker associated with the different rates of egg production[7]. These results indicate that the OCX-32 gene might have a direct effect on egg production traits. The current study was undertaken to investigate the polymorphism of OCX-32 gene among three strains of Nigerian chickens (frizzle, naked and normal neck).

MATERIALS AND METHODS

Collection of blood samples and DNA extraction: Blood samples were collected from the wing vein of a total of 201 Nigerian chickens (40 local and 81 commercial Normal feathered (NF), 40 Naked neck (NN) and 40 Frizzle Feathered (FF) obtained from different parts of the country) using vacutainer tubes containing ethylene diamine tetra acetic acid (EDTA). The blood samples were stored at -20°C until DNA extraction. Total genomic DNA was extracted using Quick-gDNA Mini Prep kit following standard protocol[8].

Primers and PCR amplification: Two pairs of primers were used for selective amplification of cOCX-32 gene based on the chicken *OCX-32* mRNA information and genome sequences on chromosome 9 in GenBank

(accession no. NM_204534 and AADN02021077, respectively). The primers were synthesized by Integrated DNA Technology (USA). The primer sequences were:
F'- 5'GGCAGGACCCGAGCGAGGAGTT-3'; R'-5'GGCTAAGGCGTGAGGACCGAAACC-3'
F'-5'GCCCACTGGTCAGAAAAGAA-3'; R'-5'CCTGCAGAGGAAAAGAGCTG-3'
Selective amplification of different regions of OCX-32 gene was performed using thermocycler GeneAmp PCR System 9700 (Applied Biosystems, Foster City, CA, USA) and PCR reagents synthesized by Norgen Biotek corporation Canada. PCRs were performed in a programmable thermocycler with the following protocol: 94°C for 5 min; followed by 30 cycles of 94°C for 30 s, 55°C for 30 s and 72°C for 1 min; with a final extension step of 72°C for 10 min. Amplification of the different segments of cOCX-32 gene was confirmed by running the PCR products on 1% agarose gel and visualizing under UV rays. Thirty microliters of each PCR product purified and sequenced using the Big Dye Terminator v3.1 Cycle Sequencing kit by standard methods[9].

Sequence analysis: Chromatographs generated from sequencing were processed using Cluster W and sequence trimming was carried out on BioEdit. Both forward and reverse primer sequences were then aligned using the ClustalW multiple sequence alignment program (http://www.ebi.ac.uk/clusatlw/) to determine the presence of genetic polymorphisms. Sequences were blasted against database on NCBI and reference sequences acquired (NC_006096.5 and NP_989865.1).

Statistical analysis: Different nucleotide combinations at the polymorphic sites for all the individuals sequenced were used to determine the different sequence variants or haplotypes and alleles at OCX-32 locus. Allele and genotypic frequencies observed, number of effective alleles haplotype diversity was determined on Genalex 6.5 software[10]. The phylogeny was constructed in MEGA X using Nei's genetic distance[11].

RESULTS AND DISCUSSION

SNP DETECTION

After the blast and cluster W multiple sequence alignment 2 SNPs sites (-162T and T229G) were found as shown in table 1, one within the exon and the other within the intron. The SNPs were numbered according to how they were ordered in the gene sequence. The position of each variant is based on the May 2006 chicken genome build (WUGSC 2.1 /galGal 3) at UCSC (http://genome.ucsc.ed).

Table 1: SNPs at OCX 32 of cDNA

Position	Location	ID	N.N.change	Codon and AA change
22596162	Intron 1	-162T	- > T	None
22596229	Exon 2	T229G	T > G	CTT>CGT:p.leu83Arg

The similarity scores of all sequences with RJ are up to 100%. The distributions of the polymorphic sites identified by sequencing of OCX 32 gene of three strains vary slightly. Polymorphic sites may still be discovered across commercial lines and local strains. T229G has been reported as one of the six variants found in exon 2 that always appeared together. SNPs that appeared together were found to be in linkage disequilibrium (LD). They are also good genetic markers that make the process of identification of haplotypes easy within an exon or entire gene[8,9].

Haplotype frequency of OCX 32 gene in 3 chicken strains

Table 2: Haplotype frequency of OCX 32 gene in 3 chicken strains

Haplotype	Haplotype code	NN	FF	NF
TT	1	0.00	0.00	0.091
-G	2	0.00	0.00	0.091
-T	3	1.00	1.00	0.818

The Genealex 6.5 revealed 3 haplotype (TT, -G and -T) at the OCX 32 cDNA of the Nigerian chicken strains. Two of the variants (TT and -G) were not found in NN and FF strains. Only one variant (-T) was ubiquitous in all the three strains. All the three OCX 32 haplotypes were found within the NF strains. The distributions of allele frequencies of OCX 32 gene at sites 162 and 229 in 3 strains are similar.
The haplotype frequencies of the 2 variants (TT and -G) at site 162 and 229 in NN and FF strains were very low (0.00) and high (0.091) in NF strains. The haplotype frequencies of the common variants (-T) were 1.00, 1.00

and 0.82 within the three strains. The haplotype frequencies of the variants observed in this study is within the range reported earlier at exon 2 of the OCX 32 gene in white leghorn chicken[12]. The NF strain used for the present study enormously manifest the characteristics of the commercial lines. This may be due in part to the history of the genetic improvement of the commercial chicken, which showed that the White Plymouth rock and Rhode Island Red breed used originally for developing the commercial lines were normal feathered breeds.

Whole Gene Protein

A total of 21 variants of proteins were detected among three chicken strains in Nigeria. The coding sequence (CDS) for proteins in the sequenced region of the three strains was present between 22596215 and 22596277.

DISCUSSION AND APPLICATION

In the present study the SNPs of chicken OCX 32 were scanned with DNA samples from three Nigerian chicken strains with many differences in size, feather color, shank color etc. The intensive sequencing, identification and genotyping of many individuals within strains showed relatively few haplotypes. One of the SNPs was reported to be in high LD with six other variants. The haplotype analysis of OCX 32 observed in this study show that multiple haplotypes are common for normal feathered chickens. The presence of multiple SNPs that are in high LD with six other variants indicates that genome selection may bring about considerable genetic improvement in the meat production and egg production traits of the Nigerian chicken strains. In view of the fact that the naked neck and frizzled strains are local chickens with slow growth, while the normal feathered comprises some commercial chickens, it was concluded that two Nigerian chicken strains followed the Hardy Weinberg equilibrium. This indicates that these two strains (NN and NF) had undergone little selection and random mating. Natural selection or long term and high pressure selection favoured some allelic frequency that resulted in enormous differences between the Nigerian chicken strains

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Comparison of White and Black Funaab Alpha Chickens Using Body Weight and Selected Body Morphometric Traits

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Abstract: This study was carried out to investigate the body morphometric traits in two plumage coloured improved Nigerian native Chickens (FUNAAB Alpha). Sixty hens comprising thirty with white plumage colour and thirty with black plumage colour of 17weeks of age were used. The experiment which lasted for 22 weeks, considered such morphometric traits as: Body Weight (BW), Body Length (BL), Chest Girth (CG), Shank Length (SL), Shank Circumference, Comb Height (CH) and Comb Length (CL). The study was conducted based on strain effect, age (weeks 20, 24, 28, 32, 36, and 40) effect and the interaction of both strain and age effect. Data obtained were subjected to statistical analysis using IBM SPSS (Version 20, 2016). The result indicates that significant difference ($P<0.05$) existed between the Whiter and Black FUNAAB Alpha hens in all the traits studied. There were significant variations in all traits studied except in comb height. White FUNAAB Alpha was 12.46% heavier than the Black FUNAAB Alpha. Furthermore, a difference of 2.11cm, 2.84cm, 0.60cm, 0.24cm, and 0.46cm existed between the White and Black FUNAAB Alpha in CG, BL, SL, SC and CL respectively. The result of age effect on body morphometric revealed that there were significant ($P>0.05$) differences at the various ages for all measured parameters. The body weight at week 40 differed by 1.45% from week 36. FUNAAB Alpha chickens are recommended for commercial production as they attained good body weight at early age when compared to other native chickens. However, within both strains the white FUNAAB Alpha did better than the black FUNAAB Alpha in virtually all the studied traits.

Keywords: Native chickens, plumage colour, body weight, FUNAAB Alpha, traits.

INTRODUCTION

The poultry industry seems to be the largest when it comes to livestock species and as such produces not less than thirty percent of animal protein (1; 2).Native chicken which compose about 96% of the entire number of poultry reserved in tropical Africa represents a huge group of untapped genetic resource and are kept for meat and egg production, their vital role in socio-economic and cultural values (3; 4; 5; 6) This class of chickens mostly exists within the poultry population, and is extensively found under scavenging systems in most rural regions particularly areas with low standard of living (7;8).Native chickens are generally hardy and cope well during epidemics and in various harsh environmental conditions (9). Most individuals prefer products from the nativechicken as a result of their taste, colouration, and leanness (10). Their egg and meat are available in rural small holder and as such are good sources of protein and income (11). Streamlined poultry breeding in Nigeria started at the National Animal Production Research Institute, Zaria in 1985 (12), although there had been broad information on the native chicken from research that begun earlier. The native chickens vary in size and growth rate (13), and possesses the potential to produce meat and egg; thus, can be well classified as dual purpose chickens (14). The Nigerian native chicken can be characterized phenotypically using their body structure (dwarf types and naked neck), plumage colour (black, barred, white, laced, mottled etc) and feathering pattern (normal, naked neck, frizzle). 15 classified the Nigerian native chicken using body weight and size as heavy and light ecotypes. Generally, the Nigerian native chicken can be classified as a light dual purpose breed with single comb, possessing varied plumage colours (14; 16).

MATERIALS AND METHODS

Experimental Location and Study Period: This experiment was conducted at the Poultry Unit of the Teaching and Research farm of Rivers State University, Nkpolu Oroworukwo, Port Harcourt, Rivers State. Port Harcourt lies between longitude 6^0 59' 54" E and latitude 4^0 47' 21" N with average monthly temperature and relative humidity of 22.54 – 31.03^{0}C and 69.08 – 112.47% respectively. The average rainfall in Port Harcourt is 200.45m (17). The study lasted for a period of 22 weeks, between December 2016 to June, 2017.

Experimental Birds: The experimental birds used for this study were FUNAAB Alpha Strain. The FUNAAB Alpha birds are genetically improved Nigerian native chickens developed at Federal University of Agriculture Abeokuta (FUNAAB) Ogun State by a PEARL Project. These birds were developed after generations of intensive selection within normal feather Nigerian native chickens and later crossbreeding with indigenous chickens of India (18). For this study, sixty FUNAAB Alpha improved Nigerian native chickens comprising thirty (30) black and thirty (30) white plumage hens between 17 and 18 weeks of age were sourced from the Poultry Unit of the Federal University of Agriculture (FUNAAB) Abeokuta, Ogun State. These were introduced into the Poultry Unit of the Teaching and Research Farm of Rivers State University, Port Harcourt Rivers State in December, 2016. The experimental birds were randomly allocated into 6 replicate deep litter pens/strain. The floor was littered with wood shavings. They were allowed to acclimatize to the new environment for two weeks before they were assigned into individual cages in a three tier battery cage at 19 weeks of age. This was to ensure accurate collection of data on individual basis.

Data Collection: This study was designed such that data was obtained on growth traits

Body weight and Morphometric Traits: Some body morphometric traits were measured and obtained from the birds at intervals of 4 weeks (from 20 weeks of age to 40 weeks of age). The variables among others measured include;

(a) Body weight: The body weight of each bird was taken with the use of an electronic weighing scale in grams.
(b) Chest Girth: This was measured as the width between two shoulder joints around the chest.
(c) Body length: This was measured as the length between the lower ends of the rostrum maxillae (beak) to the caudal tail (coccygeal bone) without feathers from body surface.
(d) Shank Length: It was measured as the length of the tars-metatarsus from the hock to the metatarsal pad.
(e) Shank circumference: This was measure as the circumference taken from the middle of the shank.

The body measurements were done using the description of (19; 20).

RESULTS AND DISCUSSION

Accurate estimates of genetic parameters are a pre-requisite for the establishment of a sustainable genetic improvement program. This is an encouraging factor for more intense selection within the Nigeria local chicken population, over several generations, before being crossbred with improved stocks in other to create new breed(s). The result which indicates the white FUNAAB Alpha having superiority over the black in body weight reveals that plumage colour is a vital feature of most living organisms. In the past, (21) testified that plumage influences growth rate in birds and as such chickens with different plumage belonging to the same breed can vary for body weight and growth performance.

Table 1 depicts the bodyweight and morphometric (mean ± S.E) of white and black FUNAAB Alpha (improved Nigerian native chicken). There were significant variations in all traits studied ($P<0.05$) except in comb height. White FUNAAB Alpha was 12.46% heavier than the Black FUNAAB Alpha. Furthermore, a difference of 2.11cm, 2.84cm, 0.60cm, 0.24cm, and 0.46cm existed between the White FUNAAB Alpha and Black FUNAAB Alpha in CG, BL, SL, SC and CL respectively. The result of this research using FUNAAB Alpha chickens indicates that it is a repository of advantageous genes. These useful genetic attributes can be harnessed in crossbreeding programs for the development of egg-type and meat-type chickens (22).

Table 1: Effect of strain on body morphometrics of FUNAAB Alpha chickens

Trait	Strain			
	White	Black	*P-value*	SEM
BW(g)	1896.46[a]	1660.07[b]	0.000	35.171
CG(cm)	38.32[a]	36.21[b]	0.000	0.352
BL(cm)	44.74[a]	41.90[b]	0.000	0.291
SL(cm)	9.50[a]	8.90[b]	0.000	0.083
SC(cm)	4.95[a]	4.71[b]	0.000	0.049
CL (cm)	7.87[a]	7.41[b]	0.004	0.156
CH(cm)	4.55	4.41	0.169	0.105

[ab]means on the same row with different superscript are significant different (P<0.05)

BW = Body Weight; CG = Chest Girth; BL = Body Length; SL = Shank circumference; SC = Shank Length; CL = Comb Height; CH = Comb Height.

The result of age effect on body morphometric as shown in Table2 revealed that there were significant (P>0.05) differences across the various ages for all the parameters measured. The body weight at week 40 differed by 1.45% from week 36. Furthermore, variations such as 0.71%, 3.74%, 5.62%, and 12.89% were noticed between weeks 32 and 36, 28 and 32, 24 and 28 and 20 and 24 respectively. Although, the disparity between weeks 32 and 36 was very slight (0.71%), meanwhile the gap between that of weeks 20 and 40 was very high (22.56%). This indicates that age is a major factor in achieving higher body weight. In terms of chest girth, significant (P<0.05) variations of 1.52cm, 1.18cm, 0.89cm, 0.04cm and 0.38cm existed between weeks 24 and 20, 28 and 24, 32 and 28, 36 and 32 and 40 and 36 respectively. Likewise, differences of 1.30cm, 1.00cm, 0.94cm, 3.00cm and 1.96cm occurred between weeks 20 and 40 for all other parameters (BL, SL, SC, CL and CH) measured respectively. There was a close relationship between weeks 32 and 36 with the later having higher values in all the selected traits. This means that body morphometric traits are positively affected as the age increases.

Table 2: Body weight and body morphometrics of the FUNAAB Alpha chickens as influenced by age

Age (Weeks)	BW(g)	CG(cm)	BL(cm)	SL(cm)	SC(cm)	CL(cm)	CH(cm)
20	1484.39±39.59[d]	34.69±0.39[d]	42.83±0.32[c]	8.76±0.09[d]	4.41±0.05[d]	6.00±0.17[d]	3.28±0.11[d]
24	1703.03±40.56[c]	36.21±0.40[c]	43.37±0.33[ab]	8.97±0.09[cd]	4.34±0.05[cd]	6.77±0.18[c]	3.86±0.12[c]
28	1804.40±42.92[b]	37.39±0.43[b]	42.49±0.35[d]	8.75±0.10[cd]	4.51±0.06[c]	7.82±0.19[b]	4.45±0.12[b]
32	1874.50±42.92[ab]	38.28±0.43[ab]	43.17±0.35[b]	9.35±0.10[c]	5.09±0.06[bc]	8.25±0.19[ab]	4.96±0.12[ab]
36	1887.80±46.01[ab]	38.32±0.46[ab]	43.95±0.38[ab]	9.62±0.10[b]	5.28±0.06[b]	8.42±0.20[ab]	5.10±0.13[ab]
40	1915.45±46.01[a]	38.70±0.46[a]	44.13±0.38[a]	9.76±0.10[a]	5.35±0.06[a]	8.59±0.20[a]	5.24±0.13[a]
P-value	0.000	0.000	0.010	0.000	0.000	0.000	0.000

Values with different letters on the same column are significantly (P<0.05) different.

BW = Body Weight; CG = Chest Girth; BL = Body Length; SL = Shank Length; SC = Shank circumference; CL = Comb height; CH = Comb Height.

Table 3 indicates that there were no significant (P>0.05) disparities in body weight and all body morphormetric traits (CG, BL, SL, SC and CL) except comb height. At 20 weeks of age, the white FUNAAB Alpha was 20.55% better than the black FUNAAB Alpha in comb height.

Table 3: Effect of strain and age interaction on body weight and body morphometrics

Strain	Age (Weeks)	BW(g)	CG(cm)	BL(cm)	SL(cm)	SC(cm)	CL(cm)	CH(cm)
White	20	1593.40±54.69	35.71±0.54	44.12±0.47	9.03±0.12	4.57±0.07	6.60±0.24	3.65±0.16[a]
	24	1838.38±57.46	37.91±0.57	45.05±0.47	9.37±0.136	4.48±0.091	7.08±0.256	4.12±0.171[a]

	28	1905.82±60.81	38.05±0.60	43.69±0.50	9.03±0.144	4.64±0.085	7.93±0.271	4.45±0.181[b]
	32	2004.50±60.81	39.24±0.60	44.25±0.50	9.64±0.144	5.22±0.085	8.35±0.271	4.93±0.181[b]
	36	2006.21±65.41	39.21±0.65	45.56±0.54	9.89±0.154	5.36±0.092	8.52±0.291	5.01±0.195[b]
	40	2030.44±65.41	39.80±0.65	45.77±0.54	10.05±0.154	5.44±0.092	8.75±0.291	5.16±0.195[b]
Black	20	1375.39±57.26	33.68±0.57	41.53±0.47	8.49±0.13	4.26±0.08	5.40±0.25	2.90±0.17[b]
	24	1567.68±57.26	34.51±0.57	41.69±0.47	8.57±0.135	4.21±0.080	6.45±0.255	3.60±0.170[b]
	28	1702.99±60.60	36.72±0.60	41.28±0.50	8.47±0.143	4.38±0.085	7.72±0.270	4.46±0.180[a]
	32	1744.50±60.60	37.33±0.60	42.08±0.50	9.06±0.143	4.95±0.085	8.15±0.270	4.98±0.180[a]
	36	1769.40±64.73	37.43±0.64	42.33±0.53	9.36±0.153	5.19±0.091	8.32±0.288	5.19±0.193[a]
	40	1800.47±64.73	37.61±0.64	42.50±0.53	9.46±0.153	5.27±0.091	8.42±0.288	5.32±0.193[a]
P-value		0.993	0.619	0.760	0.940	0.961	0.314	0.032

[ab]means on the same column with different superscript are significantly different (P<0.05)

BW = Body Weight; CG = Chest Girth; BL = Body Length; SL = Shank Length; SC = Shank Circumference; CL = Comb Length; CH = Comb Height.

CONCLUSION AND APPLICATION

The result of this study indicated that

1. Both strains of FUNAAB Alpha chickens are recommended for commercial production as they attained good body weight at early age when compared to other native chickens. Although the white did better than the black in virtually all the studied traits.
2. Age is a major factor in achieving higher body weight, with both strains having better weights between 28 and 36 weeks of age.

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Effect of Genotype on Semen Quality Parameters of Drakes

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Abstract: Semen quality plays a prominent role in the reproductive efficiency of a male animal. This study evaluated semen quality traits of Muscovy, Mallard and Mule ducks. Semen collected from the epididymis were analysed from five (5) adult males of each genotype using one way analysis of variance with genotype as the fixed factor. There was no sperm cell in the semen of Mule ducks. However, there was a significant ($P<0.05$) genetic effect on all the parameters with Muscovy duck having superior ($P<0.05$) sperm quality in mass motility, percentage motility and sperm concentration except ($P>0.05$) in livability and normal spermatozoa cell when compared with the Mallard duck. It is concluded that male Mule ducks are sterile due to the absence of sperm cells in their semen while Muscovy and Mallard drakes are fertile and their semen qualities is suggestive of their suitability for breeding purposes either in artificial insemination or natural mating.
Keywords: Artificial insemination, Epididymis, Mass motility, Mule duck, Semen quality

Description of problem

The ubiquitous role played by the semen quality in defining reproductive efficiency of a male animal cannot be overemphasized. (1) asserted that it is one of the main determinants of poultry male reproductive potential. The assessment of semen quality characteristics of poultry gives an excellent indicator of their reproductive potential and has been reported to be a major determinant of fertility and subsequent hatchability of eggs (2). (3) corroborated this submission that to optimize reproduction output; therefore, there is need for periodic evaluation of semen in a breeding stock since only fewer cocks usually run with hens. Several reports on semen characteristics of the domestic fowls have indicated that breeds and strains significantly affect semen quality and quantity (3, 4). Hence, this study aims to evaluate the semen quality parameters of Muscovy, Mallard and Mule ducks.

Materials and Methods

Experimental animals

15 drakes comprising 5 each of Muscovy, Mallard and Mule ducks were used for this experiment. These birds originated from northwest Nigeria and were sourced from the reputable Shasha Poultry market, Ibadan. They were acclimatised for three weeks and fed *ad libitum* before data collection. Besides, they were treated with broad spectrum antibiotics and anti-parasites drugs. The animals were sacrificed in the morning in order to avoid heat stress effect on semen parameters by severing the jugular veins. They were then dissected to harvest the epididymal semen. The drakes were slauthered one after the other 1ml of epididymal semen sample was collected from each drake and semen quality analysis was conducted immediately the drakes were slauthered.

Semen Analysis

The mass motility and percentage motility of sperm cells were determined according to (5). The eosin-nigrosin staining technique was used to estimate live/dead sperm cells and sperm morphology (normal and abnormal)(6). Spermatozoa concentration was measured by haemocytometer method as described by (7).

Data Analysis

The semen parameters were analysed using one way analysis of variance with genotype as the fixed effect**:**

$Y_{ij} = \mu + G_i + e_{ij}$

Where

Y_{ij} = Individual measurement.
μ = Overall mean
G_i = Genetic effect

e_{ij} = Random error

Significant differences between means were separated with New Duncan's Multiple Range at 5% probability level. All data were analysed using SPSS (8) version 16.

RESULTS AND DISCUSSION

There was a significant (P<0.05) genotype effect on all the investigated semen parameters. No sperm cell was observed in the semen of Mule ducks; however, Muscovy ducks had significantly (P<0.05) higher values for mass motility, percentage motility and sperm cell concentration compared to Mallard ducks (Table 1).

Table 1: Semen characteristics of three duck genotypes

Semen parameter	Genotype		
	Muscovy duck	**Mallard duck**	**Mule duck**
Mass motility	3.90±1.00[a]	2.00±2.32[b]	0.00±0.00[c]
Motility (%)	96.50±0.71[a]	42.50±3.54[b]	0.00±0.00[c]
Sperm Concentration ($x10^9$)	5.20±2.12[a]	4.27±3.11[b]	0.00±0.00[c]
Livability (%)	95.50±0.71[a]	90.00±0.90[a]	0.00±0.00[b]
Normal morphology (%)	99.29±1.40[a]	99.30±.61 [a]	0.00±0.00[b]

Means with different superscripts along the row are significantly different at 5% probability level

The higher mass motility score for Muscovy duck (3.90) compared to Mallard duck (2.00) was consistent with the report of (9) where Muscovy duck had higher motility score of 3.54 compared to Kuttanad (3.42) and Pekin (3.38) ducks in India. Similarly, the percentage sperm cell motility reported for Muscovy duck in this study was higher than the values reported in related studies for Muscovy ducks and other breeds of ducks (9,10, 11). The consistent higher motility (mass motility and percentage motility) of Muscovy duck sperm cells in contrast to Mallard duck is a pointer to possible genetic effect on this parameter. This assertion agrees with the submission of (12) that breed differences have influence on the motility of spermatozoa.

The range of live spermatozoa reported for both Muscovy and Mallard ducks were higher but comparable with the range reported for different breeds of ducks (9, 10, 11). The non-significant difference in liveability of the sperm cells of the two duck genotype is in agreement with previous reports on ducks (9, 11) and chickens (3). Liveability of sperm cells is a good indicator of the fertilizing potential of a sire. This parameter saliently gives insight to the genetic worth and economic value of a male animal in breeding programs. Though higher live sperm cells were recorded for Muscovy ducks; nevertheless, the percentage live sperm cells in the Mallard ducks is also suitable for either natural or artificial insemination programs.

The significant difference in the sperm cell concentration of the two genotypes is similar to the reports of (9) on White Pekin, Kuttanad and Muscovy drakes. However, sperm cell concentration in the investigated genotypes was much higher than the results obtained for the three duck genotypes reported by (9) and Pekin drakes by (10). The observed differences in the sperm cell concentration of the two genotypes under consideration and values reported by previous researchers could be attributed to genetic and environmental factors.

Similarly to the previous reports on the number of the sperm cell with normal morphology of ducks (9) and chickens (3); there was no genetic effect on this semen parameter in the present study. It is noteworthy that percentage normal sperm cells for the two genotypes were higher than the values reported for ducks (9, 13) and domestic chickens (3, 5). The proportion of normal sperm cells reported for the two genotypes in this study is suitable for breeding purpose.

CONCLUSION AND APPLICATION

1. The absence of sperm cells in the semen of Mule ducks is a pointer to the widely reported sterility in them.
2. The sperm qualities of the Muscovy and Mallard ducks imply that semen from the two genotypes is suitable for breeding purposes.

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Relationship between Body Weight and Linear Body Measurement in Two Broiler Strains

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Abstract: A study was carried out to determine the relationship between body weight and l body linear measurement in two broiler strains to check the genetic and phenotypic correlations between bodyweight and body linear measurements of Anak 2000 and Hubbard strains of broiler chickens. A total of 100 each of Anak 2000 and Hubbard were used. Body weight and body measurements were taken three times a week from 2- 8 weeks of age. The Genetic correlation showed that body weight had significant ($p<0.05$; $r=0.25$) correlation with Thigh length. Other body measurement traits were moderately-highly ($p<0.05$-0.01; $r= 0.43$-0.95) correlated with each other, all indicating positive correlation. Hence, only thigh length can be a good estimator of body weight. Body weight and body linear measurements are controlled by the same gene (pleiotropy) in two strains in this study.

Keywords: Relationship, Bodyweight, Body Measurement, Broiler, Strain

INTRODUCTION

Chicken production is increasing due to increased product output per animal, high feed conversion efficiency, improved fertility, hatchability, growth rate, egg yield and meat quality. Poultry keeping requires less land, and most of the poultry species are more prolific than other species of livestock (Kabir *et al*., 2010). Also poultry breeders have tried to establish the relationships that exist between body weight and body conformation traits such as shank length, breast width, breast ankle, keel length, neck length, back length, and thigh length as information reflect on the growth and development of broiler birds (Adenowo and Omonniya, 2004 and Abbaya *et al*., 2017). Morphological traits have been used in animals to estimate body weight (Yakubu *et al.,* 2009). This has largely been the case in rural communities where scales are not readily available. The common measures of estimation of body weights has been simple correlation coefficients between body weight and morphometric measures or regression of body weight on a number of body measurements (Kuzelove *et al.,* 2011). Correlation is a measure of strength of the relationship between records for a trait in a population. It represents the degree of association between measurements on the same animal for traits. Correlation study is of great importance in the profitability of the poultry industry. The strength and direction of correlation between traits give an indication of the extent to which selection applied at any stage will affect subsequent flock performance (Ibe, 1995). The aim of this study is to estimate the relationship between body weight and body linear traits in a population of broiler birds.

MATERIAL AND METHODS

The research was carried out at the Livestock Teaching and Research Farm (Poultry Unit), Adamawa State University, the climatic parameters of Mubi is as described by Adebayo, (2004). A total of two hundred (200) day old broiler chicks were used in this study. Prior to the arrival of the chicks, the pens were cleaned, disinfected, fumigated and littered with wood shavings to 10cm depth. Adequate temperature was maintained in the brooding house, clean drinking water and formulated broiler starter mash and finisher were provided *ad-libitum.* The birds were purchased from commercial distributor in Mubi and brooded for two weeks. Starter mash containing 23% CP and 2800 ME (kcal/kg) and a finisher mash containing 20% CP and 3000 ME (kcal/kg) were given to them at starter and finisher levels. Routine vaccinations was appropriately administered as at when due. After the brooding, the birds were randomly divided into three replications. The parameters measured are; Body weight: individual body weight (kg) was taken three times in a week. Neck length (NKL): The neck

was gently straightened out with the hand by one co-operator and measurement was taken by another co-investigator (using a tailors tape (cm). Back length (BKL): Back length was measured from the base of the neck to the uropygial gland at the tail. Shank length (SL): Shank length was measured from the hock joint to the tarsus-meta tarsus. Breast width (BRSTWT): Breast width was measured across the keel from the left armpit to the right armpit. Thigh length (THL): Thigh length was obtained by measuring from the hock joint to the hinge joint. All body measurements will be determined using a tailor's tape-rule (in cm).

Data analysis: Data obtained from the study was subjected to analysis of variance (ANOVA) using the GLM Procedure of SAS 2002 and variances were generated using the same software. The genetic and environmental correlations between two traits (X and Y) were obtained using the formula below:

$$r = \frac{cov_{xy}}{\sqrt{\sigma^2{}_x \sigma^2{}_y}}$$

RESULTS AND DISCUSSION

The genetic (above Diagonal) and phenotypic correlation (below Diagonal) of two strains of broiler chickens are presented in figure 1. The genetic correlation showed that body weight had significant ($P<0.05$; $r= 0.25$) correlation with only TL (Thigh length). Body measurement traits significantly ($P<0.0$-0.01; $r=0.043$-0.95) correlated with each other in both strains. This implies that bodyweight has less relationship with body linear measurements. Also, the moderate to high correlation coefficients observed between body measurements suggest that as one linear trait increased significantly, others also increase. This suggests that all body linear measurements are controlled by the same gene (Pleiotropy). The moderate to high correlation observed between body measurement traits in this study is in line with the report of several authors who also reported a significant relationship between body linear measurements in both exotic and indigenous breeds of chickens (Kabir *et al*., 2006; Aziz and Al-Hur, 2013; Abbaya *et al*., 2017). The insignificant ($P>0.05$) genetic correlation of body weight and other body linear measurements except thigh length in this study contradict the findings of Obike *et al*. (2016). This means that among body linear traits, only thigh length can be a good indicator of body weight in both strains.

CONCLUSION

It could be concluded therefore, that only thigh length could be a good indicator of body weight in both strains of broiler chickens used. Body measurement traits are controlled by the same gene (pleiotropy).

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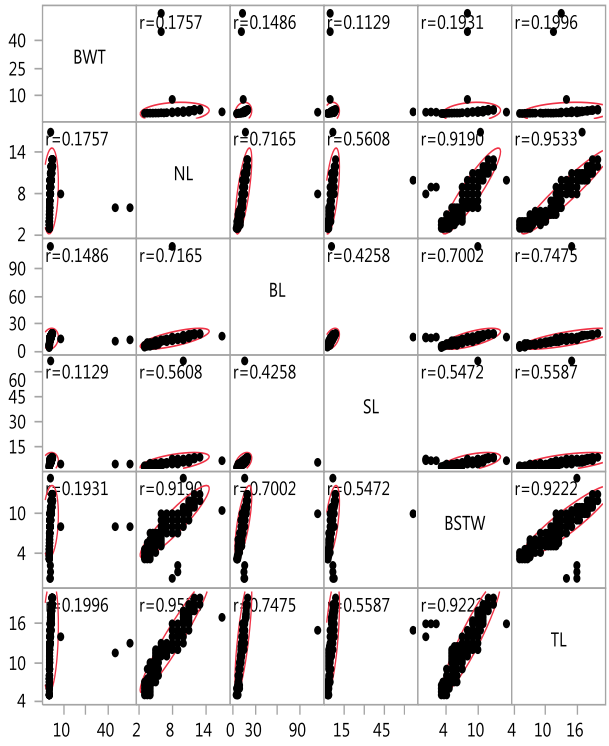
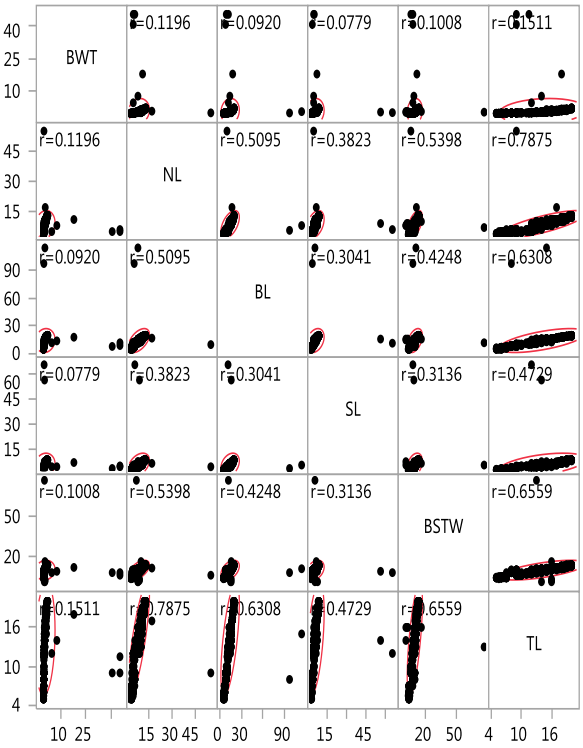
APPENDIX

Scatterplot Matrix for Anak 2000



Scatterplot Matrix for Hubbard



Phenotypic Variationamong Three Broiler Strains in the Nigerian Guinea Savannah

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Abstract: This study was conducted to investigate the phenotypic variation of growth performance and leg deformity traits among Arbor Acre, Anak and Hubbard strains of broiler chickens. Three hundred day old chicks consisting of 100each of Arbor Acre, Anak and Hubbard strains were used for the experiment, which lasted for 6 weeks in a completely randomized design.Arbor Acre had higher ($p< 0.05$) body weight and valgus and varus deformity than did other strains. The body weight and valgus and varus deformityof Anak did not differ ($p>0.05$) from those of Hubbard exhibited superiority in body weight followed by Hubbard and Anakwhereas;Arbor Acre had higher valgus and varus deformity followed by Anak and Hubbard.This study suggests that leg deformity is severe in heavier birds.

Keywords: Strain, Guinea Savannah, Valgus, Varus.

DESCRIPTION OF PROBLEM

Livestock plays a significant role in the livelihoods of many households as they contribute to the provision of food, income, security as well as other social and cultural functions (Text–Lucy, 2010).Consumption of animal protein in Africa remains one of the lowest in the world (Olopade*et al*., 2011). High stocking density together with genetic selection for higher feed conversion efficiency and growth rate has caused behavioural restriction and uneven use of space. Therefore, broilers reared using standard commercial practices suffer from many welfare problems (Scahaw, 2000).Lame broilers cannot walk freely and are not able to reach either the feeder or the drinker when hungry or thirsty, limiting their survival and productivity (Julian, 1993). There are several causes of lameness in a broiler chicken, with the aetiology generally classified as developmental, degenerative or infectious (Bradshaw *et al*., 2002). Developmental abnormalities include varus-valgus deformation (VVD) at the intertarsal joint, one of the most common leg distortions in broilers (European Community, 2000). Broilers strains are known to reach table size, sexual maturity and phenotypically different from one another, even when reared under the same management condition and fed the same diet. In Nigeria, various strains of broiler chickens reared but there is dearth of information on the phenotypic variations among the strains for growth performance and leg deformity. Thus,the objective of this study was to determine the phenotypic variations in body weight and leg deformity among three broiler strains reared in Nigerian guinea savannah.

MATERIALS AND METHODS

Experimental Site: The study was carried out at the Animal Production pavilion, Teaching and Research farm, Faculty of Agriculture, university of Ilorin, Kwara state. The study lasted 6 weeks.

Experimental Animal and Housing: A total of three hundred broilerchicks, comprising of 100 each of Arbor Acre, Anak and Hubbard strains were procured from reputable hatchery in Ibadan, Nigeria. Each day old chicks was wing tagged.Each strain was kept in separate pens in an environmental controlled brooding house.After brooding, each treatment was allocated to separate pens with floor space of 2.43m x 2.50m for 3-4 weeks and, later transferred to finisher pens with floor space of 3.0m x 4.0m. Chicks were offered clean water and fed *ad-libitum* with a commercial starter diet (22%CP, 2800Kcal/KgME) from day old to 4 weeks, and later fed commercial finisher diet (18%CP 2900Kcal/Kg ME) from 5 to 6 weeksto meet the requirement of broilers according to NRC (1994).All necessary medications and vaccinations were administeredat the appropriate ages as recommended by Oluyemi and Robberts, (2000).

Data Collection: Data on body weight and leg deformity traits (varus and valgus deformity or angulations) as described by Dawkins *et al*., 2004 by were collected on weekly basis.

Statistical Analysis

The data obtained from individual broiler strain were subjected to analysis of variance using Statistical Package for Social Science SPSS (2015) Version 23. Significant differences among means were separated using Duncan's multiple range Test procedure (Duncan, 1955).

RESULTS AND DISCUSSION

The mean body weight of Arbor Acre, Anak and Hubbard strains are presented in Table 1.From week 1 to 6, Arbor Acre and Hubbard broiler chickens had similar body weight ($p > 0.05$) while Anak body weight was significantly different ($p<0.05$) and lower than those of other strains (Table 1). The higher body weight of Arbor acre could be attributed to its genetic merit over other strains. This result supported the work of Udeh*et al*., (2011; 2015). Contrarily, Yayaya*et al*., (2012) reported higher body weight for Hubbard over Arbor Acre at age 2, 4, and 6 weeks.

Table 1: **Mean Body weight in Arbor Acre, Anak and Hubbard at 1 to 6 weeks of age**

Age (week)	Breed		
	Arbor Acre	Anak	Hubbard
1	193.7 ± 8.41 (92)^{b}	143.9 ± 2.97 (86)^{a}	197.24 ± 8.8 (89)^{b}
2	326.09 ± 12.41(92)^{b}	246.16 ± 5.01 (86)^{a}	308.09 ± 12.54 (89)^{b}
3	619.35 ± 21.08 (92)^{b}	485.24 ± 10.06 (86)^{a}	580.67 ± 22.51 (89)^{b}
4	909.02 ± 25.86 (92)^{b}	741.22 ± 14.18 (86)^{a}	880.96 ± 27.75 (89)^{b}
5	1106.2 ± 26.82 (92)^{b}	969.65 ± 18.49 (86)^{a}	1148.09 ± 29.31 (89)^{b}
6	1431.52 ± 30.18 (92)^{b}	1231.05 ± 24.4 (86)^{a}	1393.48 ± 31.61 (89)^{b}

^{abc} Mean with different superscripts along the same rows are significantly different ($p < 0.05$).

The mean valgus and varus deformity in different strains of broilers are shown in Table 2. ArborAcre had higher ($p<0.05$) valgus and varus deformity than did other strains.Anak and Hubbard had similar ($p>0.05$) valgus and varus deformity. Thehigher valgus and varus deformity in Arbor Acre could be attributed to its heavier body weight compared with other strains. These results are consistent with the findings of Nääs *et al*., (2010) and Ayorinde *et al*., (2004) who observed that locomotion disability was more severe in older and heavier birds.

Table 2: **Mean Valgus andVarus in Arbor Acre, Anak and Hubbard at 2, 4 and 6 weeks of age.**

Age (week)	**Breed**		
	Arbor Acre	**Anak**	**Hubbard**
2	17.71 ± 0.62 (92)	17.16 ± 0.66 (86)	15.92 ± 0.65 (89)
4	23.10 ± 0.63 (92)^{b}	20.02 ± 0.65 (86)^{a}	18.80 ± 0.63 (89)^{a}
6	26.97 ± 0.72 (92)^{b}	23.62 ± 0.67 (86)^{a}	23.61 ± 0.63 (89)^{a}

^{abc} Mean with different superscripts along a rows are significantly different ($p < 0.05$).

CONCLUSION AND APPLICATIONS

Arbor Acre had higher body weight and valgus and varus deformity than Hubbard and Anak strains. It can be concluded that leg deformity is severe in heavier birds.

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Coat Colour Pattern Differentiated Correlations Between Body Weight and Body Linear Measurement of Donkeys

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Abstract: Study on the relationships between body length and linear body measurements of donkeys on the basis of differentiated coat colour pattern was carried out in seven States in Northwestern Nigeria using seven hundred (700) donkeys. Morphometric measures taken were head length, head width, ear length, neck length, neck circumference, shoulder width, height at withers, heart girth, body length and taillength using flexible tailors measuring tape in centimeter. Body weight was determine using prediction equation in kilogram. Data collected were subjected to correlation procedure (Proc. Corr.) of SAS. The relationships were high for the patched colour pattern (r=0.33-1.00; P<0.05, 0.01) with the relationship between body weight and other growth measures being very high (r=0.65-0.99; P<0.01). Correlations were higher for the patched than for the solid coat colour pattern. More differentiation of features of donkeys in Nigeria should be explored on the basis of coat colour pattern.

Keywords: Body linear measurement, Donkey, correlation, coat colour pattern, body weight

DESCRIPTION OF PROBLEM

Zoometrical measures such as head length, head width, ear length, neck length, neck circumference, shoulder width, height at withers, heart girth, body length and tail length of live animals were measured to assess the relationship between these variables and the live weight for strain characterization in donkeys (1). Zoometrical measurements have heritable basis and play a major role in the subsequent carcass yield of an animal (2). The phenotypic variability in zoometrical measurements as much as performance traits in livestock production are affected by both genetic and environmental factors (3). Therefore, the relationships between the body measurements are needful for the prediction of other performance traits in animal (4). The aimed of this study is to determine the relationship among zoometrical measurements and body weightof donkeys with different coat colour patternsNorth West Nigeria.

MATERIALS AND METHODS

Seven hundred (700) donkeys were sampled for this study which was carried out in Kaduna, Kano, Katsina, Kebbi, Jigawa, Sokoto and Zamfara State.Morphometric measures taken were head length, head width, ear length, neck length, neck circumference, shoulder width, height at withers, heart girth, body length and taillength using flexible measuring tape in centimetre. Body weight was determined using prediction equation in kilogram. Reference marks for body linear measurement according to the method of (5, 6), and (7) was adapted. The degrees of relationships between all pairs of metric variables were computed for all the animals using CORR procedure of SAS (8) statistical package.

RESULTS AND DISCUSSION

The coat colour pattern differentiated correlations between morphometric traits of donkeys are presented in Table 1. The correlations between the growth measures in both the patched and solid coat patterns were positive and significant (r=0.12-1.00; P<0.05, 0.01). The relationships were high for the patched colour pattern (r=0.33-1.00; P<0.05, 0.01) with the relationship between body weight and other growth measures being very high (r=0.65-0.99; P<0.01). On the other hand, in the solid colour pattern, the relationships between body weight and other growth measures were from low to moderate (r=0.16-0.29; P<0.05) except between body weight and height at withers (r=0.65; P<0.01). Generally, the correlations were stronger for the patched than for the solid coat colour pattern.Several studies reported a strong correlation between some body linear measurements with some production traits. Body linear measurements had been used to estimate the body weight of sheep (9) and goats (10). The result of this study is similar to the findings of (11) who reported positive correlation between body

weight and body linear measurement in three pig genotype. (1) had earlier reported similar relationships among linear body measurements and body weight using other features of donkeys likehead profile, tail shape, skin type and eye colour as the basis of differentiation.

Table 1. Coat colour pattern differentiated correlations between morphometric traits of donkeys

Traits	BWT(cm)	HL(cm)	HWD(cm)	EL(cm)	NL(cm)	NC(cm)	SW(cm)	HW(cm)	HG(cm)	BL(
HL(cm)	0.99**	-								
HWD(cm)	0.99**	0.99**	-							
EL(cm)	0.92**	0.97**	0.93**	-						
NL(cm)	0.99**	0.99**	0.99**	0.92**	-					
NC(cm)	0.94**	0.97**	0.95**	0.99**	0.93*	-				
SW(cm)	0.65**	0.56*	0.64*	0.33*	0.68**	0.36*	-			
HW(cm)	0.99**	0.99**	0.99**	0.95**	0.99**	0.96**	0.60**	-		
HG(cm)	0.99**	0.99**	0.99**	0.96**	0.99**	0.97**	0.58*	0.99**	-	
BL(cm)	0.99**	0.99**	0.99**	0.96**	0.99**	0.97**	0.58*	0.99**	1.00**	-
TL(cm)	0.96**	0.99**	0.97**	0.99**	0.96**	0.99**	0.44*	0.98**	0.99**	0.99
Traits	BWT(cm)	HL(cm)	HWD(cm)	EL(cm)	NL(cm)	NC(cm)	SW(cm)	HW(cm)	HG(cm)	BL(
HL(cm)	0.27**	-								
HWD(cm)	0.23**	0.61**	-							
EL(cm)	0.23**	0.64**	0.52**	-						
NL(cm)	0.26**	0.81**	0.57**	0.57**	-					
NC(cm)	0.24**	0.79**	0.61**	0.63**	0.75**	-				
SW(cm)	0.16**	0.68**	0.62**	0.46**	0.63**	0.65**	-			
HW(cm)	0.65**	0.14*	0.14*	0.14*	0.12*	0.14*	0.09^{NS}	-		
HG(cm)	0.27**	0.72**	0.64**	0.64**	0.72**	0.78**	0.65**	0.53**	-	
BL(cm)	0.29**	0.75**	0.62**	0.61**	0.72**	0.73**	0.68**	0.13*	0.15*	-
TL(cm)	0.26**	0.56**	0.46**	0.41**	0.59**	0.59**	0.49**	0.10*	0.66**	0.52

BWT: body weight; HL: head length; HWD: head width; EL: ear length; NL: neck length; NC: neck circumference; SW: shoulder width; HW: height at withers; HG: heart girth; BL: body length; TL: tail length, **P<0.01, *P<0.05 NS: not significant difference at (P>0.05).

CONCLUSION AND APPLICATION

Different coat colour patterns on the donkeys showed varied relationships among body weight and linear body measurements. More differentiation of features of donkeys in Nigeria should be explored on the basis of coat colour pattern.

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Heritability Estimates for Pearl and Belgy Strains of Guinea Fowls in Northern Guinea Savanna Zone of Nigeria

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Abstract: A total of 60 (30 each) of two distinct strains of Guinea fowl (Pearl and Belgy) comprising of 6 males and 24 females each of Pearl and Belgy strains were obtained from Zaria in Kaduna State and Maradi, Niger Republic, respectively for the study that lasted for 16 weeks. The body linear measurements such as neck length, body length, shank length, thigh length and breast width were taken using a tailor's tape in centimeter. Data obtained from bi-weekly body weight and linear measurement data were analysed using General Linear Model Procedure of SAS. Means within the traits were compared using Duncan's Multiple Range Test. Pearl strain had higher values for all the traits considered in the study and across all the ages. The heritability estimates observed for body weight were 0.01±0.03, 0.10±0.30, 0.33±0.22, 0.45±0.30, 0.33±0.70, 0.14±0.90, 0.03±0.50 and 0.22±0.40at 2, 4, 6, 8, 10, 12, 14 and 16 weeks forBelgy strain, while the heritability estimates for body weight of Pearl strain were 0.01±0.03, 0.33±0.22, 0.40±0.87, 0.98±0.90, 0.79±0.50, 0.44±0.60, 0.48±0.30 and 0.68±0.80 at 2, 4, 6, 8, 10, 12, 14, and 16 weeks respectively. The estimates of heritability for body weight and some of the body linear measurements of Belgy and Pearl guinea fowl at 8 weeks were high. Selection among populations of Belgy and Pearl guinea fowl in the study area should be based on the individual records of the birds at 8 weeks of age.

Keywords: Guinea fowl, heritability estimate, Northern guinea savannah, strains, Nigeria

DESCRIPTION OF PROBLEM

The helmeted guinea fowl, *Numida meleagris* occur freely throughout the grassland areas spreading from the derived savanna near the forest zone in the South to the true savanna into Northern guinea savanna vegetation zones (1). The crested guinea fowl, *Guttera pucherani* is specie that is restricted in distribution to the forest and derived savanna forest edges (2). It is second to the domestic fowl in terms of number and supply of poultry protein in Nigeria. Thus, a huge number exists for various studies and from which to select for improvement (3). Improvement of traits is largely dependent on the genetic composition of stocks and its influence among traits of economic importance (4). Relative genetic diversity can be determined using phenotypic characteristics and or molecular markers (5). Phenotypic characteristics are important in identifying and defining breed attributes (6). (7) stated that phenotypic variation is exactly what characterizes local poultry strain. Body linear measurements help in the comparison of growth in different parts of the body. It has been severally used to characterize strains, evaluate carcass yield, sex effect on performance and predict live weight gain in livestock (8). This study was therefore aimed at estimating heritability of growth traits (body weight and body linear measurements) of Pearl and Belgy strains of guinea fowl in Northern Guinea Savanna zone of Nigeria.

MATERIALS AND METHODS

The experiment was carried out at the Teaching and Research Farm, Department of Animal Science, Ahmadu Bello University, Zaria. The site is geographically situated between latitude 11°12'N and longitudes 7°33'E at an altitude of 640m above sea level (9). Annual rainfall in this area ranges from 1102mm to 1904mm per annum which last from late April or early May to October. The mean temperature fluctuates from 31^{o}C maximum during the dry season to 18^{o}C minimum during the wet season. It is located 22km Northeast of Zaria city and in the Northern Guinea Savannah zone of Nigeria as reported by (10).

A total of 60 (30 each) of two distinct strains of Guinea fowl (Pearl and Belgy) comprising of 6 males and 24 females for each of Pearl and Belgy strains were obtained from Zaria in Kaduna State and Maradi, Niger Republic, respectively for the study that lasted for 16 weeks. Body weights of birds were measured in grams. Body linear measurements such as neck length, body length, shank length, thigh length and breast width were taken as described by (11). The measurements were taken using a tailor's tape in centimeter. Data obtained from bi-weekly body weight and linear measurement data were analyzed using General Linear Model Procedure of SAS (12). Means within the traits were compared using (13).

RESULTS AND DISCUSSION

The means (±SE) of body weight and body linear measurements of Pearl and Belgy Guinea fowl strains at various ages were shown in Table 1. Strain of guinea fowls affected ($P<0.01$) body weight and body linear measurements. Body weight and body linear measurements of Belgy strain were higher than those of Pearl strain from 2 weeks up 16 weeks of age. This could be due to the differences in genetic make-up of the strains. The result is in line with the report of (6) that age is a major determinant of growth and physiological development. (14) reported significant difference in the growth performance of different strains of guinea fowl. The result of body weight and body linear measurements as affected by guinea fowl strains suggested that the Belgy strain was superior to Pearl. Belgy strain was observed to have had longer skeletal frame and higher body linear measurements.

The heritability estimates for traits considered in this study are presented in Table 2. The heritability estimates for body weight of Pearl strain of guinea fowls were generally higher from the 4th week up to 16 weeks. Higher heritability estimates were also obtained for body linear measurements of Pearl as against the Belgy strain. High h^2were obtained for Belgy and Pearl strains at 8 weeks of age. The values were 0.45 and 0.98 for Belgy and Pearl, respectively. The heritability estimates obtained by (15) for naked neck broiler chickens were lower than those obtained in this study for body weight and body linear measurements. The observed differences in heritability estimates obtained may be due to the limitation caused by sample size, techniques or environmental effects. Variation in environmental (high temperature and humidity) and management conditions are known to increase the residual variance and decrease the heritability estimates (15).

Table 1: Means (±SE) for Body Weight and Body Linear Measurements in Pearl and Belgy Guinea Fowl Strains at various ages (weeks)

Week	Strain	BWT (g)	NL (cm)	BL (cm)	THL (cm)	SHL (cm)	BRWD (cm)
2	**Belgy**	69.91±00^a	5.15+0.03^a	12.07±0.12^a	4.25±0.04^a	2.73±0.02^a	4.51+0.04^a
	Pearl	53.03±00^b	4.09+0.03^b	10.34±0.12^b	4.01±0.04^b	2.50+0.02^b	4.00±0.04^b
	SEM	1.09	0.07	0.14	0.03	0.02	0.04
4	**Belgy**	174.00±3.86^a	6.28±0.06^a	15.83+0.21^a	5.32+0.07^a	2.98±0.01^a	5.47±0.07^a
	Pearl	86.44±3.86^b	5.79+0.06^b	13.53±0.21^b	5.47±0.07^b	2.97±0.01^b	5.10±0.07^b
	SEM	6.31	0.05	0.21	0.05	0.01	0.05
6	**Belgy**	266.39±5.35^a	8.92±0.09^a	20.08±0.22^a	7.28±0.09^a	3.86±0.05^a	7.59±0.10^a
	Pearl	111.39±5.35^b	6.39±0.09^b	15.26±0.22^b	6.23±0.09^b	3.24±0.05^b	6.22±0.10^b
	SEM	10.76	0.18	0.35	0.09	0.05	0.11
8	**Belgy**	334.28±6.5^a	10.02±0.2^a	23.13±0.23^a	8.16±0.08^a	4.29±0.05^a	8.54±0.11^a
	Pearl	152.85±6.5^b	6.95±0.12^b	16.92±0.23^b	6.92±0.08^b	3.58±0.05^b	7.03±0.11^b
	SEM	12.75	0.22	0.44	0.09	0.06	0.12
10	**Belgy**	378.24±6.7^a	10.90±0.2^a	24.87±0.25^a	9.08±0.10^a	4.57±0.06^a	8.96±0.10^a
	Pearl	205.01±6.87^b	7.69±0.12^b	18.80±0.25^b	7.58±0.10^b	3.91±0.06^b	7.67±0.10^b
	SEM	12.26	0.22	0.43	0.12	0.06	0.11
12	**Belgy**	419.83±8.02^a	11.83±0.13^a	25.96±0.23^a	9.83±0.10^a	4.90±0.56^a	9.52+0.09^a
	Pearl	257.61±8.02^b	8.57±0.13^b	20.80±0.23^b	8.27±0.10^b	4.02±0.56^b	8.22±0.09^b
	SEM	11.96	0.23	0.37	0.13	0.07	0.11
14	**Belgy**	443.33±7.78^a	12.75±0.12^a	27.38±0.22^a	10.50±0.10a	5.25±0.08^a	9.63±0.91^a
	Pearl	279.18±7.78^b	9.55±0.12^b	22.05±0.22^b	8.98±0.10^b	4.09±0.08^b	8.90±0.91^b
	SEM	11.99	0.23	038	0.12	0.09	0.08
16	**Belgy**	488.13±7.99^a	15.05±0.14^a	30.12±0.20^a	12.52±0.10^a	6.55±0.08^a	11.22±0.14^a
	Pearl	309.35±7.99^b	10.40±0.14^b	23.78±0.20^b	9.97±0.10^b	5.05±0.08^b	9.94±0.14^b
	SEM	12.91	0.32	0.44	0.18	0.11	0.13

BWT = body weight, NL = neck length, BL = body length, SHL= shank length, THL = thigh length, BRWD = breast width, a,b = significant ($p<0.01$) probability level, SEM = standard error of mean

Table 2: Heritability Estimates of Body Weight and Body Linear Measurements in Belgy and Pearl strains of Guinea Fowl at different ages

Week	Strain	Traits					
		BWT	**NL**	**BL**	**THL**	**SHL**	**BRWD**
2	Belgy	0.01±0.03	0.40±0.02	0.35±0.57	0.03±0.07	0.01±0.01	0.38±0.06
	Pearl	0.01±0.03	0.09±0.02	0.33±0.29	0.52±0.01	0.72±0.01	0.04±0.02
4	Belgy	0.10±0.20	0.08±0.06	0.11±2.25	0.06±0.08	0.46±0.01	0.07±0.06
	Pearl	0.33±0.22	0.18±0.06	0.28±0.53	0.26±0.16	0.35±0.01	0.07±0.16
6	Belgy	0.33±0.22	0.55±0.48	0.42±1.95	0.36±0.25	0.38±0.08	0.28±0.03
	Pearl	0.40±0.87	0.11±0.10	0.50±1.18	0.34±0.23	0.85±0.32	0.12±0.32
8	Belgy	0.45±0.30	0.66±0.09	0.62±1.84	0.32±0.22	0.04±0.13	0.03±0.34
	Pearl	0.98±0.90	0.91±0.18	0.17±1.43	0.53±0.15	0.79±0.02	0.25±0.31
10	Belgy	0.33±0.70	0.38±0.58	0.01±2.19	0.01±0.24	0.73±0.18	0.24±0.24
	Pearl	0.79±0.50	0.56±0.27	0.37±1.68	0.48±0.37	0.44±0.01	0.14±0.38
12	Belgy	0.14±0.90	0.38±0.51	0.23±1.98	0.34±0.26	0.19±0.08	0.12±0.29
	Pearl	0.44±0.60	0.39±0.26	0.22±1.45	0.76±0.33	0.01±0.11	0.63±0.27
14	Belgy	0.03±0.50	0.29±0.49	0.18±1.35	0.14±0.27	0.05±0.25	0.79±0.29
	Pearl	0.48±0.30	0.47±0.25	0.48±1.55	0.57±0.33	0.32±0.07	0.08±0.16
16	Belgy	0.22±0.40	0.12±0.69	0.39±1.36	0.29±0.41	0.01±0.35	0.46±0.74
	Pearl	0.68±0.80	0.91±0.17	0.03±1.07	0.17±0.25	0.12±0.04	0.06±0.29

BWT = body weight, NL = neck length, BL = body length, SHL= shank length, THL = thigh length, BRWD = breast width

CONCLUSION AND APPLICATION

The estimates of heritability for body weight and some of the body linear measurements of Belgy and Pearl guinea fowl at 8 weeks were high. Selection among populations of Belgy and Pearl guinea fowl in the study area should be based on the individual records of the birds at 8 weeks of age.

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Growth Performance and Heterosis of Pure and Crossbred Nigerian Sheep

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Abstract: The significance of birth, weaning and yearling weights in determining the breeding potentialities of domestic animals at an early age has long been recognized by livestock breeders. Data on 119 sheep producing 158 lambs' weights from birth, weaning and yearling were collected. Prior to breeding, ewes were weighed and flushed for three weeks. The ewes were synchronised using Prostaglandin ($PGF_2\alpha$). A total of 158 lambs produced through pure and reciprocal crossing of West African Dwarf (WAD), Balami and Uda sheep were used for this experiment. Data were collected on body weight at birth, weaning and yearling of the lambs. The data were used to estimate genorype differences and heterosis for the hybrids. The result showed that the crossbred lambs had similar birth and weaning weights with purebred Uda (UU) except Uda-WAD (UW) and Balami-WAD (BW) respectively. At yearling, BW sheep compete favorably with purebred Balami (BB) with average weights of 28.53 ±0.64 and 31.33 ±1.20 respectively. The hybrid vigour in the crossbred WU and UW were superior both at birth and at weaning over the crossbred WB and BW while the latter was superior at yearling. The negative heterotic values indicated better performance of the purebred over the crossbred. It is recommended that Uda sheep should be given priority over the Balami sheep when weaning weight is the target while adequate yearling and survivability performance can be guaranteed with the use of Balami sheep.

DESCRIPTION OF PROBLEM/INTRODUCTION

Crossbreeding is employed in taking advantage of the different and complementary strong points of two or more breeds and to utilize hybrid vigour (1). Crossbreeding offers two distinct advantages over pure-breeding and these are heterosis and breed complementarity (2). Complementarity is achieved when the weakness of one breed is offset by the strength of the other breed(s) and vice versa (3). Breed complementarity means evaluating the strengths and weaknesses of potential breeds and selecting those that complement each other which eventually results in an animal possessing the best traits of both breeds (4).

Heterosis is maximised when a crossbred ewe is mated to a crossbred ram (3). (4) Observed that heterosis is greater in genetically distant or heterozygous parents than in closely related parents. Hybrid vigour and breed complementarity are essential tools to improving productivity of commercial sheep flocks and an organized cross breeding size (5). In Nigeria, sheep is used mainly for meat production. Thus, rapid growth rate is of paramount importance for efficiency (6).

MATERIALS AND METHODS

This experiment was carried out at YOA Farms Limited, Afon, ASA Local Government Area, which is located on latitude 8º 001 and 9º101 North of the Equator and longitude 2º451 and 4º151 East of Kwara state (Ministry of Lands and Survey, 2016). A total of one hundred and nineteen sheep were procured and used for the study. Sheep were purchased from markets from two agro-ecological zones of Nigeria namely: Sudan Savannah (Sokoto and Kebi states) and Guinea Savannah (Oyo and Kwara states). The animals comprised of three breeds (35, 30 and 45 for Balami, Uda and WAD sheep, respectively). The Balami and Uda sheep were purchased from *Ilela, Achida and Ambrossa* markets in Sokoto and Kebbi states. The WAD sheep were procured from *Akinyele, Ojoo, Igbeti and Ajase* markets in Oyo and Kwara states. Each of the three breeds included three rams. Prior to breeding, ewes were weighed and flushed for three weeks. The ewes were synchronised using Prostaglandin ($PGF_2\alpha$). Before mating, animals were dewormed and flushed. The ewes were fed with formulated ration, Guinea grass (*Panicum maximum)* and Elephant grass (*Pennisetum pupurium)* from the farm paddock *ad libitum.* WAD was the sire in the first pen and mated the WAD, Balami and Uda ewes. Balami was the sire in the second pen and was mated to Balami and WAD ewes while Uda male in the third pen was mated to Uda and WAD ewes.

The genotypes of the lambs in the first pen were WB, WU and WW. The genotypes in the second pen were BW and BB while UU and UW were the lambs in the third pen.

The data obtained on body weight at birth, weaning and yearling were subjected to Tthe General Linear Model (PROC GLM) procedure of Statistical Analysis Software System (SAS 9.4 2013). was used to generate the average birth and live weights at weaning and Yearling. Means separation was done using Duncan's Multiple Range Test (7) of the same statistical package at probability level of 5%.

Heterosis was estimated using the formulae described by ( ) as indicated below. used for heterosis can be represented as: Y = (A+B) /2 – (C+D) /2 = (A+B) /2 is the average weight of the crossbred; (C+D) /2 is the average weight of the purebred
Y is the average general heterosis
Specific Heterosis E was calculated as:
A - (C+D) /2 = E; General % Heterosis was derived by: Y/C+D/2 * 100
Specific % Heterosis was derived by: E/ C+D/2*100.
The model used was:
$Y_{ij}=\mu+a_i+e_{ij}$;Where: Y_{ij}= body weight measurement, μ= overall mean; $a_{i=}$ effect of the i^{th} genotype.$e_{ij=}$ residual effect.

RESULTS

Body weights at birth, weaning and yearling for pure and crossbred WAD, Balami and Uda sheep is presented Table 1. Purebred Balami had the highest weight at birth, weaning and yearling. The birth weights of purebred Uda and some WAD crosses (WB, BW and WU) were similar. There were no significant differences in the birth weights of all the WAD crosses except in UW. The pure WAD had the lowest birth weight which was significantly ($p<0.005$) different form other lowest compared to the rest of the genotypes. At weaning, BW and UW had similar weights with purebred Uda and were significantly ($p<0.005$) different from purebred Balami. At yearling, crossbred WAD showed superiority alongside purebred Balami over the rest of breeds of sheep. Plates 3 to 9 showed the sizes of the purebred and the crossbred lambs at birth and at 4 weeks old. The crossbred lambs had almost the same size compared to the purebred lambs while the former were as big as the purebred WAD at 4weeks old. Purebred WAD (WW) had the least birth, weaning and yearling weights of 1.21±0.03, 6.71±0.16 and 16.98 ±0.90 respectively.

Table 1: Birth and live weights at weaning and yearling of Pure and crossbred WAD, Balami and Uda Sheep

Genotype	Birth	No	Weaning	No	Yearling	No
BB	3.83^{a} ±0.17	25	$13.13.27^{a}$ ±0.25	9	31.33^{a} ±1.20	3
UU	2.96^{b} ±0.05	16	$10.110.63^{b}$ ±0.50	6	23.50^{c} ±0.50	2
WB	3.20^{b} ±0.13	24	9.07^{c} ±0.50	12	25.75^{bc} ±1.65	4
WU	2.91^{b} ±0.11	19	8.43^{c} ±0.45	13	22.67^{c} ±1.45	3
BW	2.97^{b} ±0.16	28	10.99^{b} ±0.23	10	28.53^{ab} ±0.64	4
UW	2.29^{c} ±0.08	24	10.58^{b} ±0.38	8	23.25^{c} ±2.21	4
WW	1.21^{d} ±0.03	22	6.71^{d} ±0.16	11	16.98^{d} ±0.90	5

^{abcd} Means along the same column with different superscripts are significantly ($p<0.005$) different. B = Balami; U = Uda; W = West African Dwarf.

Table 2 shows at birth, the percentage the general and specific percentage heterosis for body weight in the crossbred lambs. The crossbred WB and BW had 22.42% general heterosis which was lower than the 24.70% obtained for crossbred WU and UW. WAD and Uda crosses had were superior general heterosis at weaning, than WAD and Balami crosses with negative heterosis. However, Balami and WAD crosses had higher general heterotic estimate at yearling compared to other crossbred WB. However, both showed negative estimates at weaning for specific heterosis when WAD was used as sire. All the genotypes had positive specific heterosis at yearling with crossbred BW having the highest.

Table 2: Heterosis for body weights in the crossbred lambs

Heterosis		%Heterosis		
	Genotype	Birth	Weaning	Yearling
General	WB&BW	22.42	-4.84	16.50
	WU&UW	24.70	9.25	13.44
Specific	WB	26.98	-9.48	14.88
	BW	17.86	26.32	18.11
	WU	39.57	-3.10	12.01

UW	9.83	21.61	14.87

DICUSSION

The crossbred WB, BW and WU had similar birth weights except UW. The crossbred lambs at birth were superior at birth with regards to their body weights throughout and this was an indication towards achievement of advantage of crossbreeding. The result of this study was similar to the works report of (5) where Yankassa crossed with Yankassa-WAD; Yankassa crossed with Uda- WAD had superior birth weights than the pure WAD. The small body size of the WAD was masked by the heavy bodies of Balami and Uda hence, complimentarity reflected. The superior weight at birth of Balami in the present study is similar to that of (8) and (9)). The lamb weights at birth from the straight crossing were greater than that of the reciprocal crossing. This could be due to the effect of the large size of the Balami and Uda dams, thereby accommodating the big developing fetus as well as providing adequate nourishment through the body reserves. Also, at weaning, half of the crossbred had similar weights with the purebred Uda which is also as a result of complimentarity. However, the yearling weight (31 kg) of purebred Balami in the present study was low compared to the 35 kg reported by (10). The low weight may be as a result of unfavourable climate conditions that affected generally, the performance of the animals used for the study. Uda is one of the biggest Nigerian breeds of sheep (11) and the appropriateness of this study was evident as there were no significant differences in the birth weights of purebred UU and the crossbred. The claim of (12) that no breeding practice or method can elude Balami and Uda, being the two largest breeds in Nigeria was apparent in the growth of the crossbred lambs.

The result of this present study revealed moderate values for specific heterosis (except for crossbred UW) and general percentage heterosis at birth, for Uda straight and reciprocal crosses despite the superiority of purebred Balami. This was due to the fact that average weight of the purebred was far greater in Balami than in Uda. This was expected as Balami had been described to be the biggest breed of Nigerian sheep (12). The superiority in birth and body weights of the crossbred lambs was apparent as the average body weights exceeded that of the purebred. This could be linked to the effect of the increase in heterozygosity in the crossbred which is a reflective of the reports of. (13) and (14). The present result is low when compared to the General percentage heterosis of 38.75% reported by (6) on crosbred Yankassa WAD. The slight variation could be traced to the large size of the Uda and Balami sheep used in the present studies as against the Yankassa by the authors hence; bigger average weight of the purebred was expected. Also, the superiority with respect to live weight of crossbred Uda over that of Balami could be linked to more tolerance and adaptability of Uda. (9) reported on the vulnerability and tendency to mortality respectively when Balami sheep were raised outside the Northern regions of the country. The genotypes with negative heterosis during weaning were improved at yearling as all the lambs showed positive heterosis and the crossbred BW and their reciprocals had the most superior General and Specific heterosis estimates at yearling which is an indication of increased tolerance and adaptability.

CONCLUSION

The result from the present study showed that birth and live weight and growth performance of the crossbred lambs competed favourably with purebred Uda and surpassed that of the purebred WAD. The male lambs had superior birth weights over the female lambs. Crossbred UW and WU showed superior percentage heterosis at birth except UW, suggesting improving the WAD sheep should be first considered by crossing with Uda sheep for weaning weight. The crossbred BW and UW were superior at weaning while their reciprocals showed negative hetarosis. All Balami crosses were superior to the Uda crosses at yearling which means the Balami sheep can be used to achieve optimal yearling weights. The superiority in weight of the crossbred lambs over the purebred WAD showed that WAD can be improved with either of the two largest breeds of Nigerian sheep.

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Identification of Kappa-Casein Genotype in Two Indigenous Nigerian Cattle

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Abstract: Kappa-casein as a mammalian milk protein is involved in a several important physiological processes and it's about 80% of the total protein in cow milk. This study aimed at identifying kappa-casein (*CSN3*) genotype in two indigenous Nigerian cattle populations and to determine the frequency distribution of Kappa casein variants as detected across the animals examined. DNA was extracted from 100 blood samples of 50 white Fulani and 50 N'dama cattle for identification and genotyping of kappa-casein gene by polymerase chain reaction restriction fragment length polymorphism (PCR-RFLP) test using *HindIII* restriction endonucleases. The PCR product of the specific primer K-F and K-R for the two cattle breed gives 530bp and 528bp specific band. Digestion of 530bp for white Fulani and 528bp for N'dama fragment by restriction endonuclease *HindIII* generated three fragments each for the two breeds. Results of the cuts with this enzyme show the presence of genotypes *AA*, *AB* and *BB* in the samples. These findings suggested that *BB* genotype could be a good factor for increase of fat and protein content of milk.

Key words: (PCR-RFLP), kappa-casein gene, genotyping, white Fulani, N'dama cattle.

INTRODUCTION

Casein is one of the members of milk proteins family that exists in different molecular forms and is the main protein present in the cow's milk (Alipanah *et al.*, 2005). It is also a member of phosphoproteins family (αS1, αS2, β, κ). Each of the first four caseins (αs1, αs2, β and κ) manifests variability at the level of phosphorylation and glycosylation. Phosphorylation is a key factor responsible for the stabilization of calcium phosphate nanoclusters in casein micelles (Huppertz, 2013). In the intestine, the protein ingested is divided into a non-dissolved peptide (Para kappa-casein) and a soluble hydrophilic glycopeptide (caseinomacropeptide) (Ageitos *et al*., 2006). Caseinomacropeptide is known to be responsible for a rise up in digestion efficiency of, prevention of newborn hypersensitivity of proteins ingested, and gastric pathogens inhibition (Ageitos *et al*., 2006). Kappa-casein is responsible for the formation, stabilization and aggregation of the casein colloidal aggregate thereby changing the manufacturing properties and digestibility of milk (Jann, 2004). Kappa casein is different from other caseins in structure and other properties (Azevedo *et al*., 2008).Two allelic variants, *A* and *B* is seen on exon IV of the bovine kappa casein gene on point mutation (Alipanah *et al*., 2007). These variants can be differentiated by polymerase chain reaction and restriction fragment length polymorphism (PCR-RFLP) analysis (Rachagani and Gupta, 2008). Also, *CSN*3 gene has been seen to be highly polymorphic in bovine and according to recent review of milk protein nomenclature (Caroli *et al*., 2009). PCR-RFLP is one of the most frequently used methods for genetic polymorphism studies because it's simple, (Yahyaoui, 2003) and it involves the amplification of a target DNA region including the polymorphic restriction enzyme sites by PCR afterward digesting the amplicon with the respective restriction enzymes.

MATERIALS AND METHODS

Blood collection

Blood samples were collected from a total of 100 healthy animals belonging to two indigenous cattle. White Fulani (n=50) and N'dama (n=50). Blood was drawn from the ventral region of the tail from each animal into a 10ml EDTA bottle containing (Ethylene Di amine Tetra acetic Acid) as an anticoagulant and kept on ice until transferred to -4^{o}C freezers.

Genomic DNA extraction and PCR-RFLP assay for kappa-casein genotypes

The Genomic DNA was extracted from whole blood using the DNA Genomic kit (Bioline) following the manufactural's protocol. DNA fragment was amplified by PCR, using Kappa casein forward primer as K-F:5'–ATAGCCAAATATATCCCAATTCAGT-3' and reverse primer asK-R:5'TTTATTAATAAGTCCATGAATCTTG-3'. The PCR reaction volume of 50µl contains 3µl of genomic DNA, 1µl of each primer, 10µl of NFW and10µl of Master Mix to a final volume of 50µl. the amplification conditions include: pre –denaturation at 94ºC for 4 minutes, annealing temperature at 54.74ºC for 30s, extension of DNA at 72ºC for 30s, final extension at 72ºC for 4minutes,ending at 4minutes to keep it cool and the cycle repeated for 35 times. For genotyping, PCR products were digested with *HindIII* restriction enzyme which was used for the determination of kappa-casein *A* and *B* alleles.

RESULTS AND DISCUSSION

The genomic DNA extraction protocol used in this study gave a reasonable quality and quantity of DNA. Upon gel electrophoresis on 1.5% agarose gel, sharp high molecular weight bands suitable for PCR-RFLP analysis were observed. Also, PCR amplification using Kappa casein Forward and Reverse primers yielded a high molecular weight band of 530 bp DNA fragment of *CSN3* gene from all tested animals. The amplified products from the two indigenous *Bos indicus* cattle, after the digestion with *HindIII* endonuclease generated three different DNA fragments of 530bp, 370bp and 160bp. The restriction digest of *CSN3* with *HindIII* endonuclease reveal three distinct genotypes. Genotype *AA* with a single undigested fragment of 530-bp, genotype *AB* has two digested fragments of 370- and 160-bp and genotype *BB* with three fragments of 530-, 370- and 160 bp. Hence, two kappa casein variants *A* and *B* were identified in this study (Fig.1).

The *CSN3* variants detected in this study and their frequencies are presented in Table 1. The genotypic frequencies and gene frequencies of the *CSN3* variants varied across the two breeds examined. Genotypes *AA* and *AB* were more predominant compared to genotype *BB* in the two breeds examined in this study. In all, genotypic variant *BB* was less frequent in the two breeds but appears more frequent in the N'dama breed (0.20) than in the white Fulani breed (0.18) (Table 1). In White Fulani breed, the genotypic frequency of the *BB* and *AB* variants were found to be identical (0.18) and (0.64) for *AA* variant. While for N'dama we have AA (0.52), BB (0.22) and AB (0.26). Also allele frequencies *A* and *B* were found on both breeds. Allele *A* was predominant than allele *B* in the two breed population in this study. The allele frequencies for the White Fulani are *A* (0.73) and *B* (0.27) and that of N'dama, *A* (0.66) and *B* (0.34). The highest frequency of *B* allele (0.34) was found in the N'dama breed. The results from this study were in line with the reports of Yanar *et al*. (2000); Liron *et al*. (2002); (Alipanah *et al*. (2005); Ahani *et al.* (2006); Azevedo *et al*. (2008); Beata *et al*. (2008); and Anggraeni *et al.* (2010).

Table 1: Genotypic and allele frequencies of *CSN*3 genetic variants

Breeds	**Genotypic frequency**			**Allele frequency**	
	AA	*BB*	*AB*	*A*	*B*
White Fulani	0.64	0.18	0.18	0.73	0.27
N'dama	0.52	0.22	0.26	0.66	0.34

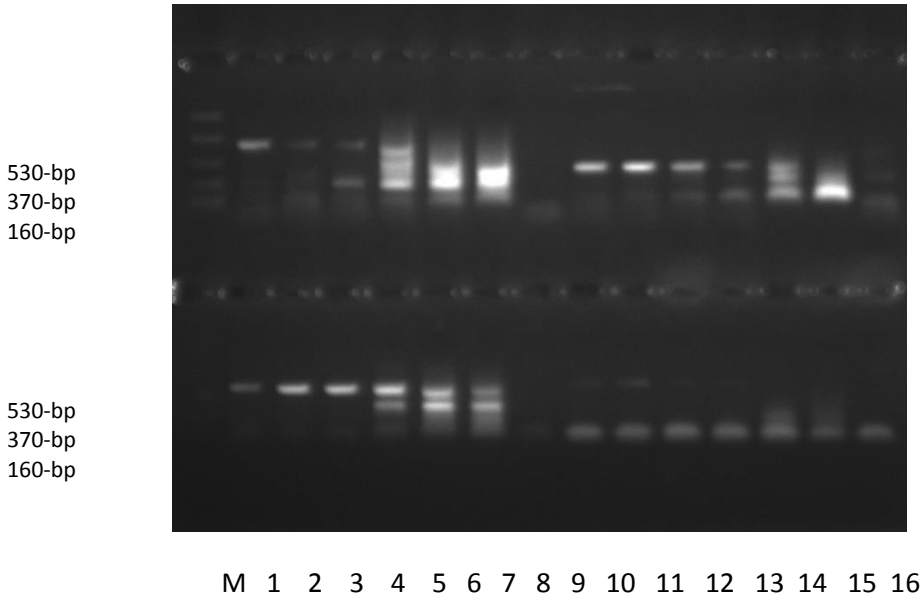

Fig. 1: The electrophoretic pattern obtained after digestion of PCR amplified cattle K-CN products with *Hind*III. Lane M: 100- bp ladder marker. Lane 10-16: Undigested fragment at 530-bp. Lanes 1-3 and10–13: Homozygous BB genotypes showed two restricted fragments at 370- and 160-bp.

CONCLUSION AND APPLICATION

The PCR-RFLP technique used was informative in distinguishing between the most widely reported *CSN3* variants, sequencing of the PCR fragments can also be done to reveal additional *CSN3* variants which were not previously identified through restriction digest analysis. The genotype frequency of *AA* was higher than that of *AB* and *BB* in the White Fulani and N'dama cattle population studied and the allele frequency of *A* was also higher than that of allele *B*. However, allele *B* is positively correlated with milk proteins and as such, the *AB* and *BB* genotype identified in *CSN3* gene is associated with higher milk protein and cows with *AB* and *BB* genotype were seen to have longer and larger and as such will produce higher amount of milk. Therefore incorporation of these genotypes for *CSN3* may help to improve the milk yield in the two indigenous cattle population.

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Phenotypic Characterization of Cephalic Traits of West African Dwarf Goat Population in Nigeria

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Abstract: The study aimed at classifying WAD of goats on the basis of their head conformation using. Three hundred goats were sampled form which 12 cephalic traits were measured. Data were subjected to PROC GLM of Univariate analysis using SAS (2004). Result revealed that there were significant effects ($p<0.05$) of sex on some cephalic traits of the WAD goats. Doe had significant higher values of horn space, skull length; face width, head length, neck length and neck width. However, there was no significant effect ($p>0.05$) of sex on skull width, head width, horn length, horn width, face length, head depth and cephalic index. Furthermore, on the basis of cephalic index, the result revealed that WAD goat is brachycephalic (short-headed) animal. Based on the result of the study, it was concluded that WAD goat is brachycephalic (short-headed) with, a skull that is relatively broad and short, typically with the breadth at least 80% of the length.

Keywords: Cephalic, conformation, goat, population, traits

INTRODUCTION

Goats constitute the largest group of small ruminant livestock in Nigeria totaling about 53.8 million and also constituting 6.2 percent of the World's goat population (FAOSTAT, 2011). The ability of goats to tolerate harsh climates, the presence of trypanotolerance in some breeds (Salako, 2004), suitability to traditional systems on account of small size, short generation interval (Abdul-Aziz, 2010) and ability to thrive on poor quality diets provided by scarce grazing on marginal lands (Adedeji *et al.*, 2011) all these combine to make small ruminants strategic to increasing livestock productivity in rural agricultural systems (Adedeji *et al.*, 2011). In south-west Nigeria, goats are used for customary rites in addition to meat production and religious purpose (Odeyinka and Ajayi, 2004).

According to Osinowo *et al* (1992), there are three indigenous breeds of goat in Nigeria Red Sokoto, West Africa Dwarf and Sahel.The West African Dwarf (WAD) goat is widely distributed across the rainforest belt of Southern Nigeria. They are short-legged and small-bodied animals, weighing between 22 and 26kg. They also present variable coat colors, ranging from black, brown, gray, red and white, and sometimes combinations of these in a variety of patterns (Mourad *et al.*, 2000).

Morphemetric measurement have been used to evaluate the characteristics of various breeds of animal and could provide first/hand information on the suitability of the animals for selection (Mwacharo *et al*, 2006, Yakubu, 2010). Cephalic index is the ratio of the maximum width of the head of an organism multiplied by 100 divided by its maximum length (Edilberto *et al.*, 2011). Given their biometric nature, cephalic measurements and indices allow comparisons between breeds from very distant geographical areas, and permit research into the distinctiveness of breeds based on cephalic evaluation (Pares and Jordan, 2008). Thus, this study sought to characterize WAD goat using its head dimension by means of multivariate analyses via principal component and discriminant analyses

MATERIALS AND METHODS

The study was conducted in Ibadan, the capital city of Oyo State, Southwest Nigeria. For this study, three hundred WAD goats were sampled from which twelve morphostructural traits were taken. Traits measured were

head width, head length, head depth, face width, face length, skull width, skull length, neck length, neck width, horn length, horn circumference and horn space. The measurement followed a standard procedure and anatomical reference points as described by Peres *et al. (*2012) and FAO, (2012). From these measurements, cephalic index was estimated according to Salako (2006) and Edilberto *et al*. (2011) as: Cephalic Index = Head width × 100 / Head length

Data were subjected to Univariate analyses using UNIVARIATE and FREQ of SAS (SAS INSTITUTE® 9.13, 2004).

RESULTS AND DISCUSSION

The result of summary statistics of cephalic traits of WAD goat is presented in Table 1. Results revealed that mean of values obtained range between 2.62 ± 0.78cm (horn space) and 81.68 ± 21.50% (cephalic index). Also the values of coefficient of variation (CV) ranged between 29.38% and 15.68% with the highest CV obtained for horn width and the lowest was obtained for face width respectively. However, relative high and low values of CV have been reported in earlier studies on cattle (Parés and Jordana, 2008); sheep (Popoola, 2015; Popoola and Oseni, 2018).

Table 1: Summary statistics of cephalic traits of WAD population

Traits (cm)	Mean	Statistical Deviation	Variance	Coefficient of variation
Horn Space	2.62	0.78	0.61	21.51
Skull Width	10.17	2.80	7.82	24.76
Head Width	11.45	2.50	6.29	18.95
Skull Length	8.10	1.67	2.81	20.14
Horn Length	6.11	2.96	8.78	28.33
Horn Width	4.92	2.64	7.00	29.38
Face Length	6.39	2.06	4.26	16.84
Face Width	10.19	2.23	5.00	15.68
Head Length	14.50	3.25	10.61	19.20
Head Depth	8.56	1.64	2.72	19.19
Neck Length	16.71	5.40	29.26	21.13
Neck Width	24.92	6.07	36.88	24.07
Cephalic index (%)	81.68	21.50	45.36	17.65

The descriptive statistics of effect of sex on cephalic morphological traits of WAD goat is presented in Table 2. Result revealed that there were significant effects ($p<0.05$) of sex on cephalic traits of the WAD goats. Doe had significant higher values of horn space, skull length, face width, head length, neck length and neck width. However, there was no significant effect ($p>0.05$) of sex on skull width, head width, horn length, horn width, face length, head depth and cephalic index. Furthermore, with the cephalic values obtained for both doe (81.45 ± 3.38%) and buck (87.29 ± 3.38%), the result revealed that WAD goat is brachycephalic (short-headed) animal. An individual is said to be brachycephalic or brachycranial when its cephalic index is greater than 81.1% (Schleter *et al*., 2009). A brachycephalic individual is characterized with short skull, flattened and widened occiput, that is, a skull that is relatively broad and short, typically with the breadth at least 80% of the length (Schleter *et al*., 2009). Sarma (2006) reported Kagani goat to be dolichocephalic (long-headed) with cephalic index of 41.95

Table 2: Effect of Sex on Morphological Traits of WAD Goat

Traits (cm)	Doe	Buck	SEM (±)
Horn Space	2.98[a]	2.28[b]	0.12
Skull Width	9.73	10.57	0.43

Head Width	11.67	11.25	0.38
Skull Length	8.67 [a]	7.56 [b]	0.26
Horn Length	6.94	5.31	0.45
Horn Width	5.32	4.55	0.40
Face Length	6.92	5.88	0.31
Face Width	11.03 [a]	9.38 [b]	0.34
Head Length	15.59 [a]	13.45 [b]	0.50
Head Depth	8.89	8.25	0.25
Neck Length	19.29 [a]	14.25 [b]	0.82
Neck Width	28.11 [a]	21.86 [b]	0.93
Cephalic Index	81.45	87.29	3.28

[a,b] means of different superscripts along the same row are significantly different ($p<0.05$); SEM – Standard error of mean

CONCLUSION

Based on the result of the study, it was concluded that WAD goat is brachycephalic (short-headed) with, a skull that is relatively broad and short, typically with the breadth at least 80% of the length.

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Evaluation of the sixth generation of Nigerian heavy-local chicken for Productive Traits in the Derived Savannah

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Abstract: A multiple selection programme was designed and carried out to further determine the genetic response of productive traits of the Nigerian heavy local chicken ecotype (NHLCE) using selection index from fourth to sixth generations. A total of 270 pullets (23 weeks old) from a random breeding population of heavy local chicken ecotype were used for the study. The birds have been subjected to three generations (G_1, G_2 and G_3) of index selection. The parameters measured included Body Weight at First Egg (BWFE), Average Egg Weight (AEW), and Total Egg Number (TEN). The hens were housed individually in cages and fed layers' ration G_4 and G_5: 110g/hen/day; G6: 125g/hen/day. Water was also given *adlibitum*for 16 weeks' egg production (short term egg production). A control population was established to monitor forenvironmental (rE) effects and estimate genetic responses. Data on BWFE, AEW, and TEN were evaluated using Analysis of Variance (ANOVA). Selection response indicators namely, Selection differential (ΔS), expected, predicted and realized genetic gains were determined for each trait. Direct selection responses namely expected, predicted and realized genetic gains were all positive for all the traits selected. Expected average genetic gain per generation for BWFE, TEN and AEW were 66.2g, 4.19 and 1.01g respectively. For gain in index traits due to selection on index score, a mean value of 1.96eggs was recorded for TEN, 0.14g for AEW and 11.65g for BWFE. The ratio for realized to expected genetic gains were all positive across the three generations with values of 0.96 for BWFE, 1.42g for AEW and 1.62 for TEN.

Keywords: Sixth generation, performance evaluation, productive traits, local chicken ecotype and selection index.

INTRODUCTION

The local chickens of Nigerian play major roles through their contributions to food security, household income, employment and quick funds in emergencies [1], [2], [3]. Hence the desire for the development of Nigerian breed of egg chicken, integration and commercialization into the production systems through selection for productive traits. The improvements of the indigenous chicken genetic resources require sustained and painstaking approach which would make Nigeria self-sufficient in poultry products. Biochemical genetics/genetic engineering biotechnology and more recently genomics offer useful information to breeders with regard to poultry improvement; however, they are not likely to replace the conventional methods of selection [4], [5]. The novel methods could augment the traditional methods such that information obtained could be incorporated into an overall selection index to make selection more effective. Hence, for Nigeria to develop her own indigenous breed of egg chicken, selection is still a basic technology and a better option for now [6].

MATERIALS AND METHODS

Study site: The study was conducted at the Department of Animal Science Teaching and Research Farm, University of Nigeria Nsukka. Nsukka lies in the derived Savannah region, and is located on longitudes 7^0 24^1E and latitudes 5^0 22^1N with annual rainfall range of 986 – 2098mm. The climate is of humid tropical setting with relative humidity range of 56.01 – 100%. The average diurnal minimum temperature ranges between 20.99 – 37^OC [7]. Nsukka is characterized by two seasons of the year. The rainy season extends from April – October while the dry season spans from November – April with no sharp demarcation.

Management of Experimental Animals: Artificial insemination technique was used to generate the foundation stock. Six (6) heavy local chicken ecotype cocks and sixty (60) hens were randomly selected from the reference population and housed in a battery cage system in the Teaching and Research farm of the Department of Animal Science, University of Nigeria, Nsukka, in a mating ratio of one cock to ten hens (1:10). The cocks (sires) and hens (dams) were identified with sire and dam numbers using tags: sire identification was 1,2,3,4,5 and 6, while dams were in groups of tens group A, B, C, D, E and F. Semen was collected according to the massage technique [8] from each of the cocks and diluted or extended using sodium citrate dehydrate. The dams were artificial inseminated according to dam group to produce generation four (G_4). Fertile eggs were collected and hatched to produce the day old chicks. The management system adopted was as described by [9] from day-old (0 – 8weeks), (9 – 22weeks) and (23 – 39weeks) of age. Formulated rations were fed according to each growth phases. The layer's ration contained 16.5% crude protein and 2,600 Kcal ME/kg at the rate of 110g/hen/day in G_4 and G_5 generations. The layer's ration was fed 125g/hen/day in G_6 due to improvement in body weight. Water was given *adlibitum*, while routine vaccinations were administered at each growth phase.

Data Collection and Measurement: A simplified linear selection index according to [4] in the relative economic weights and heritability of the traits was constructed and used as weighing factors for phenotypic values. All hens belonging to the G_4 generation were subjected to selection using a selection index incorporating, BWFE, AEW and TEN. The phenotypic performance of each hen in these traits was represented in the index as X_1, X_2, and X_3 for BFWE, AEW, TEN respectively. The index score (1) for each hen became a univarite character (trait) subjectable to selection. The index score (1) thus, enabled the ranking of the hens for the purpose of selection and a hen which attained the index score or above the score was selectedfor the next generation.
The general form of the index is given as

$$I = \sum bix_i = \sum aih_1^2 X_1^1 + a_2h_2^2X_1^1 + ----- aihiX_i^1$$

Where $bi = aih_i^2$
$ai =$ the relative economic weight of the trait in the index
$h_i^2 =$ heritability estimate of the trait in the index
Xi = standardized phenotypic value of the ith trait in the index BWFE, AEW & TEN
$I =$ Index
The standardized variable xi was obtained according to [10]
as $xi = \frac{xi - \bar{x}i}{\sigma xi}$
Where $xi =$ Record of the performance of an individual in the trait of the index
$\bar{x}i =$ mean of the performance of the whole population in the ith trait of the index
$\sigma xi =$ population phenotyphic standard deviation for the ith trait

RESULTS AND DISCUSSION

Table 1 presents the expected direct response (Ri), Cumulative (CUMR), expected average ($\bar{R}i$) and per generation response across the three generations. The table shows that the expected direct response did not increase progressively in BWFE as it did in TEN & AEW. However, all the traits showed positive responses across the generations. The expected average ($\bar{R}i$) genetic response recorded were 51.11g(BWFE), 6.46(TEN) and 1.20g (AEW) the values obtained for average direct genetic response per generation in this study indicated positive selection response after three generation of index selection with a value of 51.11g for BWFE, 13.13 TEN and 1.20g AEW which were however higher than the G_3 base population.

Table 1: Expected Direct Response (Ri), Cumulative (CUMRi) and Average Genetic Response for selected traits across G_4, G_5 and G_6 generation.

Trait	Gen.	Ri(g)	CUMRi (g)	$\bar{R}i$ (g)	Ri/yr (g)
BWFE	G_4	66.26	66.26		66.26
	G_5	16.13	82.39		16.13

	G_6	70.94	53.33	51.11	70.94
AEW	G_4	1.01	1.01		1.01
	G_5	1.08	2.09		1.08
	G_6	1.50	3.59	1.20	1.50
TEN	G_4	4.19	4.19		4.19
	G_5	6.09	10.28		6.09
	G_6	9.11	19.39	6.46	9.11

BWFE = Body Weight at First Egg, AEW = Average Egg Weight, TEN = Total Egg Number, G_4,G_5,G_6 = Generation four, five and six, **Ri =** Expected Direct Genetic Response, CUMRi = Cumulative Genetic Response, $\overline{\mathbf{Ri}}$ = Average Genetic Response per Generation, **Ri/yr** = Expected Direct Genetic Response per year

Table 2 presents the predicted genetic response (RPi) and the realized genetic gains(ΔGR) for the index selected traits across the three generations. The table shows that for BWFE, the predicted genetic gain was negative across the three generations while TEN and AEW were fluctuating. However, for AEW both predicted response and realized genetic gains were positive and increased from G_4(0.198) and (0.590) respectively before dropping to (0.093) and (0.18) in G_4 with appreciable increase to (0.217) and (0.37) in G_6 above G_5; for the TEN, there was progressive increase from G_4 (0.030) and (0.51), G_5 (0.732) and (3.27) and G_6 (1.089) and (2.41) for both the predicted genetic gain and the realized genetic responses. The significance of index selection on the three selected characters have shown much genetic progress which one can physically see in the size and number of eggs produced by the heavy local chicken ecotype.

Table 2: Predicted Genetic Response (RPi) and realized genetic gain (ΔGR)

Trait	Gen.	RPi (g)	ΔGR (g)
BWFE	G_4	-8.80	-12.87
	G_5	-2.66	-22.94
	G_6	-3.17	-10.06
AEW	G_4	0.198	0.59
	G_5	0.093	0.18
	G_6	0.217	0.37
TEN	G_4	0.030	0.51
	G_5	0.732	3.27
	G_6	1.089	2.41

BWFE = Body Weight at First Egg, AEW = Average Egg Weight, TEN = Total Egg Number, G_4,G_5,G_6 = Generation four, five and six, RPi = Predicted Direct Genetic Response, ΔGR = Realized Genetic Gain/Response

Table 3presents the expected genetic gain / response in index traits as a result of selection on index score and the ratio of realized to expected genetic gain in index traits for G_4, G_5 and G_6 generations. The observed expected genetic response in the index traits as a result of selection on the index score was positive for the three traits selected across the three generations. The BWFE increased from 13.27(g) in G_4, decreased to 11.94(g) G_5 and finally dropped to 9.753(g) in G_6 while the average genetic gain per generation was 11.65(g). The values for AEW presented similar trends rising from 0.17(g) in G_4 to 0.18(g) in G5 before dropping to 0.07(g) in G_6 generation with average of 0.14(g). For TEN, the genetic gain recorded were 0.52 eggs in G_4, 4.37 eggs in G_5 and 0.98 eggs in G_6 with average per generation of 1.96 eggs. The results revealed that among the three index-selected traits, BWFE reflected the largest response in all the three generations of the study though it had the least economic weight associated with it. [11], reported that a trait that had the largest economic weight associated with it tended to dominate the index. The present study, however failed to present such scenario and this could be traced to the large genetic and phenotypic variances of BWFE when compared to other traits in the index.

Table 3: Expected Genetic Gain / Response in Index traits as a Result of Selection on Index Score

Trait	Gen.	ΔGi (g)	CUMΔGi (g)	ΔGR/ΔGi
BWFE	G_4	13.27	13.27	0.97
	G_5	11.94	25.21	1.00

	G_6	9.73	34.95	0.91
Average/Gen		11.65	-	-
	G_4	0.17	0.17	3.47
AEW	G_5	0.18	0.35	1.00
	G_6	0.07	0.42	0.91
Average/Gen		0.14	-	-
	G_4	0.52	0.52	1.00
TEN	G_5	4.37	4.37	0.75
	G_6	0.98	5.87	2.50
Average/Gen		1.96	-	-

BWFE = Body Weight at First Egg, AEW = Average Egg Weight, TEN = Total Egg Number, G_4,G_5,G_6 = Generation four, five and six, ΔGi= Expected Genetic Gain/Response, CUMΔGi = Cumulative Genetic Gain per Generation, ΔGR = Realized Direct Genetic Gain

CONCLUSION

The conventional selection method used for the simultaneous selection of body weight at first egg, average egg weight and total egg number was effective in improving the traits concerned since the genetic responses were positive and relatively high. This virtually suggests that selection based on an index can be applied in breeding programmes for the development of the Nigerian heavy local chicken ecotype for increased egg production traits. The selection intensity pressure applied brought about improvement in the traits studied and that significant genetic variation still exists which provides room for future selection responses in subsequent generations.

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Modeling the Growth Curve of Japanese Quail under different Nutritional Environments

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Abstract: Previous studies on Japanese quails have fitted non-linear models to growth data and assessed resultant parameters under a restricted nutritional environment. There are limited studies on quail for growth modeling under different nutritional environments. This study therefore modeled the growth of Japanese quails under different nutritional environments, compared them in order to choose the best fitted model and investigated the statistical interaction between sex and diet using the best fitted model. Weekly body weight (BW) records were collected from 360 quails from hatch up to 56 days at the Quail Unit, OAU, T&R Farm, Ile Ife, Nigeria. Bertalanffy, Gompertz and Logistic models were used for the study. Each model was fitted separately to BW using the NLIN procedure of SAS®. Parameters were estimated for each model and comparison was based on R^2, AIC and BIC. Across the diets, asymptotic weight (A) for Gompertz ranged from 147.0-162.7g, Bertalanffy, 167.0-176.7g and Logistic, 135.0-146g. Growth rate (k) for Gompertz model ranged from 0.35-0.48, Bertalanffy, 0.29-0.37 and Logistic, 0.60-0.81. A for males of 22%-20%, 22%-22% and 26%-20% combinations were significantly ($P<0.05$) higher than those of other diet combinations. A for females of 26%- 20% were significantly ($P<0.05$) higher than those of other diet combinations. No significant difference ($P>0.05$) was observed in the k of the male under all diets combinations and no significant difference ($P>0.05$) was observed in the k of the females under all diets combinations. The study concluded that Logistic model (R^2=0.99634-0.99891; AIC=4.5392-57.8418; BIC=8.67-62.10) resulted in the best fit model.

Keywords: Nutritional environments, Non-linear models, body weight, R^2 and Japanese Quails.

INTRODUCTION

Japanese quail (*Coturnix coturnix japonica)* has a small body size. Genetic evaluation of animals has been based on several traits depending on the species such as body weight, feed intake and longevity (9). Selection in poultry is traditionally based on body weight for a standard age, leading to a reduced age at slaughter. However, this kind of selection increases mature weight, which requires different management for breeders (13). Japanese quail is being used as a model type in poultry breeding experiments because of its short generation interval, high fertilization efficiency and simple equipment for its rearing (9). Growth models are of great importance for animal production in that they provide an opportunity for practical interpretations about growth and feed conversion (2). The most commonly used models to analyze growth of poultry are Von-Bertalanffy, Gompert and Logistic models (3, 14, 10). The parameters of growth models, and especially their biological meaning, are informative for breeders as they permit the inference and accurate prediction of relevant economic information with regard to the inflection point and maturity that are not accessible from simple analysis of growth traits such as weights at different key ages (birth, weaning and slaughtering) or daily gains. Hence, the need to model the growth of Japanese quails under different nutritional environment. Previous studies on Japanese quails have fitted non-linear regression models to growth data and assessed resultant parameters under a restricted nutritional environment. There are limited studies on quail for growth modeling under different nutritional environments, hence this study. Therefore, the objectives of the study were to model the growth curves of Japanese quails under different nutritional environments using four nonlinear growth models, to compare the models in order to establish the most appropriate model under different nutritional environments and investigate the statistical interaction between sex and diets in the growth model using the selected model.

MATERIALS AND METHODS

The experiment was carried out at the Quails Unit of Obafemi Awolowo University, Teaching and Research Farm, Ile Ife, Nigeria. Three hundred and sixty Japanese quails hatched from eggs collected from parents that were randomly mated were used for the study. After hatching they were randomly distributed to three dietary treatments, tagged, weighed and brooded for 4 weeks. The dietary treatments contained three different levels of crude protein, 22, 24, and 26% each with 2,800 kcal/kg metabolizable energy. At the end of the 4th week, the birds under each dietary treatment were further randomly distributed to three new dietary treatments comprising 18, 20 and 22% crude protein, each with 2,800 kcal/kg metabolizable energy. In all there were nine (9) diets

combination as follows: 22% starter and 18% finisher diet= T1; 22% starter and 20% finisher diet= T2; 22% starter and 22% finisher diet= T3; 24% starter and 18% finisher diet= T4; 24% starter and 20% finisher diet= T5; 24% starter and 22% finisher diet= T6; 26% starter and 18% finisher diet= T7; 26% starter and 20% finisher diet= T8; 26% starter and 22% finisher diet= T9. Individual body weight (BW) was obtained weekly from hatching to eight (8) weeks using a sensitive digital.

Statistical analysis: The nonlinear growth models, the Gompertz, the Bertalanffy and the Logistics were applied to the data using the PROC NLIN of SAS software. The parameters of these models were fitted based on the mathematical functions below:

Gompertz: $W_t = A*e^{(-B*e(-k*t)}$ (8)

Von-Bertalanffy: $W_t = A\,(1 - B*e^{-kt})^3$ (4)

Logistic: $W_t = {}^{A}/_{(1 + B * e^{-k*t})}$ (11)

W_t= Body weight of individual at age t (weeks), t = Age in weeks, A= Asymptotic weight (mature weight) of the animal; B= Constant of integration (the proportion of asymptotic weight) and k= Growth rate/maturation rate (how fast animal approaches adult weight).

Four statistics were used to determine the goodness of fit, that is, most appropriate model. These include coefficient of determination (R^2), Mean Square Error (MSE), Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). The influence of different dietary crude protein levels and sex on the parameters of the selected model was also investigated using the procedure of nonlinear models (PROC NLIN) of SAS software.

RESULTS AND DISCUSSION

Table I shows the estimates of growth curve parameters under different crude proteins combination. The table shows that asymptotic weight (A) for Gompertz model ranged from 147.0-162.7g for T1 and T7 respectively, Bertalanffy model ranged from 167.0-176.7g for T3 and T7 respectively, Logistic model ranged from 135.0-146.3g for T1 and T7. The constant of integration (B) of the growth functions for Gompertz ranged from 2.56-3.41 for T7 and T6 respectively; Bertalanffy ranged from 0.61-0.71 for T7 and T3 respectively, Logistic ranged from 7.69-14.11 for T7 and T6. Growth rate (k) for Gompertz model ranged from 0.35-0.48, Bertalanffy model ranged from 0.29-0.37 and Logistic model ranged from 0.60-0.81. Table II shows the goodness of criteria to select the model that most appropriately fits the data on Japanese quail under different nutritional environments. The goodness of fit criteria includes the coefficient of determination (R^2), Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC). The model that had the highest R^2 and lowest AIC and BIC was the model that best fits the data (5). R^2 for Gompertz model ranged from 0.99327-0.99628, for Bertalanffy model ranged from 0.95271-0.99316 and Logistic model ranged from 0.99634-0.99891. Logistic model had the highest estimate for R^2. AIC for Gompertz model ranged from 53.7872-86.5716, Bertalanffy model ranged from 69.7527-107.5471 and Logistics model ranged from 4.5392-57.9737. BIC for Gompertz model ranged from 58.85-88.55, Bertalanffy model ranged from 83.02-109.73, and Logistics model ranged from 8.67-62.10. Table III shows estimates of asymptotic body weight and growth rate of Logistic model, according to dietary crude protein levels and sex in Japanese quail. Asymptotic weight for males of T2, T3 and T8 were significantly ($P<0.05$) higher than the males under other diets. No significant difference was observed in the growth rates of the male birds under all diets combination. Asymptotic weight for females of T8 are significantly ($P<0.05$) higher than the females under other diets. No significant difference was also observed in the growth rates of the female birds under all diets combination. The results of this study agree with (12) who compared different models to describe the growth of Japanese quail fed 23% starter and 18% finisher diets and reported asymptotic weight of 153.111g for Gompertz and 151.227g for Logistic models. (10) reported 222.0g, 222.1g and 201.9g for Richards, Gompertz and Logistic models respectively which are higher than those obtained in this study. This could be due to the fact that asymptotic weight is directly related to genotype and environmental effects, hence different quail genotypes fed different environment would have different asymptotic weight (10). The results of this study disagree with (7) who compared Richards, Gom[illegible]z and Logistics for growth of Japanese quail and reported asymptotic weight of 200.3g for Logistic mod[illegible]nder 26% starter and 22% finisher diet. The constant of integration (B) in this study for Gompertz and L[illegible]tic models were similar to (10) and (6) who reported 3.31 and 12.82; 3.80 and 16.24 for Gompertz and Lo[illegible]c models respectively. B for Bertalanffy in this study was

close to (10) and (6) who reported 0.81-0.84 for chicken and 0.84 for Japanese quail respectively. The constant of integration indicates the scaling parameter of the growth functions. The growth rate indicates the rate of growth when the animal reached mature size. This result agrees with (7) who reported growth rate of 0.3-0.4 and 0.6-0.7 for Gompertz and Logistic models respectively but disagrees with (10) who reported 0.08, 0.14 and 0.05 for growth rate of Gompertz, Logistic and Bertalanffy models respectively. On the basis of the R^2, AIC and BIC, Logistic model was the most appropriate model that best described the data on Japanese quail under different nutritional environments. The results of this study agree with (7) who reported that Logistic was the best model for describing the growth of Japanese quail when the data was truncated before maturity for males, but this result disagrees with (10) who reported R^2 of 0.99998, 0.99968 and 0.99918 for Gompertz, Bertalanffy and Logistic models; AIC of -2.010, 19.6830 and 24.37812 for Gompertz, Bertalanffy and Logistic models; BIC of -2.17221, 19.4670 and 24.21543 for Gompertz, Bertalanffy and Logistic models. (1) who compared Richards, Gompertz, Logistic, and a spline growth models in a study of growth in chickens reported high R^2 values for all four growth models. Reports on the significant interaction effect of different dietary crude protein and sex on the asymptotic weights (*A*) of Japanese quail are scarce in the literatures.

CONCLUSION

1. The generally high R^2 for Gompertz, Bertalanffy and Logistic models observed in the present study indicates that the models were adequate in describing the growth pattern in Japanese quail under different nutritional.
2. However, based on the goodness of fit criteria; R^2, AIC and BIC values, the Logistic model best described the live weight data of Japanese quail under different nutritional environments. Asymptotic weight was influenced by different nutritional environments but growth rate was not.
3. The results of this study can help planning farm management strategies and decision-making regarding the culling of poor producers and selecting the highly productive animals just by considering their growth parameters.

Table I: Estimates of Growth Curve Parameters under different Crude Protein Combination

Diets/ Models	Model Parameters								
	Asymptotic Weight (A)			Constant of Integration (B)			Growth Rate (k)		
	Gomp	Bertfy	Logs	Gomp	Bertfy	Log	Gomp	Bertfy	Log
T1	147.0±7.71	152.0±13.37	135.0±2.46	3.14±2.32	0.69±0.07	11.98±1.32	0.44±0.05	0.33±0.06	0.77±0.
T2	152.8±9.27	163.6±15.69	140.1±3.33	3.19±0.39	0.70±0.07	12.51±1.81	0.44±0.06	0.33±0.06	0.77±0.
T3	154.1±11.13	167.0±19.03	139.4±4.21	3.26±0.43	0.71±0.07	13.29±2.33	0.42±0.06	0.31±0.07	0.76±0.
T4	148.8±8.17	159.8±14.16	135.8±2.94	3.11±0.32	0.69±0.06	11.81±1.48	0.43±0.05	0.32±0.06	0.75±0.
T5	151.2±9.62	162.9±16.55	137.6±3.38	3.20±0.38	0.70±0.07	12.64±1.81	0.43±0.06	0.32±0.06	0.76±0.
T6	149.1±10.07	158.4±16.39	137.8±3.89	3.41±0.54	0.74±0.10	14.11±2.73	0.47±0.08	0.36±0.08	0.81±0.
T7	162.7±17.31	176.7±24.40	146.3±11.00	2.56±0.29	0.61±0.05	7.69±1.87	0.35±0.07	0.29±0.06	0.60±0.
T8	152.7±9.70	161.9±15.11	141.4±4.60	3.05±0.41	0.68±0.08	11.22±2.21	0.45±0.07	0.35±0.07	0.77±0.
T9	150.5±8.72	158.4±13.43	140.8±4.18	3.06±0.42	0.69±0.08	11.15±2.17	0.48±0.07	0.37±0.07	0.80±0.

Gomp=Gompertz model; Bertfy=Bertalanffy model; Logs=Logistic model; T1=22% starter and 18% finisher diet; T2=22% starter and 20% finisher diet; T3=22% starter and 22% finisher diet; T4=24% starter and 18% finisher diet; T5=24% starter and 20% finisher diet; T6=24% starter and 22% finisher diet; T7=26% starter and 18% finisher diet; T8=26% starter and 20% finisher diet; T9=26% starter and 22% finisher diet.

Table II: Goodness of Fit Criteria to select the most appropriate model

Diets/ Models	Goodness of Fit Criteria								
	R^2			AIC			BIC		
	Gomp	Bert	Logs	Gomp	Bert	Logs	Gopmp	Bert	Logs
T1	0.99628	0.95271	0.99891	54.8264	72.4558	4.5392	58.95	85.40	8.67
T2	0.99519	0.99162	0.99757	65.6220	79.8607	27.8250	71.60	93.14	33.80
T3	0.99448	0.99107	0.99741	72.0999	84.6285	41.8027	77.17	96.29	46.75
T4	0.99627	0.99317	0.99854	53.7872	69.7527	16.3404	58.85	83.02	21.41
T5	0.99529	0.99184	0.99819	65.9935	80.8396	26.8412	70.12	95.58	30.97
T6	0.99327	0.98891	0.99722	86.5716	107.5471	48.4703	88.55	109.73	50.64
7	0.99141	0.99143	0.98939	78.3346	83.3262	37.8854	63.89	84.31	43.86
T8	0.99391	0.99072	0.99634	78.7904	89.7565	57.9737	82.92	100.10	62.10
T9	0.99388	0.99035	0.99654	79.1190	97.7380	55.8418	83.25	101.87	59.97

Gomp=Gompertz model; Bertfy=Bertalanffy model; Logs=Logistic model; T1=22% starter and 18% finisher diet; T2=22% starter and 20% finisher diet; T3=22% starter and 22% finisher diet; T4=24% starter and 18% finisher diet; T5=24% starter and 20% finisher diet; T6=24% starter and 22% finisher diet; T7=26% starter and 18% finisher diet; T8=26% starter and 20% finisher diet; T9=26% starter and 22% finisher diet.

Table III: Estimates of Asymptotic Weight and Growth Rate ± standard error of Logistic Model, according to Dietary Crude Protein Levels and Sex in Japanese quail

Growth	Male		Female	
parameter/ Diet	A	K	A	K
T1	125.3±1.99[c]	0.78±0.04	143.9±4.00[c]	0.76±0.06
T2	130.8±2.79[a]	0.74±0.05	149.6±5.31[b]	0.82±0.61
T3	134.3±3.74[a]	0.74±0.06	143.6±4.98[c]	0.78±0.07
T4	127.3±2.12[b]	0.74±0.06	142.1±3.97[c]	0.77±0.06
T5	129.9±2.82[b]	0.77±0.05	146.3±4.60[b]	0.76±0.06
T6	129.5±3.27[b]	0.79±0.06	144.9±4.60[c]	0.83±0.08
T7	128.6±2.66[b]	0.76±0.05	148.5±4.69[b]	0.78±0.07
T8	131.3±3.84[a]	0.78±0.07	157.1±12.86[a]	0.77±0.09
T9	128.7±3.31[b]	0.77±0.06	149.8±5.66[b]	0.82±0.10

[a,b,c] Means within rows with different superscripts are significantly (P<0.05) different.

A= Asymptotic weight, k= Growth rate; T3=22% starter and 22% finisher diet; T4=24% starter and 18% finisher diet; T5=24% starter and 20% finisher diet; T6=24% starter and 22% finisher diet; T7=26% starter and 18% finisher diet; T8=26% starter and 20% finisher diet; T9=26% starter and 22% finisher diet.

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Phenotypic Correlations and Body Weights Prediction of Laying Birds Fed Maize and Acha-Based Diets

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Abstract: Study was conducted to determine the relationship between body weight and linear body parameters in laying birds fed maize and acha based diets. A total of 120 laying birds (21 weeks old) were used for the experiment. Shank length, wing length, thigh length, body girth and back length, were measured using a measuring tape. Data were analyzed using SPSS version 21.0. The results showed that Pearson's correlation coefficient (r) between ST and SL, NC with ST and TL were high, positive and significant ($P<0.05$) for maize fed birds while SL and BH, TT with BG and SL were negative and significant ($P<0.05$). The values of the coefficients of determination (R^2) ranged from 0.194 to 0.494 and 0.095 to 0.623 respectively for 0 and 100% acha, with the combination of traits showing the highest R^2 value. The predictive equations showed that there were no significant ($P>0.05$) relationships between body weight and linear body measurements. High R^2 values observed in this study shows that the predictive equations could be used to predict body weight accurately. The positive, medium and significant correlation between the body weight and linear body measurements is useful in the prediction of body weights, selection and breeding of laying birds for improvement. The regression analysis in this study also indicated that body weight of birds could easily be predicted from any of the linear body measurements. The traits combined could be the best predictor of body weight of laying chickens.
Keywords: Linear body measurements, correlation, maize diet and acha diet

INTRODUCTION

In Nigeria, the most popularly incorporated cereal grain in feed formulation is maize where it supplies more than half of the metabolizable energy requirement of poultry. Researchers focuses on the exploration of locally available cheapest alternative feed resources that can replace conventional cereal grains (sorghum, maize, etc.) mainly because of the global demand which has exceeded production (Ukim *et al*., 2013).

Acha (*Digitaria iburua*) commonly called black fonio is an indigenous cereal of West African dating back to 7,000 years (Cruz *et al*., 2011; Dachi *et al*., 2014). Acha grain has crude fibre (1.03 – 8.57%), crude protein (5.75-12.00%), fold ash (1.08-5.70%), carbohydrate (67.24-83.38%) with gross energy of 3556.06-3786.40kcal/kg. The amino acid profile of acha is comparable to that of whole egg protein and it is a rich source of minerals (magnesium, zinc, iron and manganese) (Cruz *et al*., 2011; Ukim *et al*., 2013; Dachi *et al*., 2014).

Morphometric characters have for years been used to predict body weight of animals; where different regression models are explored. This study was carried out to establish a detailed relationship between body weight and linear body measurements of laying birds fed maize and acha based diets.

MATERIALS AND METHODS

Research was conducted at the poultry unit of the Teaching and research farm of the Department of Animal Science, Faculty of Agriculture, University of Calabar. Experimental duration was ten weeks. 120, laying chickens (21 weeks old) of Isa-Brown were allotted to two treatments (Table 1). Data were collected on body weight (BW), body length (BL), body girth (BG), body height (BH), shank length (SL), shank thickness (ST), thigh length (TL), thigh thickness (TT) and neck circumference (NC). Measurements were done according to the illustrations by FAO (2012) using a weighing balance of 0.05 g sensitivity and measuring tape. Data were analyzed using SPSS (version 21) for correlation and regression functions for predicting body weights from quantitative traits.

RESULTS AND DISCUSSION

Table 1. Gross composition of Experimental birds

Ingredient	0%	100%
Maize	50.00	0.00

Acha	0.00	50.00
FF Soybean meal	10.00	10.00
Fish meal	2.00	2.00
Wheat offal	24.00	24.00
Palm kernel cake	8.00	8.00
Palm oil	0.50	0.50
Limestone	1.50	1.50
Bone meal	3.00	3.00
Salt	0.25	0.25
Vitamin Premix*	0.25	0.25
Methionine	0.25	0.25
Lysine	0.25	0.25
Total	**100.00**	**100.00**
Calculated values		
Cost per kg (Nkg^{-1})	144.97	245.69
Crude protein	15.38	16.88
ME (Kcal/kg)	2829.10	2797.78
Analyzed values		
Crude protein	17.55	18.49
ME (Kcal/kg)	2826.60	2838.00

Vit-min premix – vitamin-mineral premix. *Bio-Super Premix provided: Vitamin A, 1,500,000IU; vitamin D3, 300,000IU; vitamin E, 400mg; vitamin K3, 100mg; vitamin B12, 2000mcg; Nicotinamide, 2,000mg; Calcium D-Pantothenate 800mg; Choline Chloride, 40,000mg; Ferrous Sulfate, 2,000mg; Manganese Sulfate, 5,000mg; Copper Sulfate, 80mgl Zinc Oxide, 3,000mg; Cobalt Sulfate, 10mg; Potassium Iodide, 120mg; Magnesium Sulfate, 1,000mg; DL-Methionine, 10,000mg; Antioxidant, 18,000mg.

Table 2: Correlation matrix of body weight and linear body measurements of laying birds (acha based diet in upper diagonal and maize based diet in lower diagonal)

	BW	**BL**	**BG**	**BH**	**SL**	**ST**	**TL**	**TT**	**NC**
BW	**1.000**	0.095	-0.294	-0.024	0.063	0.391	0.242	0.181	-0.307
BL	0.194	**1.000**	0.050	0.225	-0.169	0.348	-0.061	-0.085	0.032
BG	0.178	0.243	**1.000**	-0.157	-0.169	0.123	0.017	-0.505*	0.084
BH	0.296	0.131	0.126	**1.000**	-0.505*	0.022	0.107	0.298	-0.119
SL	0.112	-0.228	0.345	-0.143	**1.000**	0.001	-0.350	-0.435*	0.045
ST	0.000	-0.181	0.167	-0.178	0.572*	**1.000**	-0.073	-0.115	-0.065
TL	0.158	0.109	-0.161	-0.213	-0.003	0.208	**1.000**	0.306	0.317
TT	-0.052	-0.090	-0.114	0.373	-0.070	-0.060	-0.100	**1.000**	0.015
NC	0.163	-0.313	-0.275	-0.086	0.188	0.436*	0.540*	-0.245	**1.000**

BW = Body Weight; BL = Body Length; BG = Body Girth; BH = Body Height, SL = Shank Length; ST = Shank Thickness; TL = Thigh Length; TT = Thigh Thickness; NC = Neck Circumference; *($P<0.05$)

Table 3: Simple linear regression equations relating live body weight to body linear measurements

Levels (%)	**Live Weight (Y) (g)**	**Linear body Measurement (X) (cm)**	**Prediction Equation**	**R**	**R^2**
0% acha	LW	BL	1306.66+3.00BL	0.194	0.038
		BL,BG	1254.58+2.48BL+1.71BG	0.237	0.056
		BL,BG,BH	1111.38+2.04BL+1.39BG+7.86BH	0.353	0.124
		BL,BG,BH,SL	939.80+2.95BL+0.38BG+8.73BH+20.96SL	0.388	0.151
		BL,BG,BH,SL,ST	950.29+2.93BL+0.38BG+8.62BH+23.33SL-3.78ST	0.389	0.152

		BL,BG,BH,SL,ST,TL	761.23+2.06BL+1.05BG+9.90BH+25.28SL-11.07ST+13.29TL	0.453	0.205
		BL,BG,BH,SL,ST,TL,TT	837.13+1.84BL+0.78BG+11.65BH+25.32SL-10.71ST+13.03TL-6.43TT	0.472	0.223
		BL,BG,BH,SL,ST,TL,TT,NC	815.11+2.97BL+1.57BG+9.64BH+24.26SL-18.62ST+6.79TL-2.86TT+9.40NC	0.494	0.244
100% acha	LW	BL	1426.59+0.63BL	0.095	0.009
		BL,BG	1576.45+0.73BL-3.72BG	0.314	0.098
		BL,BG,BH	1626.36+0.89BL-3.94BG-2.12BH	0.329	0.108
		BL,BG,BH,SL	1652.99+0.89BL-4.04BG-2.44BH-1.94SL	0.330	0.109
		BL,BG,BH,SL,ST	1442.08-0.17BL-4.70BG-2.44BH-4.32SL+36.25ST	0.531	0.282
		BL,BG,BH,SL,ST,TL	1533.98-0.33BL-4.88BG-2.89BH-11.17SL+35.52ST-0.52TL	0.579	0.335
		BL,BG,BH,SL,ST,TL,TT	1380.14-0.18BL-3.58BG-2.72BH-5.04SL+35.29ST-0.57TL+3.08TT	0.590	0.348
		BL,BG,BH,SL,ST,TL,TT,NC	1445.64+0.04BL-3.13BG-3.07BH-1.62SL+33.65-0.40TL+3.53TT-8.29NC	0.623	0.388

BW = Body Weight; BL = Body Length; BG = Body Girth; BH = Body Height, SL = Shank Length; ST = Shank Thickness; TL = Thigh Length; TT = Thigh Thickness; NC = Neck Circumference; R^2= coefficient of determinations; R= coefficient of correlation

Correlation between traits: Results showed that the pairs of phenotypic traits evaluated in the maize based diet expressed positive, negative, medium and significant ($P<0.05$) correlations (Table 2). SL versus ST, ST versus NC and TL versus NC were positive and significantly ($P<0.05$) correlated. The highest correlation value ($r=0.572$) was expressed between SL and ST while the lowest correlation value ($r=0.000$) was expressed between BW and ST. BH versus SL expressed the highest correlation value while SL versus ST had the lowest correlation for acha fed birds. The positive correlations expressed by some of the evaluated traits indicated that selection and improvement of one trait will lead to a corresponding improvement in the other trait (s).

Prediction of body weight from measurements: Prediction equations to estimate body weight from quantitative traits are presented in Table 3. Regression coefficients (R^2) for the quantitative traits measured were not significant ($P>0.05$). The value of R^2 increased as more independent variables were added to the regression equation, showing that estimating body weight using a single body measurement is not the only suitable criterion for predicting body weight. The variation in body weight was explained to a large extent by the combination of all the traits with the highest R^2 in both 0 and 100% acha. The results of this study confirmed that body weight of layers can be predicted with confidence from most of the quantitative traits measurements.

CONCLUSION AND APPLICATION

From the result of this study, maize fed birds expressed positive, high and significant correlation values while acha fed birds expressed negative, high and significant correlation values. It could be concluded that the traits of maize fed birds are controlled by the same gene (s). The regression analysis in this study also indicated that body weight of birds could easily be predicted from any of the linear body measurements. The combination of all the body measurement is the suitable criterion for predicting body weight.

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Associations between Polymorphisms of the Yankasa Sheep IGF-1 Gene and Growth Traits

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Abstract: A study was conducted at the Small Ruminant Research Programme of National Animal Production Research Institutte (NAPRI) Shika, Zaria, Kaduna State, Nigeria to determine association between polymorphisms of the sheep IGF-1 and growth traits in Yankasa breed of Sheep. Random samples of 140 sheep (70 males and 70 females) were selected for the molecular study. Animals were measured for growth traits namely: birth weight, average daily gain, weaning weight, weight at 6, 8 and 12 months, chest girth and height at withers. Blood samples were collected from the animal's neck region through the jugular veins into 0.5ml EDTA vacutainer tubes and transferred to the laboratory for DNA extraction. Frequency of alleles was calculated according to Hardy-Weinberg's. Association between genotypes and growth traits were determined through the general linear model (GLM) procedure of the SAS program (Statistical Analysis System, 2000). All growth traits (birth weight, weaning weight, average daily gain, weight at 6 months, weight at 12 months, height at withers and chest girth) with the exception of Body weight (Kg) at 8 months showed significant ($P<0.05$) variations. Sheep with AA and AB genotype were similar in performance across all traits (birth weight, average daily gain, weaning weight, weight at 6 months, weight at 8 months, weight at 12 months and height at withers) with the exception of average daily weight gain (g/day). It was therefore concluded that association between genotype and growth traits showed that the AA and AB genotype were superior to the BB for most measured traits. It is recommended that polymorphism of the IGF-I gene may be a potential molecular marker for growth traits in Yankasa sheep.

INTRODUCTION

The Yankasa is a meat breed found in north and north central Nigeria. The Yankasa is a medium-sized breed of Sheep. The tail is long and thin, the ears moderately long and somewhat droopy. Rams have curved horns and a hairy white mane and ewes are polled (Mason, 1996). They have white coat colour with black patches around the eyes, ears and muzzle.

Insulin-like growth factor-1 (IGF-1) is an important regulator of cell proliferation, differentiation, and apoptosis, has acute insulin-like metabolic effects, and is important for growth and development throughout the body. The level of IGF-1 peaks during puberty and after which it declines with age. Although the IGF-1 serum level is influenced by many factors, such as nutritional status, liver function, and serum levels of sex steroids and insulin, the secretion of this peptide is mainly regulated by growth hormone (GH) (Froesch and Zapf, 1985 cited in Licht *et al*., 2014). It has been estimated that up to 60% of the variance in IGF-1 serum level has a genetic basis (Harrela *et al*., 1996 and Hong *et al*., 1996 cited in Licht *et al*., 2014). Several polymorphisms in the promoter region of the IGF-1-gene have been identified, comprising a variable length cytosine-adenine (CA) repeat sequence (Kato *et al*., 2003). These polymorphisms are thought to influence the transcription rate of IGF-1, which in turn affects serum IGF-1 levels (Fletcher *et al*., 2005). The 192 bp allele is the most common allele and therefore is called the wild type (Fletcher *et al*., 2005; van Turenhout *et al*., 2011).

MATERIALS AND METHODS

Study Location: The research was carried out at the Small Ruminant Research Programme of National Animal Production Research Institutte (NAPRI) Shika, Zaria, Kaduna State, Nigeria. Shika lies between latitude 11^0 12'N, longitude 7^0 33'E and at an altitude of 640m above sea level. The area falls within the Northern Guinea Savannah having an average annual rainfall of 1100mm which starts from late April or early May to mid-October, followed by a dry period (which is divided into early and late dry periods). The early dry period is characterized by cold period and lasts from November to February. The mean temperature is about 24.4^{o}C (14.5-39.5^{o}C) with the lower humidity of 21% and 72% occurring during the early dry and wet seasons respectively (Institute for Agricultural Research Meteorological unit, 2016).

Experimental Animals and their management: The animals were kept separately at the Experimental Unit of NAPRI and reared under semi-intensive system. The breed was randomly selected among the stock at NAPRI. The ewes that were selected for the study were between two and three years old based on the recommendation of Taiwo *et al*. (1982). All the sheep were maintained on concentrate diets. Supplementary feeding was provided

to the advance pregnant and lactating ewes and young lambs. The animals were watered twice, once in morning and again in evening. The sheep were housed during night in sheds covered with asbestos sheets with open sides during winter and in open corrals made by chain link fencing during summer months.

The sheep were fed concentrate supplements (3% of body weight) in the morning at 8:00 am. The concentrates were compounded using cotton seed cake, ground maize grain or maize offals, bone meal, vitamin and mineral premix and salt to make a diet of 18% crude protein (CP) for weaners and 15% CP for yearlings and other adult sheep. Gamba grass (*Andropogon gayanus*) hay was also provided after the concentrates. Nursing ewes and their lambs were kept intensively up to weaning at 90 days while the other sheep in the flock were daily released to graze on improved pastures of *Digitaria smutsii; Bracharia decumbens;* Gamba grass; *Cynodon dactylon and Hyperenia rufa*, between 8:00 am and 4:00 pm. Drinking water was provided *ad libitum*. More feed was allocated to pregnant ewes during the last two month of pregnancy corresponding to 3% of body weight. Routine medication consisted of anti-helminthic, drenching (deworming) was carried out.

Statistical analysis: On the basis of identified genotypes of Yankasa Sheep, the frequency of alleles was calculated according to Hardy-Weinberg's equation (Kubek and Bardun, 1990). This equation is based on the binomial expansion of

$(p+q)^2=1$ which gives $p^2+2pq+q^2=1$

Where; p = Dominant allele
q = Recessive allele

Body linear Measurement: Height at wither: Measured by taking the measurements of the circumference of the chest; behind the forelegs.

Chest girth: Measured as a distance from the surface of the platform to the withers of the animal.

Data collection: The Yankasa Sheep was measured for growth traits (birth weight, weight at 6, 8 and 12 months, average daily gain, weaning weight, chest girth and height at withers each of the experimental Sheep was scored according to its band for the SNPs either as fast (AA), midway (AB) or slow (BB).

To determine associations, the traits of interest was analyzed using the general linear model (GLM) procedure of the SAS program (Statistical Analysis System, 2000), the following statistical model was used for association of SNP with any measured variable:

$Y_{ij}= \mu + G_i + e_{ij}$

Where:

Y_{ij}= growth parameters,
μ = the overall mean,
G_i= the fixed effect of the i^{th} genotype for IGF-1,
e_{ij}=the random residual error

RESULTS AND DISCUSSION

Table 1: Association between IGF-1 genotypes and growth traits in sheep

Traits	AA	AB	BB	SEM	LOS
Birth weight (Kg)	2.35[a]	2.33[a]	1.80[b]	0.25	*
Weaning weight (Kg)	12.42[a]	12.29[a]	11.16[b]	0.50	*
Average Daily Gain (g/day)	0.14[a]	0.11[b]	0.11[b]	0.01	*
Weight at 6 months (Kg)	23.58[a]	22.01[ab]	20.12[b]	1.05	*
Weight at 8 months (Kg)	28.12	28.66	29.09	1.31	ns
Weight at 12 months (Kg)	33.19[a]	32.57[a]	29.01[b]	1.82	*
Height at withers (cm)	58.07[a]	57.51[a]	51.45[b]	2.90	*
Chest Girth (cm)	69.34[a]	68.79[a]	67.25[b]	0.60	*

[ab]means across rows differ significantly (P<0.05); ns: non-significant

The association between the polymorphic forms of IGF-1 genotypes and growth traits in the Yankasa sheep breed is outlined in Table 1. All growth traits or parameters (birth weight, weaning weight, average daily gain, weight at 6 months, weight at 12 months, height at withers and chest girth) with the exception of Body weight (Kg) at 8 months showed significant (P<0.05) variations. The AA and AB genotypes were mostly similar for birth weight, weaning weight, weight at 6 months, weight at 12 months, height at withers and chest girth and

differed significantly (P<0.05) from the BB genotypes. Animals with the AA genotype had the highest birth weight, weaning weight, average daily gain, weights at 6 and 12 months, height at withers and chest girth followed by AB genotyped individuals, BB individuals had the lowest growth characteristics of the studied population.

Observed differences in growth traits due to the various genotypes observed in this study agreed with the findings of Kazemi *et al*. (2011) that polymorphism in 5´ flanking region had a significant effect on growth traits, live weight and carcass weight in Zel sheep and also that of Kurdistani *et al*. (2013) in Kurdish goat, were the polymorphism of *IGF-I* gene was associated with growth traits and yearling fleece weight. But differed from the reports of no significance (P>0.05) reported in Chinese dairy goats for body size, milk yield and birth weight (Deng *et al*., 2010; Wang *et al*., 2011) and Gholibeikifard *et al*. (2013) in Baluchi sheep.

This significant impact of the various genotype on birth weight, weaning weight, average daily gain, weight at 6, 8 and 12 months, height at withers and chest girth in this study supports the assertion that Insulin-like growth factor-1 (IGF-1) is an important regulator of cell proliferation, differentiation, and apoptosis, has acute insulin-like metabolic effects, and is important for growth and development throughout the body. The level of IGF-1 peaks during puberty and after which it declines with age (Licht *et al*., 2014). According to Fletcher *et al*. (2005), the polymorphisms are thought to influence the transcription rate of IGF-1, which in turn affects serum IGF-1 levels which influences growth trait. It is however cautionary to note that Results of studies that evaluated the relationship between the IGF-1 promoter polymorphisms and IGF-1 levels are contradictory; the homozygote 192 bp genotype has been associated with both higher and lower IGF-1 levels compared to the heterozygote and non-carrier genotypes (Fletcher *et al*., 2005 and Euser *et al*., 2011).

CONCLUSION

Association between genotype and growth traits or parameters showed that the AA and AB genotype were superior to the BB for most measured traits.

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Reproduction in Dairy Cows as Affected by Nutrition – A Review

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Abstract: Nutrition plays an important role in enhancing reproductive efficiency of all animals. Energy and protein are the keynutrients required in the greatest amounts and should be in the topmost priority in order to optimize reproduction indairy cattle. Minerals and vitamins also cannot be neglected and must be balanced in the diet. In the other hand, thenutrient should not be over-fed as this may also impairs the reproduction. This review generally focuses on theeffectof various nutrients on reproductive efficiency of dairy cattle.

Keywords: Reproduction, Nutrition, Dairy Cows, Energy, Protein.

INTRODUCTION

The relationship between nutrition and reproduction is anarea of increasing significance and concern among dairyproducers, reproductive physiologist, feed dealers and extension workers. The interaction between nutrition and reproduction haslong been known to have important implications for the reproductive performance (Smith *et al*., 2010). Inadequate nutrition results in the loss of body weight and body condition, delays the onset of puberty, increases the post-partum interval to conception, interferes with normal ovarian cyclicity by declining gonadotropin secretion and increases infertility (Capuco*et al*., 1990, Boland *et al*., 2001). A clear understanding of how and when nutrition affects reproduction may provide an alternative approach to managing reproduction in commercial systems. (Pradhan and Nakaghosi, 2003).

NUTRITIONAL FACTORS AFFECTING REPRODUCTION

Energy: Inadequate intake of energy, protein, vitamins, and micro- and/or macro-minerals has all been related with suboptimal reproductive performance. Of these nutritional effects on reproduction, energy balance is probably thesingle most vital nutritional factor related to poor reproductive function in animals (Puls, 1994; Randal, 1990). Short and Adams prioritized the metabolic use of available energy in ruminants ranking each physiological state in order of importance, as follows: basal metabolism, activity, growth, energy reserves, pregnancy, lactation, additional energy reserves, estrous cycles and initiation of pregnancy, and excess energy reserves (Ryan *et al*., 1992). Based on this list of metabolic priorities for energy, reproductive function is compromised because available energy is directed towards meeting minimum energy reserves and milk production. Restricting energy intake during late gestation increases the length of postpartum anestrous (Bellows *et al*., 1982) and reduces subsequent pregnancy rate. The impact ofinsufficient energy intake during late gestation cannot be overcome by increasing energy intake postpartum (Scramuzzal and Matin, 2006).
Extreme energy intake during late lactation and the dry period can cause "fat cow" problems which lowerreproductive efficiency in the next lactation. When heifers are fed inadequate amounts of energy, they reach sexual maturity late (Hetzel, 1990; Kreplin and Yaremcio, 2009).

Protein: The effect of dietary protein on reproduction is complex (Surai, 1999). Prolonged inadequate protein intake has been reported to reduce reproductive performance. More recently it has been found that reproductive performance may beimpaired if protein is fed in amounts that greatly exceed the cow's requirements. Overfeeding protein during the breeding season and early gestation, particularly if the rumen receives an

inadequate supply of energy may be associated with decreased fertility (Dunn and Moss, 1992). This decrease in fertility may result from decreased uterine pH during the luteal phase of the estrous cycle in cattle fed high levels of degradable protein. However, regardless of a possible effect on reproductive performance, overfeeding protein should be discouragedsimply on an economic basis. It is costly and wasteful.

Fats: The impact of fats on reproduction in cattle is a focus of considerable research (Elrod and Butler, 1993). Because fatty acids and cholesterol are substrates for hormone synthesis, increasing fat in the diet may increase levels of reproductive hormones (progesterone, prostaglandins) or fats may act directly on the reproductive axis. Therefore, the effects of fat may be independent of or additive to those of increased energy availability. Cattle diets usually contain less than 2 or 3% fat.

Minerals: Minerals are important for all physiological processes in animals including reproduction (Elrod and Butler, 1993). Mineral deficiencies and imbalances are often cited as causes of poor reproduction. It is clear that adequate amounts of minerals must be provided, but little is known about the effects of marginal deficiencies and imbalances. The same is true of excessive intakes of minerals which may indeed be harmful. Producers should avoid overfeeding minerals. If a little bit is enough, twice as much will not be better and may in fact cause problems (Schweigert and Zucker, 1988).

Phosphorus (P): There has been much debate and research conducted on phosphorus supplementation effects on reproductivefunction Elrod and Butler,1993). Decreased fertility rate, feed intake, milk production, decreased ovarian activity, irregular estrous cycles, increased occurrence of cystic ovaries, delayed sexual maturity and low conception rates have been reported when phosphorus intakes are low (Cromwell, 1997).

Calcium (Ca): Milking cows should always be provided adequate amounts of calcium to maximize production and minimize health problems. One of the functions of calcium is to allow the muscle contraction. Clearly a reduction in muscle contractility will lead to a decrease in dry matter intake (DMI) as rumen function decreases, leading to severe Negative energy balance (NEB). As consequences, there is an increase in fat mobilization that may result in fatty liver syndrome and ketosis. An excess of ketone bodies can further suppress appetite (Boland *et al*., 2001), it has been shown that plasma calcium concentration of 5mg/ml reduce abomasal motility by 70% and the strength of the contraction by 50% (DCRC, 2010).

Selenium (Se): Selenium is important for normal spermatogenesis and largely as a component of seleno-proteins phospholipidhydroperoxide glutathione peroxidase (PHGPx/GPX4) and Seleno-protein V. Most of the selenium found in thetestis is associated with PHGPx/GPX4. It serves as a powerful antioxidant protecting cells from oxidative stress. PHGPx also appears to be involved as a structural protein to provide normal sperm motility (Hemler and Lands, 1980). It has also been shown that a variant to this protein is necessary for normal chromatin condensation and subsequent normal spermatozoa head formation. Both deficiency and excessive selenium have been demonstrated to be detrimental to normal spermatogenesis (Wiltbank*et al*., 2007).

Potassium (K): Limited research suggests that feeding high levels of potassium may delay the onset of puberty, delay ovulation, impair corpus luteum (yellow body) development and increase the incidence of anestrous in heifers. Smith andChase (2010) reports lower fertility in cows fed with high levels of potassium or diets in which the potassium-sodium ratio was too wide.

Vitamins: The vitamin requirements of dairy cows are met by a combination of rumen and tissue synthesis, natural feeds andfeed supplementation (Schweigert and Zucker, 1988; Elrod and Butler,1993) Most commercial concentrates contain supplemental vitamins so the probability ofinfertility due to a vitamin deficiency is greatly reduced. When commercial concentrates are not fed, vitaminsupplements should be provided. Proper vitamin and mineral balance must be provided in dry cow rations when feedintake is restricted and (or) low quality forage is fed to control or reduce body condition. To ensure adequate intake, vitamins and minerals should be fed in small amounts of low energy concentrates or mixed in a complete dry cowration (Schweigert and Zucker, 1988).

Vitamin A: Vitamin A is one of the fat soluble vitamins and is well known to regulate the development, cellular growth anddifferentiation, and tissue function. Its metabolites affect ovarian follicular growth, uterine environments and oocytematuration (Scramuzzal and Matin, 2006). Vitamin A is required for maintaining healthy tissue in the reproductive tract. In deficient cattle, delayed sexual maturity, abortion, the birth of dead or weak calves, retained placenta and metritis have been reported.

Vitamin D: Vitamin D is required for normal calcium and phosphorus metabolism. However, deficiencies are seldomencountered in commercial herds. Animals with vitamin D deficiency symptoms have a stiff gait, labored breathing, weakness and possibly convulsions. Swollen knees and hocks can also occur. Bones may be soft (rickets) or be reabsorbed in older animals. Calves may be born dead, weak or deformed. Cows may not show heat when exposed. Recent research has implicated Vitamin D with heart health, cancer and infectious diseases (Keen and Zidenberg, 1990).

Vitamin E: Vitamin E functions as an intra-cellular antioxidant scavenging for free reactive oxygen and lipid hydroperoxidases, and converting them to non-reactive forms, thus maintaining the integrity of membrane phospholipids againstoxidative damage and peroxidation (Sinclair *et al*., 2000; Wichtell*et al*., 1996).
To date there is no documented evidence that vitamin E deficiency is a significant cause of reproductive failure indairy herds (Williams, 1989). Moreover, the vitamin E requirement of milking cows is not known with certainty. In oneexperiment, cows were fed low vitamin E rations for four generations. There were no measurable effects onreproduction (Schweigert and Zucker, 1988).

CONCLUSION

It is clear that nutrition is directly related to reproduction in the dairy cow. Nutrient either in deficient amount or inhigher amount has been shown to be capable of altering reproduction. The basic problem is that the degree of theexcess, deficiency or imbalance which is required to alter reproduction is still unclear. The best recommendation atpresent is to provide a feeding program for dairy cows which is balanced for all nutrients and meets all knownnutrient requirements.

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Influence of Wattle on Body Weight and Linear Body Measurements Red Sokoto Does Kept Semi-Intensively in Niger State, Nigeria

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Abstract: A study aimed at evaluating the influence of wattle on the body weight and linear body measurements was carried out using 32 Red Sokoto does (ages ranging between six months to twelve months) raised semi intensively in Niger State. The study lasted for a year during which data were collected on the body weight and linear body measurement before the does were mated and after kidding. Data obtained were subjected to statistical package (SAS, 2000). It was observed that only the body length, head length, head width and the fore leg length were significantly influenced ($p>0.05$) by the presence of wattle before mating. The body weight and linear body measurements of does after kidding were however not affected ($p<0.05$) by the presence of wattle. Based on the outcome of this study it was concluded that does with wattle gene were not superior to does without wattle in body weight and linear body measurements.

Keywords: Does, Wattle, Red Sokoto, Bodyweight, Linear Measurements

INTRODUCTION

The red sokoto goat is the most predominant goat breed and accounts for about 70 % of Nigeria's total goat population, which have been estimated at 17.5 million [1]. It is commonly found among the agro pastoralist mainly within the northern sub humid and semiarid zone of the country [2]. The breed is predominantly reddish brown in colour and is found in the savannah zone of Nigeria ($8^{o}N – 11^{o}N$) where it constitutes more than 90% of the goat population in the area. The breed weighs about 1.5 – 2.0kg at birth and reaches about 12 kg when weaned at 3 months under good management. Weight of adult does and bucks are 20 – 35kg and 25 – 40kg respectively [7]. The skin of red sokoto goat is reputed to be of high quality; therefore, it is used in the leather industry locally and internationally [2]. The red Sokoto breed have some unique features among which includes the development of wattles.

Wattles are those little tufts of hair that covers the skin that dangles from the throat of some goats. Wattle have been regarded as a structural outgrowth in the body of animals (goats) whose function is still under debate [10] but was of the opinion that wattle could be utilized during selection for productive purposes. Research on the incidence and relative effect of wattle traits and its association with body measurements have been done by [8] in West African Dwarf goat. Similarly, several research findings on the association between wattle traits and performance growth, reproduction and heat tolerance) have been done by [9] on West African Dwarf goats but similar works are limited on indigenous Red Sokoto goat in the Northern part of Nigeria. This study is therefore aimed at assessing the influence of wattle on body weight and linear body measurement of Red Sokoto does.

MATERIALS AND METHOD

This study was conducted at the cattle, sheep and goat unit of the teaching research farm, School of Agriculture and Agricultural Technology, Federal University of Technology, Gidan Kwano Campus, Minna, Niger State. Minna is located at the Southern Guinea savanna zone on the Latitude (9^{0}-36 and 9^{0}-50 North) and longitude (6^{0}-33 and 6^{0}-25 East) [6]. Thirty-two red Sokoto does used for the study were purchased from Mariga, Kanfaninbobi and Bida goat markets in Niger State. the does were randomly allotted to four (4) treatments groups. Each treatment contains four replicates of two does per replicate making a total of eight doe per treatment in a Completely Randomized Block Design. Treatment 1 contained does without wattle crossed with bucks

without wattle (Control). Treatment 2 of contained does without wattle crossed with wattled bucks. Treatment 3 is made up of wattled does crossed with bucks without wattle and T_4 was constitutes wattled does crossed with wattled buck. The animals were given routine treatment using prescribed dose of penstrep, oxytetracycline, ivometin and multivitamins. Vaccination against PPR was also given. The does were managed under a semi-intensive system. The animals were provided feed supplement such as Maize bran/offal, Beans husk, and Guinea corn shaft and mango leaves. Animals were also left to graze freely on natural rangeland daily from 10:00 am until 6:00 pm in the evening after which they are returned to the pen. The animals were tagged using rope and well label plastic material for identification. The experiment lasted for one year (January- December 2017).

Data Collection

Data was collected on the following parameters:

Body weight (kg): The weight was taken using hanging weighing balance,

Body length (cm): This was measured as the horizontal distance from the shoulder point to pin bone.

Head length (cm): This was measured as the distance from the nostril to the poll.

Head width (cm): This was measured as the distance between the outer canthus of the right and left eye.

Height-at-wither (cm): This was taken as the vertical height from the hoof to the highest point of the shoulder.

Chest girth (cm): This was measured as the circumference of the body immediately behind the shoulder blades in a vertical plane perpendicular to the long axis of the body.

Rump length (cm): This was measured as the distance from the point of the ischium to the pin bone.

Rump width (cm): This was measured as the distance between the two points of ischium.

Fore leg length (cm): This was taken as distance between the shoulder and the hoof.

Hind leg length (cm): This was measured as the distance between the pin bone and the hoof.

Shine circumference (cm): measured as the canon bone perimeter.

Statistical Analysis

Data collected will be analyzed using SAS statistical package [11].

RESULT AND DISCUSSION

Table 1: Morphometric Parameters of Female before Mating

Parameters	T1 (NWDxNWB)	T2 (NWDxWB)	T3 (WDxNWB)	T4 (WDxWB)	SEM
Body weight (kg)	10.18	11.30	11.33	11.26	0.33
Body length (cm)	47.83^{a}	43.58^{b}	48.60^{a}	48.83^{a}	5.04
Head length (cm)	13.91^{a}	13.23^{ab}	12.96^{b}	13.60^{ab}	0.22
Head width (cm)	11.26^{b}	11.90^{a}	12.04^{a}	11.88^{a}	0.22
Height-at-wither(cm)	46.41	46.80	46.60	47.89	0.78
Chest girth (cm)	50.91	51.28	50.50	51.46	1.49
Rump length (cm)	13.90	13.29	14.10	11.91	0.24
Rump width (cm)	13.53	13.41	13.93	14.20	0.28
Fore leg length (cm)	39.80^{ab}	39.08^{b}	37.79^{b}	41.40^{a}	0.87
Hind leg length (cm)	45.10	44.33	44.49	46.61	1.66

^{abcd} Means within a row having different superscripts differed significantly ($P<0.05$);

NWD x NWB = No wattled does mated with No wattled Bucks; **NWD x WB** = No wattled does mated with wattled Bucks; **WD x NWB**= Wattled does mated with No wattled Buck:**WD x WB**= Wattled does mated with Watted bucks.

Table 2: Morphometric Parameters of Female immediately after birth

Parameters	T1 (NWDxNWB)	T2 (NWDxWB)	T3 (WDxNWB)	T4 (WDxWB)	SEM
Body weight (kg)	17.20	17.50	16.50	15.90	4.74
Body length (cm)	54.14	53.34	52.52	56.42	5.32
Head length (cm)	14.60	14.04	14.24	14.32	5.29
Head width (cm)	12.16	12.62	12.73	12.52	5.07
Height-at-wither(cm)	51.48	53.54	52.74	52.04	4.99
Chest girth (cm)	63.22	62.38	61.18	63.98	5.04
Rump length (cm)	15.62	16.20	16.46	15.76	4.77
Rump width (cm)	17.30	18.52	18.76	18.42	4.83
Fore leg length (cm)	42.38	44.98	44.92	43.94	4.94
Hind leg length (cm)	52.20	51.74	52.96	51.48	5.35

[abcd] Means within a row having different superscripts differed significantly (P<0.05);

NWD x NWB = No wattled does mated with No wattled Bucks; **NWD x WB** = No wattled does mated with wattled Bucks; **WD x NWB**= Wattled does mated with No wattled Buck; **WD x WB**= Wattled does mated with Watted bucks.

Table 1 shows the result for the initial body weight and morphometric parameter taken for Does of 6 month to one year of age. The table shows that only the body length, head length, head width and the fore leg length were significantly influenced (p>0.05) by the presence of wattle. For body length doe in treatments 1, 3 and 4 had equal values and had no significant difference (p>0.05) between them but the three treatments were higher (p>0.05) than treatment 2 does. Does in treatment 1 (NWD) were similar (p<0.05) to does in treatment 2 (NWD) and treatment 4 (WD) while does in treatments 2 and 4 are statistically similar (p<0.05) to does in treatment 3 (WD) for the head length. The head width of does in treatments 2, 3 and 4 were statistically similar (p<0.05) but the three are wider (p>0.05) than the head width of does in treatment 1. Finally does in treatment 4 were statistically similar to does in treatment 1 while treatment 1 had similar values with treatments 2 and 3. Table 2 revealed no significant different (p<0.05) in all the parameter measured for does after kidding.

The non-significant different (p<0.05) in most parameter measured and the similarities in values of those that are actually significant between wattled and non wattled does makes it hard in deciding which of the gene gives an outstanding result in body weight and morphometric parameters. This is in line with the finding of [4] who stated, "There is no clear demarcation between goats with wattle and those without wattle in zones A and B of Niger State Nigeria." [13] who carried out a study on dairy goats concluded that there is no difference between goats born with wattle and those without wattles. [5] claimed that wattles had no obvious significance to the physiology of goats. [3] observed no difference in the body conformation traits between Red Sokoto goat having wattle and those without wattle. The above results however were not in line with the findings of [8] who reported that wattle genes had significant influence on body measurements such as body length, heart girth and height at withers in West African dwarf Sheep.

CONCLUSION

Based on the outcome of this study it was concluded that goats (Does) with wattle gene were not superior to non wattled goats (Does) in body weight and linear body measurements. However, it is advised that farmers should keep goats with wattle as the wattle gene is gradually going into extinction.

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Effect of Haemoglobin Polymorphism on adaptive traits in White Fulani Cows

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Abstract: This research was conducted to determine the effect of haemoglobin polymorphism on the adaptive traits in white Fulani cows raised in Vom. A total of 62 White Fulani cows were used for the study. The population of white Fulani cows Hb types was studied in Hardy-Weinberg equilibrium. Three haemoglobin type were identified namely: HbAA, HbAB and HbBB. The gene (allelic) frequencies for haemoglobin A and B was 0.6 and 0.4 respectively. The genotype frequencies of HbAA, AB and BB were 0.36, 0.48 and 0.16 respectively. The respected ratio of Hb variant (HbAA,HbAB and HbBB) in the population of the cows were 2:3:1 which was different ($p<0.01$) from the observed ratio 5:7:1. The rectal temperature, respiratory rate and adaptive coefficient were 37.8ºC, 20.0breath/min and 1.9 Haemoglobin types influenced ($P<0.05$) the adaptive characteristics of the white Fulani cows. Overall, Hb types BB was superior for adaptive trait of the cows. In conclusion, the study showed that Hb the type BB cows were better adapted to the environment.

Keywords: Haemoglobin, polymorphism, genotype, allele, frequency

INTRODUCTION

Haemoglobin have been previously reported to have variants and these variants have been reported to be associated with environmental adaptability as well as being clinically important as causes of a variety of genetic disorders of blood. Consequently, the genetic background of the haemoglobins merits examination in some detail. (Peters *et al*., 2004).

According to Petazzi *et al*. (2004); the choice of genetically adapted breeds is a prerequisite for a basic condition of well being in whatever environment.

Measured environmental effects on the performance of cows led to the establishment of a critical mean ambient temperature (27ºC) (Johnson *et al*; 1987) and a temperature-humidity index (THI) which considers the ambient temperature and relative humidity (NOAA, 1996).

Critical values for minimum, average and maximum THI were reported to be 64, 72 and 76 respectively (Igono *et al*., 1992) THI increase as cow body temperature increase (West, 2003). Under conditions of high temperature and relative humidity, change in THI can be measured via rectal temperature, pulse and respiration in European borines (Vilalobos *et al*., 1975).

This study was therefore undertaken to establish the relationship between the haemoglobin types and adaptive characteristics of white Fulani cows.

MATERIAL AND METHODS

A total of 62 White Fulani dairy cows were evaluated. The animals were raised during raining season on paddock. During the dry season, hay or silage supplemented with concentrate were given to them. Salt lick was provided and the animal had access to water *ad-libitum*. They were allowed to graze under the supervision of herds men for about 6-8 hours daily and were regularly sprayed against external parasites.

Data Collection: Rectal temperature was taken by using thermometer inserted approximately 7.5cm into the rectum of each animal, the reading was taken per minute with the aid of a stop watch. Respiratory rate for each cow was taken using stethoscope placed in their abdominal cavity and counting abdominal breathing movement per minute with the aid of stop watch. Coefficient of adaptability (CA) was the estimated using the formula

$$CA = \frac{RT}{} + \frac{RR}{}$$

38.3 23

The experimental animals were restricted in the crush while the data were being collected.
Where RT =Rectal temperature, RR= Respiratory rate, and the numerical values in the denominators corresponds to normal values per minutes for rectal temperature and respiratory rate (Armando *et al*., 2007) Blood samples were obtained through jugular vein puncture about 5ml of blood was drawn using syringe with 5ml drawn into a heparinzed vacutainer (EDTA) as anticoagulant. Haemoglobin alleles were typed using cellulose acetate electrophoresis as described by Fairban and Klee (1986). The direct gene counting method as described by Zaragoza *et al* (1987) was used to score Hb bands on the separation of Hb variations after electrophoresis is as follows: -

- A single faster bond in an animal was designed as AA homozygote.
- The presence of a single slower band in an animal was designated as BB homozygote.
- The presence of both bands in an animal was designated AB heterozygote.

Data Analysis: Haemoglobin types, gene and genotypic frequencies were estimated using Hardy-Weinberg's equilibrium equation. This equation is based on the binomial expansion $(P+q)^{2} = p^2 + Pq + q^2$ where P =Dominant gene, q = Recessive gene.

Effect of Haemoglobin types on adaptive traits was determined using general linear model procedure of SAS (2004). The model is as follows:

$YIj = \mu + Hbi + Aj + eij$

Where μ = Overall mean
Hb = Effect of ith haemoglobin types (I = AA, AB, BB).
A = Effect of jth adaptive traits.
C = residual error.

RESULT AND DISCUSSION

Table 1: Gene and genotypic frequencies of haemoglobin types in white Fulani Cows

Sample	Gene Frequencies		Genotypic frequencies		
Size	Hb^A	Hb^B	Hb^{AA}	Hb^{AB}	Hb^{BB}
62	0.60	0.40	0.36(24)	0.48(33)	0.16(5)

Figures in parenthesis indicate the number of animals.

The gene frequencies indicate higher HbA (0.06) in the population of the cows studied than HbB(0.40) alleles. The genotypic frequencies revealed that the AB (0.48) genotype was higher than the AA (0.36) with the BB (0.16) being the least. Thus indicating that the heterozygote genotype (AB) was more favorable to the environment than the homozygote. AA and BB.

The frequency of B allele was found to be lower than that of the A allele, this is in agreement with the result of the earlier workers in Bos Taurus (Abdussamad *et al*, 20004). However, the observation in this study was contrary to the report of Rachagani *et al*, (2006) who observed high frequency of B allele in both Sahiwal and Tharparker cattle breed. The result of this study was also in agreement with the findings of Mario *et al*, (1982) who observed a general frequency of 0.56 for HbA and 0.40 for HbB in Brazilian Nelore cattle.

Table 2: Observed and expected number of haemoglobin genotype in White Fulani Cows

Sample	Haemoglobin Types	Observed No.	Ratio	Expected No.	Ratio	df=2
Overall	HbAA	24	5	22	2	62
	HbAB	33	7	30	3	10.54**
	HbBB	5	1	10	1	
62	0.60	0.40	0.36(24)	0.48(33)	0.16(5)	

** = highly significant P<0.01

The observed genotype frequencies of HAA, AB and BB in this study were 0.36, 0.48 and 0.16 indicating a low-high- low pattern of genetic frequencies. This was in contrast with the reported genotypic frequencies of 0.000, 0.0027 and 0.0973 for Hb BB having an overwhelming majority and HbAA being totally absent (Das *et al*., 2004). The result of this study suggests that the low frequency of the HbBB genotype might be as a result of their few numbers in the population of the studied animals. Evans and Warren (1958) reported that HbA has selective advantage in sheep at higher altitudes because it constitutes the most common allele in highland breeds of English and Scottish sheep. Salako *et al.* (2007) also reported that Red. Sokoto goats sampled in the South West of Nigeria (Ibadan) had a higher frequency of HbB suggesting they are for lower altitudes.

Table 3 presents the effect of haemoglobin type on adaptive traits of white Fulani cows. The effect of Hb- type was significant ($p<0.05$) on the adaptive traits the AA genotype had higher rectal temperature than the Ab and BB. The Hb type BB cows had the lowest value for adaptive traits compared to Hb types AA and AB. This implies that the BB type cows are well adapted to climatic condition and superior than the AA and AB haemoglobin types in coping with heat stress. The high values of adaptive traits in Hb AA and AB types cows' shows that they are less tolerant to heat stress. This finding agrees with the report of Armando *et al.* (2007) who observed that high rectal temperature, high respiratory rate and high plasma cortisol are indicators of heat stress when of course other pathological signs are absent.

Table 3: Mean values of adaptive traits as influenced by haemoglobin types of White Fulani Cows

Traits	Haemoglobin Types			**SEM**	Sig. Level
	AA	**AB**	**BB**		
Adaptive traits					
Rectal temperature	37.80^{a}	37.87^{c}	37.70^{b}	0.003	*
Respiratory rate	19.67^{b}	20.46^{a}	16.00^{c}	0.050	*
Adaptive coefficient	1.85^{b}	1.92^{a}	1.70^{c}	0.002	*

abc: means with different superscript within a row differ significantly

* = ($P<0.05$)

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Early Growth Characteristics of Progenies from Fulani Ecotype Dams Mated with Different Sires in Southern Guinea Savanna Environment of Nigeria

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Abstract: The early growth characteristics of progenies derived from crosses of normal feather (NF), frizzled feather (FF) and Rhode Island Red (RIR) chicken sires on Fulani ecotype (FE) dams were determined. The crosses involving FF x FE, NF x FE and RIR x FE was used to produced FF x FE, NF x FE and RIR x FE progenies. The progenies produced were monitored for body weight, body length, shank length, thigh length, keel length and wing length for period of 20 weeks. The result indicated that progenies produced by RIR (RIR x FE crossbred) had the highest body weight (1325.55 g), body length (23.47 cm), keel length (11.50 cm), thigh length (16.42 cm), shank length (8.69 cm) and wing length (36.99) than its counterpart progenies of FF x FE and NF x FE at 20 week of age. The phenotypic coefficient correlation of each progeny produced were very highly significant and positive correlated magnitudes among the parameters measured with strong relationship of range of 0.40 to 0.94, 0.81 to 0.93 and 0.86 to 0.98 recorded for NF x FE, FF x FE and RIR x FE respectively throughout the study period. It can be concluded that progenies from RIR sires had the best performance for early growth characteristics and the relationship should be a useful information for selection when FE dams need to be sired for RIR.

Keywords: Growth traits, local chickens, Rhode Island Red, dams, sires.

DESCRIPTION OF PROBLEM

According to (1) that the Nigerian local chicken is known to adapt and produce valuable product (meat and egg) under variable environments and low external input while the productivity of local chickens is however reduced by adverse environmental factors such as unfavorable climatic condition and poor genetic profile. (2) noted that growth in all apart from relating to increase in body cells also influenced by both genetic and non-genetic factor, Hence, growth in farm animals is a reflection of an intricate balance between a great number of endogenous and exogenous factor. Through, body weight is usually used as a measure of growth in farm animals; however numerous studies have shown that other growth traits relating to body morphometric measurement such as body length, shank length and chest girth can serve as good indicator of growth (3, 4, 5). Growth and body conformation trait are therefore important parameter in assessing the potential of genetic improvement and development of any livestock breed/strain, such knowledge and in adopting breeding choices/strategies (6). The growth and body conformation traits are also essential in poultry production being fundamental attributes for assessing growth and feed efficiency as well as important yardstick in management and economic decision making (7).

Crossbreeding of local stock with an exotic commercial stock could take advantages of artificial selection for productivity in the exotic birds and natural selection for hardiness in the indigenous birds (8). Crossbreeding is one of the tools for exploiting genetic variations, it is the mating of two individual with different breeds make up. The main purpose of crossbreeding is beneficial for two primary reason which are complementary and hybrid vigor (9).

Linear measurements are traits of economic important as they are the visible proof of growth in chicken (10) while the variations in the linear body measurement in chickens have been discovered to be very useful in comparing body size and shape of birds, also as an indirect method of predicting body weight (11). Many studies have a strategy to improve productivity of the indigenous chicken of Nigeria and this study was conducted to evaluate the potential crossbreeding in improving the productivity of indigenous chicken breeds with an exotic birds using sires and dams of these chickens under the southern Guinea Savanna conditions of Nigeria.

MATERIALS AND METHODS

Experimental Site: The study was carried out at the Poultry Unit of Teaching and Research Farm, Emmanuel Alayande College of Education, Oyo, Oyo state, Nigeria. Oyo lies on longitude $3^{o}5^{'}$ east of the green witch meridian and latitudes $7^{o}5'$ North eastwards from Ibadan, the capital of Oyo State. The altitude is between 300 and 600 meter above level. The mean annual temperature and rainfall are $27^{o}C$ and 1,165 mm respectively. The vegetation of the area is Southern Guinea Savanna zone of Nigeria (6).

Experimental birds and Management: A total of 120 birds were procured around the Oyo metropolis and in a reputable farm in Ibadan for the experiment. The birds were comprising of normal feather x Fulani ecotype (10cocks: 30 hens) frizzle feather x Fulani ecotype (10 cocks: 30 hen), Rhode Island Red x Fulani ecotype (10cocks: 30 hens). Each of the chicken were properly identified using a wing tagged made from industrial galvanized aluminum and the birds were strictly under the intensive management system of production in galvanized battery cage.

Feeds and Feeding: The cocks were fed *ad-libitum* with commercial breeder's mash containing 16% crude protein and 2600kcal/kg Metabolizable energy while the hens were given layer mash containing 16% crude protein and 2800 kcal/kg Metabolizable energy and clean and cool water were also supplied *ad-libtum* to the birds.

Mating Technique and Procedure: Artificial Insemination (AI) was adopted in mating the hens. The massage technique was used to collect semen from the cocks of Normal feather, frizzled feather and Rhode Island Red birds. The semen collected was inseminated immediately into the left vent of the hens. This was done twice weekly in the evening. For each hen 0.1 mol of undiluted semen was used for insemination each time with mating procedures follow:
Normal feather (sire) x Fulani ecotype (dam) = NF x FE, Frizzled feather (sire) x Fulani ecotype (dam) = FF x FE, Rhode Island Red (sire) x Fulani ecotype (dam) = RIR x FE

Egg collection and incubation: Egg from artificially inseminated hens were collected and stored along genotype lines in a room with temperature ranging from $18\text{-}20^{o}C$, for five days before being transferred to the hatchery for incubation. The incubation period was for 21 days. After hatching, the chicks were sorted for health chicks to be reared.

Brooding and management of chicks: The day old chicks obtained from the hatchery were wing tagged along genotype and brooded with artificial heat supplied through charcoal and lantern. The feeds were given *ad-libitum* containing 18% Crude Protein and 2650kcal/kg Metaboliazable Energy (chick mash) from day old to eight weeks to the end of the experiment of 20 weeks the feed given contains16% crude protein and 2700k cal/kg Metaboliazable energy while clean and cool water were also supplied *ad-libtum* to the birds.

Data collection: Data were obtained from early growth traits of the progenies produced from this study on body weight (g), body length (cm), keel length (cm) and shank length (cm) from day old to 20 weeks on a weekly basis with the procedure described by (4).

Analysis of Data: All data was subjected to one-way analysis of variance in a completely randomized design using the procedure of General Linear Model of (12) while significant means were separated with the same procedure of (12). The below model was adopted.

$Y_{ij} = \mu + \beta_i + e_{ij}$

Where,

Y_{ij} = individual observation

μ = overall mean

β_i = fixed effect of the genotype (1,2,3)

e_{ij} = experimental errors which is evenly distributed

Correlation analysis for the growth traits was done with Pearson moment correlation of (12).

RESULTS AND DISCUSSION

Table 1: Mean values of bodyweight and linear body conformation as affected by chicken genotype

Traits	N	FF x FE	NF x FE	RIR x FE
Bodyweight (g)	100	1184.35 ± 11.55^{b}	1102.90 ± 18.90^{c}	1325.55 ± 34.90^{a}
Body length (cm)	100	22.90 ± 0.44^{b}	20.80 ± 1.06^{c}	23.47 ± 0.67^{a}
Keel length (cm)	100	11.05 ± 0.34^{b}	10.02 ± 0.23^{c}	11.50 ± 0.32^{a}
Thigh length (cm)	100	14.22 ± 0.45^{b}	13.14 ± 0.48^{c}	16.42 ± 0.47^{a}
Shank length (cm)	100	8.80 ± 0.89^{b}	8.40 ± 0.23^{c}	8.69 ± 0.77^{a}
Wing length (cm)	100	34.68 ± 1.09^{b}	36.06 ± 0.67^{b}	36.99 ± 1.20^{a}

^{abc}Means along the same row with different superscripts are significantly (P<0.05) different

N= Number of Observation, FF x FE = Frizzled feather Fulani Ecotype crossbred, NF x FE = Normal feather Fulani Ecotype crossbred, RIR x FE = Rhode Island Red Fulani Ecotype crossbred

Table 2: Phenotypic correlation coefficients of NF x FE and FF x FEcrossbreds

Traits	BW	BL	SL	TH	WL	KL
BW	1	0.84***	0.89***	0.86***	0.89***	0.85***
BL	0.91***	1	0.84***	0.81***	0.82***	0.87***
SL	0.41***	0.41***	1	0.93***	0.95***	0.90***
TH	0.94***	0.91***	0.39***	1	0.93***	0.88***
WL	0.91***	0.94***	0.40***	0.91***	1	0.90***
KL	0.80***	0.87***	0.36***	0.84***	0.91***	1

***P <0.001 = Very highly significant

BW = Bodyweight, BL=Body length, SL= shank length, TL =Thigh length, WL =Wing length, Kl = Keel length, Lower diagonal represent NF x FE crossbred, Upper diagonal represent FF x FE crossbred

Table 3: Phenotypic correlation coefficients of RIR x FE crossbred

Traits	BW	BL	SL	TH	WL	KL
BW	1					
BL	0.92***	1				
SL	0.99***	0.98***	1			
TH	0.96***	0.92***	0.90***	1		
WL	0.91***	0.93***	0.94***	0.95***	1	
KL	0.86***	0.87***	0.91***	0.93***	0.95***	1

***P <0.001 = Very highly significant

BW = Bodyweight, BL=Body length, SL= shank length, TL =Thigh length, WL =Wing length, Kl = Keel length,

The mean values of bodyweight and linear body measurements as affected by different chicken genotype are presented in Table 1. Crossbred genotype chickens significantly affected (P<0.05) bodyweight, body length, keel length, thigh length, shank length and wing length. Genotype Significantly affected the progenies derived

from Rhode Island Red Fulani Ecotype crossbred had highest bodyweight (1325.55 g), body length (23.47 cm), keel length (11.50 cm), thigh length (16.42 cm), shank length (8.69 cm) and wing length (36.99 cm) followed by FF x FE crossbred with least observable values of these traits were recorded for crosses of FF x FE at age of 20 weeks. This result implies that RIR x FE crosses were better in respect to growth traits and Rhode Island Red sires were superior in terms of sires used. Among the local bird's crosses, the cross of FF x FE were better in terms of growth traits measured than its counterparts NF x FE crosses at 20 weeks of age. This result of surpassed growth traits of RIR x FE crosses was in line with the earlier observation of (8) and (13) who reported that Rhode Island Red chicken had an outstanding combination with local chicken especially in the tropical regions while (2) observation also agrees with thisfindings that improved indigenous bred of chicken has a good combination effect with exotic when used as a sire line rather than a dam line. This result also implies that the improved indigenous breed of chicken combined significantly well with the exotic strain to achieve an improved body trait as the paternal line rather maternal line. The phenotypic correlation coefficients of crossbreds involving NF x FE, FF x FE and RIR x FE are presented in Tables 2 and 3. Generally there are very highly and positive significant ($P<0.001$) correlations amongst growth traits. The correlations magnitude recorded for NF x FE ranged between 0.40 – 94 (lower diagonal) and that of FF x FE varies from 0.81 to 0.93 (upper diagonal) while the ranges of 0.86 to 0.98 was observed for RIR x FE crossbred. High and positive phenotypic correlation between the growth traits conform to the reports of (9). Also, the positive correlations of the growth traits suggest that the traits are under the same gene action and this indicated that selection for improvement in one trait would eventually improve the other trait as correlated response. These observations on phenotypic correlation agree with the findings of (14) on comparison of morphological characteristics of frizzled feather and naked neck chicken in derived savannah zone of Nigeria.

CONCLUSION

It can be concluded from the study that among the different sires used, Rhode Island Red were better in respect to growth traits than its counterparts Normal feather and Frizzled feather sires while the phenotypic correlation amongst the growth traits of highly positive and significant suggests that the traits can be selected for in breeding programme for their pleiotropism actions.

APPLICATION

The results of the study could be useful for animal breeders in their breeding and selection planning programmes.

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Traditional and Medicinal Uses of *Huntaria umbellata* (ABERE): A Review

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Abstract: Phyto-biotic additives are wide range of plant-derived products that can be added to the diet of commercial animals to improve their productivity by enhancing feed properties, promoting animals' production performance, and improving the quality of products derived from these animals. *Hunteria umbellata* is plant species in the family Apocynaceae and it is the most prominent among the 12 species in the family. Traditionally, *Hunteria umbellata* is renowned for its effectiveness in the treatment of pile, haemorrhoids, diabetes mellitus, dysmenorrhoea, menstrual pain, sexually transmitted infections, stomach ache, ulcers, wounds and the let-down of baby in labouring mothers. *Hunteria umbellata* has a relatively low oral toxicity profile but its high dose could be hepatic when used for a long time. Phytochemical profile of *Hunteria umbellata* plant extract revealed the presence of saponins, steroids, tannins, volatile oils, phenols and copious amount of alkaloids. Scientific evidences have shown that *Hunteria umbellata* is active against various diseases such as bacterial infections, pain, fever, inflammation, diabetes, obesity, hyperlipidemia, heart problems, childbirth and malaria in human and other animal species. This review is aimed at exploring the potentials of *Hunteria umbellata* in the areas of ethno-medicinal, toxicological, safety, phytochemical and nutritional studies for livestock feeding systems.

Keywords: *Hunteria umbellata*, Growth Performance, Proximate, Oxytocic, Anti-bacteria

INTRODUCTION

Phyto-biotic is plant derived products added to feed in order to improve performance. They are usually additives or spices derived from leaves, seeds, roots, tubers or fruits of plants. They may be available in raw or processed into powder and extracts form. Some phyto-biotic additives that have been explored in livestock industries and reported to give positive results are turmeric (Morakinyo *et al*., 2017), scent leaf (Odunsi *et al*., 2015), *Morinda lucida*, (Lala *et al*., 2017) and so on.

Hunteria umbellata (K. Schum) Hallier f; Phyto-biotic of interest belongs to the Kingdom Plantae, family Apocynaceaae and genus Hunteria. It is grown across - West + Central Africa from Senegal to Zaïre and commonly known in Nigeria as abere (Yoruba), osu (Edo), nkpokiri (Ibo) and the English name is Grey plum or rough skin plum (World Checklist of selected plant families, 2014). Seed is the known propagation method of *Hunteria umbellata* and the products has international trade value being exported in Ghana for medicinal uses, though no record for quantity but the major destination seems to be Germany (Boone, 2006). Ecologically, *Hunteria umbellata* is usually available during the rainy season in the rain forest, it could also be found in the secondary forest up to 600m altitude. Before now the use of *Huntaria umbellata* seed is relatively of less demand for medicinal application because of existing uncertainty about its value and fear of higher concentration of alkaloids and other toxic materials than the other parts of the plant (Adegoke and Alao, 1986) but Ibeh *et al. (*2007) reported that the seed is not different from the roots, leaves or back of the plant in terms of toxicity. This study therefore aimed at accessing and documenting its pharmacological and medicinal uses for livestock feeding systems.

GENUS HUNTERIA SPECIES AND THEIR DISTRIBUTION AREA

Hunteria ballayi (Central African Republic, Republic of Congo, Cameroon, and Gabon), *Hunteria camerunensis* (Republic of Congo, Cameroon and Gabon), *Hunteria congolana* Pichon (Republic of Congo, Zaïre and Kenya), *Hunteria densiflora* (Zaïre and Republic of Congo), *Hunteria ghanensis*: Ivory Coast and Ghana), *Hunteria hexaloba* (Pichon) (Gabon), *Hunteria macrosiphon* (Republic of Congo and Gabon), *Hunteria myriantha*

(Republic of Congo and Zaïre), *Hunteria oxyantha* (Republic of Congo, Zaïre and Gabon), *Hunteria simii* (Guinea, Ivory Coast, Liberia and Sierra Leone), *Hunteria umbellata* (K.Schum) (West + Central Africa from Senegal to Zaïre), *Hunteria zeylanica* (Retz.) (Somalia, Kenya, Tanzania, Mozambique, Southern China, India, Sri Lanka, Andaman & Nicobar Islands, Indochina, Western Malaysia and Sumatra). (World Checklist of Selected Plant Families, 2014)

CHEMICAL CONTENT of *Hunteria umbellata*

Proximate composition of *Hunteria umbellate*: The proximate analysis of *Hunteria umbellata* seeds reveals that it is of high nutritional value (dry mater = 23.30%, crude protein = 21.31%, crude fibre = 5.95%, ether extract = 17.6%, ash= 5.56, nitrogen free extract = 26.28% and energy = 1468.9Kcal/100kg) as reported by Ajayi and Ojelere, (2013).

Mineral Elements of *Hunteria umbellate*: *Hunteria umbellata* (Abere) seed is a good source of mineral elements while comparing with some other phyto-biotic plants due to its appreciable amount of calcium 68.55%, magnesium 1.82%, potassium 4.53%, Iron 0.45%, manganese 0.14%, zinc 2.12%, sodium 20.0% (Ajayi and Ojelere, 2013).

Phytochemical contents of *Hunteria umbellate*: Appreciable amount of saponins, glycosides, steroid, tannins, volatile oils, phenols and copious amount of alkaloids were reported to be present in plant extract of *Hunteria umbellata* (Falodun *et al.,* 2006). The powdered seed had also been reported to show the presence of alkaloids, glycoside, saponins, flavonoids, reducing sugar and tannin (Ajayi and Ojelere, 2013; Olufunmilayo *et al*., 2015). *Hunteria umbellata* Stem bark extract showed the presence of alkaloids, flavonoids, saponins, reducing sugars and cardiac glycoside, the leaf extract also contain same phyto chemicals with the stem bark but with the addition of volatile oil (Josephs *et al*., 2011).

PHARMACOLOGICAL EFFECTS OF *Hunteria umbellata*

Anti-inflammatory and antioxidant effect of *Hunteria umbellate*: Aqueous seed extract of *Hunteria umbellata* obtained by maceration technique (Adeneye *et al.,* 2011) was examined for anti-inflammatory effect in pre–treated adult male Wistar rats and reported to have anti-inflammatory activity which could be attributed to its alkaloid content. Alkaloids were partly mediated via free radicals scavenging and antioxidant mechanism. The acute inflammatory activity could be mediated by either inhibition or by blocking the release of prostaglandins and histamine, thus supporting the usage of the plant in traditional medicine in treatment of inflammation (Igbe *et al*., 2010).

Analgesic activity of *Hunteria umbellate*: Adeyemi *et al*. (2011) evaluated aqueous seed extract of *Hunteria umbellata* for analgesic activity in rats that were orally pre-treated with 50-200 mg/kg of *Hunteria umbellata* and the results showed that *Hunteria umbellata* at the experimented doses possess analgesic effect which lends support to its folkloric use in the local management of pain.

Oxytocic effect of *Hunteria umbellate*: Oxytocic is the ability to hasten or facilitate childbirth, especially by stimulating contractions of the uterine smooth and involuntary muscle (uterus). *Hunteria umbellata* seed has also been reported to have oxytocic effect which justifies its use for labouring mothers (Falodun *et al*., 2006).

Anti-bacteria activity of *Hunteria umbellate*: An in-vitro antibacterial activity of *Hunteria umbellata* Seed extract was evaluated using minimum inhibitory concentration (MIC) assay. It was reported that the stem bark methanol extract inhibited the growth of Staphylococcus aureus and Escherichia coli. The methanolic leaves extract had a minimum inhibitory concentration of 150mg/ml against Staphylococcus aureus and Escherichia coli, the activity could be attributed to the phytochemical constituents (alkaloids, glycoside, saponin, flavonoids, reducing sugar and tannin) in the plant (Ajayi and Ojelere, 2013; Olufunmilayo *et al*., 2015)

Hypoglycemic effect of *Hunteria umbellate*: Hypoglycemic is an abnormally low level of sugar glucose in the blood, usually a complication of diabetes, in which the body does not produce enough insulin to fully metabolize glucose. Erinidine was suggested to be the possible antihyperglycemic agent in *Hunteria umbellata* seed extract mediating its antihyperglycemic action via intestinal glucose uptake inhibition (Adejuwon *et al*., 2013). Male

albino rats with weight range of 130-160g were made diabetic by injecting them with alloxan intraperitoneally (100mg/kg body weight) and the result elicited that 100mg/kg body weight of *Hunteria umbellata* has hypoglycemic effect and may also reduce oxidative stress (Olufunmilayo *et al*., 2015). *Hunteria umbellata* significantly ameliorated the hyperglycemia and oxidative stress in alloxan-induced diabetic rats which was mediated via increased hepatic glycogen deposit, decreased hepatic glucose-6-phosphatase activity and improvement in antioxidant/free radicals scavenging activities (Adeneye *et al.*, 2014).

Weight Losing Effects (Antihyperlipidemic and Cardioprotective): Repeated oral treatment doses of 25 and 50 mg/kg/day of alkaloid fraction of *Hunteria umbellata* elicited weight loss, anti hyperlipidemic, cardioprotective effects and significantly improved the histological lesions of fatty hepatic degeneration induced by triton WR-1339 treatment in triton WR-1339 induced hyperlipidemic Wistar rats (Adejuwon and Peter 2015).

Toxicological effect of *Hunteria umbellate*: *Hunteria umbellata* seed has a relatively low oral toxicity profile but its prolonged use, particularly, at high doses should be with great caution (Kaur and Singh, 2016). Ibeh *et al.* (2007) has earlier reported that there were no significant variations in the roots, leaves, and or back of *Hunteria umbellata* in terms of toxicity of the plant to consuming subjects.

Growth Performance and Blood profile of livestock fed diets supplemented with *Hunteria umbellata* Seed: Olufunmilayo *et al*. (2015) and Adeneye *et al*. (2014) had reported *Hunteria umbellata* to be used as feed supplement and medicine to improve growth performance and health in humans and livestock due to the presence of alkaloids, glycoside, saponins, flavonoids and reducing sugar. Ibeh *et al.* (2007) had injected rabbits with 0.5ml and 1.0ml of both aqueous and alcohol based extract of *Huntaria umbellata* and reported that it has no significant effect on the growth performance of rabbits negating the report of Olufunmilayo *et al.* (2015) who reported increased growth rate in induced diabetic rats treated with *Hunteria umbellata* seed.

The methanolic seed extract of *Huntaria umbellata* contain some secondary metabolites and not hematotoxic but prolonged use of high dosage may be hepatotoxic and harmful to the body (Olufunmilayo *et al.*, 2015; Adeneye *et al.*, 2014). There was enhancement in the activities of alkaline phosphatase, aspartate transaminase and alanine transaminase in the rabbits exposed to 0.5ml aqueous extract of *Hunteria umbellata* compared to the controlled animals, indicating hepatic damage (Olufunmilayo *et al*., 2015) of rats exposed to 100 and 250mg/kg/ body weight of *Hunteria umbellata*. Increase in the serum levels of AST and ALT (especially ALT) were reported to be associated with liver damage (Momoh *et al*., 2014). Nelson and Cox (2005) reported that a rise in plasma level of bilirubin suggests liver cell damage, since liver cells are responsible for removing bilirubin from serum.

Traditional medicinal values of *Hunteria umbellate*: *Hunteria umbellata* plant parts (Leaf, pulp and seed) are used in traditional medicine to: reduce blood sugar levels (Olufunmilayo *et al*., 2015) in diabetic patients, reduce blood cholesterol levels, reduce blood pressure levels, lose weight, treat pain and aches, kill intestinal worms, treat leprosy sores, resolve liver issues, treat stomach issues, reduce fevers, boost libido and male potency, boost the immune system, reduce heavy menstrual flow, treat amenorrhea or the absence of menses, boost female fertility, prevent miscarriage, heal peptic ulcers, treat skin infections and issues, manage arthritis and other inflammatory conditions of the joint and it hasten child delivery by inducing uterine contractions (Akinsola, 2016). It is also used for treatment of pile and haemorrhoids (Borokini *et al*., 2013). However, most of the reported cases did not have dosage and time values of usage.

CONCLUSION

This review paper explored the traditional and medicinal uses of *Hunteria umbellata*. Having elicited several studies both in-vitro and in-vivo that confirms it's encompassing medicinal values, therefore, there is the need to further exploit its beneficial effects in the livestock industry as a possible ethno medicinal phyto additive. It could also be useful in areas involving organic livestock production.

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Discriminant Analysis of Four Strains of Broiler Chickens

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Abstract: This study was conducted to assess the magnitude of genetic diversity and interdependence of morphological traits in 4 strains of broiler chicken (Arbor Acre, Hubbard, *Marshall* and Ross 308) using stepwise discriminant analysis and cluster analyses. A total of 800 birds were used, 200 per strain. The parameters recorded throughout the 8 weeks period were body weight, body length, keel length, shank length, body height, drumstick length, thigh length, wing length, shank circumference, comb length, body girth, neck length and beak length. Data collected at the 8th week were analysed using STEPDISC procedure. Stepwise discriminant analysis indicated that shank length, neck length, thigh length, body girth, drumstick length and body weight were retained as the discriminating variables. Ross 308 had higher body weight, long shank and keel length compared to the other three strains. Three discriminant functions were extracted accounting for 100% of the total variance. The hierarchical cluster analysis showed that the morphometric parameters of Arbor acre birds were similar to Hubbard and Marshall birds while Ross 308 birds were similar to both Arbor acre and Marshall birds.

Key words: Body parameters, Cluster, Dendogram, Diversity, Strain

DESCRIPTION OF PROBLEM

Livestock is important to the livelihoods of 80% of the 800 million people living in Africa and about 160 million poor people keep livestock in Sub Saharan Africa (FAO, 2005). There is variable morphological identity in chickens present in Nigeria. Different studies have been carried out on the characteristics of some strains of chickens in Nigeria (Ozoje *et al.*, 1999). The detection of variation due to differences in DNA sequences or specific genes or modifying factors is known as characterization. This characterization might be carried out via different methods with the use of morphometric parameters as an example (de Vicente *et al*., 2005). It is therefore important to have knowledge of the variation of morphometric traits because such measurements have been discovered to be very useful in comparing body size and by implication, shape of animals (Latshaw and Bishop, 2001). Such comparison could be used as basis for selection and improvement programmes. Multivariate analysis is a suitable approach of analysing performance data of broiler chickens. Some interesting results have already been obtained on performance demonstrating that it is viable to use multivariate approaches, such as cluster analysis using canonical variables (Pires *et al.*, 2002, Ogah *et al*., 2013). Hence, it is important to accurately analyse the morphological variables that enable us to distinguish between genotypes, as well as explore the use of various discrimination methods to assess the potential of each of the variables under study (Rodero *et al*. 2011). Hence, one of the purpose of this study was to use discriminant analysis for differentiation of broiler strains by taking quantitative morphometric traits into consideration.

MATERIALS AND METHODS

The experiment was carried out at a Private Farm (Fair and Firm Farm), Tanke Oke-Odo, Ilorin, Kwara State. The study lasted for a period of eight (8) weeks. Eight hundred (800) day-old broiler chicks of different genotypes was bought and used for the experiment. The birds were housed in a ventilated metabolic cage for the first three (3) weeks before they were moved to a deep litter house for the remaining 5 weeks, the birds were weighed at the beginning of the experiment and thereafter on a weekly basis. A total of four treatments were used for the study, comprising of 200 randomized birds per treatment, the treatment was then replicated eight times with twenty-five birds per replicate. The birds were fed *ad-libitum* throughout the period of the experiment. Feed intake and weight gain of the birds was monitored. The following thirteen (13) morphometric measurements were taken on weekly basis on each bird viz: Body weight (BW), Body length (BL), Keel length (KL), Shank length (SKL), Body height (BH), Drumstick length (DSL), Thigh length (THL), Wing length (WNL), Shank circumference (SC), Comb length (CBL), Body girth (BG), Neck length (NKL) and Beak length (BKL). Body weight of individual birds was determined by placing each one on the loading pan of the Mettler Toledo® top loading scale. All linear measurements was determined using a Tailor's Measuring Tape and Venier calliper as described by Sola-Ojo *et al*, (2011).

Data Analysis: The Linear traits were analyzed using the general linear model of (SPSS, 2013). PROC CANDISC procedure was used to perform the univariate and multivariate analysis to derive canonical variables. The classified ecotypes and the thirteen linear traits were used to separate canonical variables. Stepwise discriminant analysis using PROC STEPDISC was employed to determine the best combination of variables that would differentiate the strains. The DISCRIM procedure (hierachical cluster analysis) was used to find the percentage of correct assignment of each bird to its genotype. The Average Linkage method was used to construct dendograms for the identification of the morphologically homogenous groups (clusters) using the same software.

RESULTS AND DISCUSSION

Multivariate Analysis

Table 1 shows the the eigen values, variance proportion, canonical correlation and standardized discriminant coefficient of the variables. Three discriminant functions were extracted, the significance of the discriminant function tested with Wilks Lambda (0.000, 0.016, 0.190) and Bartlett's test (Chi-square 5877.477 P<0.001, 3153.593 P<0.01, 1259.446 P<0.001) for the three functions, provided validity for the canonical discriminant analysis. On obtaining the weighing power of each of the 13 original independent variables to discriminate between the four genotypes, SL, NKL, THL, BG, DSL and BW were retained as the discriminating variables which was similar to the works of Ogah *et al.* (2011).

Table 2 presents the standardized canonical coefficient and total variance explained by each canonical variable. The first canonical variable (Can1.) or Fisher linear discriminant function explained 69.6% of the total variation, Can2 explained 22% and Can3 explained 8.4% of the total variation. It is clear that for the thirteen traits used in this study, the three canonical variables extracted explained the total variation (100%). The canonical discriminant analysis performed here helped in weighing each original traits contribution to the three canonical variables, this observation was similarly reported by Rosario *et al*.,(2008). The first canonical variable Can 1 loaded highly body girth, CAN 2 loaded for shank length, neck length and thigh length and Can 3 loaded high for thigh length, drumstick length and body length. These traits that loaded high in CAN1, CAN2 AND CAN3 demonstrates their relevance in discriminating between the strains.

Table 1: Summary of Canonical Discriminant function at 8 weeks of age

Function	Eigen Value	% of Variance	Cumulative %	Canonical Correlation	Chi-square	Sig.	Wilks' Lambda
1	35.448[a]	69.6	69.6	0.986	5877.477	0.000	0.000
2	11.189[a]	22.0	91.6	0.958	3153.593	0.000	0.016
3	4.273[a]	8.4	100.0	0.900	1259.446	0.000	0.190

Table 2: Standardized Canonical Discriminant Function Coefficients at 8 weeks of age

	Function		
	1	2	3
SL		.515	
NKL		-.575	
THL		-.544	-.561
BG	.586		
DSL			.536
BW			.667

Discriminant analysis of morphometric traits in this study correctly classified 100% of the experimental birds. One hundred percent of the four genotypes were correctly assigned into their distinct genetic groups. No errors existed in this classification which means that no individual from a particular strain was classified wrongly as another strain. This indicates that linear body measurements such as the ones used in this study are reliable for classification of birds to distinct genotypes. The result of the canonical discriminant analysis agrees with that of Ogah *et al.* (2011) where higher classification success rate was reported and the birds were correctly classified as 71.9%, 85.4% and 94.9% of Guinea savanna, dry savanna and rain forest Nigerian Muscovy ducks respectively. Yakubu *et al.* (2010) used discriminant analysis to correctly classify West African Dwarf and Red Sokoto goat populations of Nigeria into their distinct populations. The current classification function is a prime tool available to differentiate between the four strains under field conditions, which could aid their effective management. Figure 1 showed that Hubbard birds were marked distinct from their exotic counterparts. Similarly, the classification results revealed that 100.0% of Arbor acre, Hubbard, Marshall and Ross 308 chickens were correctly classified (Table 4).

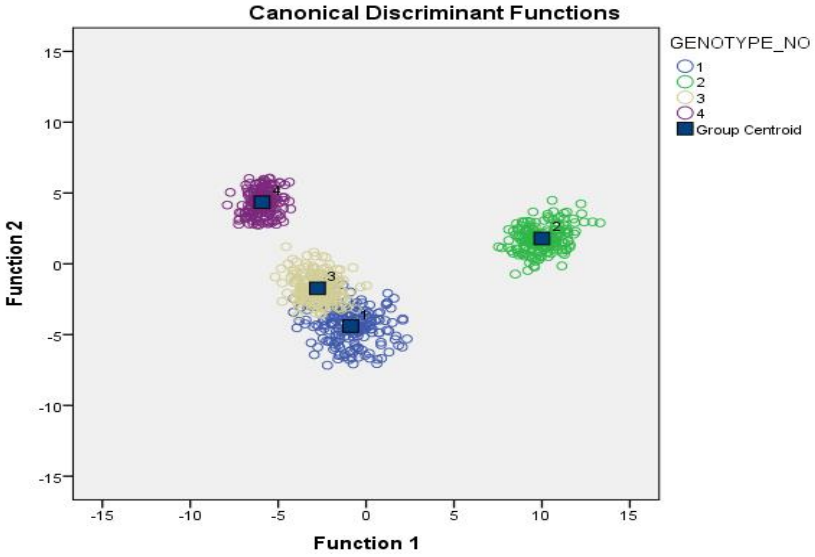

Figure 1: Canonical discriminant function showing the distribution among the four broiler strains at 4 weeks of age. 1, 2, 3 and 4 represents Arbor acre, Hubbard, Marshall and Ross 308 strains, respectively

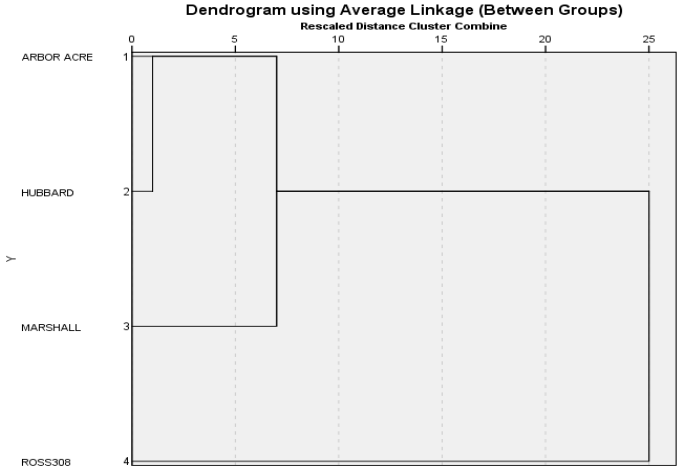

Figure 2: Dendogram from average linkage method (between groups) hierarchical agglomerative cluster among the four-broiler strain

Hierarchical Cluster Analysis of the experimental birds

Dendogram using average linkage method showed four major clusters. The hierarchical cluster analysis showed that the morphometric parameters of Arbor acre birds were similar to Hubbard and Marshall birds while Ross 308 birds were similar to both Arbor acre and Marshall birds. This observation can be due to their pattern of

growth either at the starter phase or finisher phase and this similarity could be from their genetic stand point which means they may be closely related by decent (Figure 2).

CONCLUSION

The use of canonical discriminant analysis in evaluating morphometric trait between four broiler genotypes has helped in understanding the genetic relatedness between the genotypes. Of the total variables considered, six (6) latent variables (shank length, neck length, thigh length, body girth, drumstick length and body weight) were discovered to distinguish between the strains in the finisher phase. The result gotten from this study can help to make crosses between strains that are far apart in descent so that we don't use strains that are close to themselves in cross breeding experiments. This study also has revealed the discrimination of four exotic broiler strains predominant in Nigeria. The performance of these strains revealed that some morphometric traits i.e. linear measurements can be tapped in order to make strategic improvement programme in the poultry industry and also help in designing a long term genetic improvement programme for the broiler breeding industry in Nigeria using growth or morphometric parameters.

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Phenotypic Correlations Between Bodyweight and Linear Body Measurements of Cross Between Dutch × Dutch And New Zealand White × Chinchilla Rabbits (*Oryctolagus cuniculus*)

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Abstract: Data on 16 weaner rabbits were obtained from the crosses between Dutch × Dutch (DU ×DU) and New Zealand White × Chinchilla (NZ ×CH). The experiment was conducted at the Skills Acquisition and Entrepreneurship Development Centre of National Agricultural Extension Research and Liaison Services (NAERLS), Ahmadu Bello University, Zaria-Nigeria. Data on bodyweight and linear body measurements (LBMs) namely: body length (BL), chest girth (CG), head-to-shoulder(HS), shoulder-to-tail drop (ST), length of hind leg (LHL), ear length (EL), height at withers (HTW) ear length (EL), heart girth (HG), body length (BL), head to shoulder (HS), leg length (LL) and tail length (TL) were collected after weaning (6 to 14 weeks of age). The relationships among the measured traits were determined using Linear Correlation Procedure of SAS (version 8.0, 2004). The value of the Pearson's linear correlation coefficient determines the level of relationship between the LBMs. Correlation coefficients ranged from 0.05-0.99 and 0.00-0.99 in DU×DU and NZ×CH respectively. The correlation coefficients varied from positive to negative; low to moderate and high correlation coefficients were observed among body weight and LBMs. In conclusion, offspring from DU×DU and NZ×CH genotype of rabbits had both positive and negative correlation coefficients between the body weight and LBMs.

Keywords: Dutch**,** New Zealand White, Chinchilla, Linear body Measurements, Phenotypic correlations.

DESCRIPTION OF PROBLEM

Rabbit production is increasing due to its high reproductive performance, genetic variability, roughage utilization potential and very low cost of production. Likewise, rabbit meat is of high protein level and of high nutritional values due to its low cholesterol.

It is imperative to improve rabbits in order to increase their contribution to the much-needed animal protein in Nigeria. It is essential for rabbit breeders to establish the relationship that exists between life weight and linear measurements as well as to organize the breeding programs, so as to achieve an optimum combination of body weight and good conformation for maximum economic returns (Khalil *et al*., 1987). This makes the work of the breeders easier and faster as its effects can then be concentrated on traits that are easier to measure.

Breeds such as Dutch, New Zealand White and Chinchilla are some of the most commonly identified breeds, which have peculiar characteristics that distinguish them from another. This study was conducted to identify the level of phenotypic correlation that exists between the linear body measurement and bodyweight of purebred Dutch and crossbred New Zealand White ×Chinchilla rabbits at post-weaning.

MATERIALS AND METHODS

Description of Experimental Site: The study was conducted at the Skills Acquisition and Entrepreneurship Development Centre of National Agricultural Extension Research and Liaison Services (NAERLS), Ahmadu Bello University, Zaria, Kaduna State, Nigeria. Zaria is located within the Northern Guinea Savannah Zone of Nigeria between latitude 11^0 33᾽ N and longitude 12^0 33′E (Ovimaps, 2016).

Experimental Animals and Management: A total of 16 weaner rabbits consisting of 8 from each genotype were housed in individual row cages of metal and wire-gauze of 60×44×50cm^3. The weaner rabbits were fed concentrate ration (16% crude protein and 2504 Kcal/kg metabolizable energy) and forage legume. Forage legume (*Digitaria smutssi*) was chopped and mixed with the formulated feed before feeding. Routine

management operations such as regular cleaning of the cages and feeders were carried out throughout the research period

Data Collection: The traits measured were bodyweights (BW) and linear body measurements (LBMs) namely: body length (BL), chest girth (CG), head-to-shoulder (HS), shoulder-to-tail (ST), length of hind limb (LHL), ear length (EL) and height at withers (HTW). Bodyweight was taken in grams using a weighing scale (Dimensions: 56 x 47 x 37cm, Model Number: KFC, Manufacturer: Yongkang Huaying weighing apparatus company limited, China) and height at withers with a ruler in centimeters. Measurements were done after weaning on a bi-weekly basis for 5 weeks (6, 8, 10, 12 and 14 weeks). All the traits, except for bodyweight and height at withers were measured using measuring tape in centimeters.

Statistical Analysis: The relationships among the measured traits were determined using Linear Correlation and Analysis Procedure of SAS (version 8.0, 2004).

RESULTS AND DISCUSSION

Table 1: Phenotypic correlations among Body weight and LBMs of Purebred Dutch and New Zealand White × Chinchilla weaner rabbits

Genotype	Traits	BW(g)	BL(cm)	CG(cm)	HS(cm)	LHL(cm)	EL(cm)	ST(cm)	HTW(cm)
DUxDU	BW(g)	-							
	BL(cm)	0.17^{NS}	-						
	CG(cm)	0.44*	0.95***	-					
	HS(cm)	-0.71^{NS}	0.52*	0.23^{NS}	-				
	LHL(cm)	0.65*	0.84**	0.91***	0.07^{NS}	-			
	EL(cm)	0.73**	0.66*	0.74**	- 0.05^{NS}	0.95***	-		
	ST(cm)	0.66*	0.77**	0.84**	0.06^{NS}	0.99***	0.99***	-	
	HTW(cm)	0.85**	0.65*	0.85**	- 0.29^{NS}	0.91***	0.85**	0.87**	-
NZxCH	BW(g)	-							
	BL(cm)	0.92***	-						
	CG(cm)	0.80**	0.97***	-					
	HS(cm)	0.89**	0.68*	0.55*	-				
	LHL(cm)	0.55*	0.51*	0.32^{NS}	0.29^{NS}	-			
	EL(cm)	0.21^{NS}	0.52*	0.73**	0.00^{NS}	-0.29^{NS}	-		
	ST(cm)	0.82**	0.97***	0.99***	0.52*	0.39*	0.69*	-	
	HTW(cm)	0.91***	0.96***	0.87**	0.63*	0.74**	0.32^{NS}	0.90***	-

DU= Dutch, NZ=New Zealand White, CH=Chinchilla, BW=Body weight, BL= Body length, CG= Chest girth, HS= Head-to-shoulder, LHL= Length of hind leg, HTW=Height at wither, EL= Ear length, ST=Shoulder-to-tail drop, NS=Not significant ($p>0.05$), *=$p<0.05$, **=$p<0.01$, ***= $p<0.00$.

Table 1 shows the coefficients of correlation for bodyweight and linear body measurements of DUxDU and NZxCH**.** All the bodyweight and linear body measurements showed varying degrees of relationships. The correlation coefficients were positive and negative, low to high ranged from 0.00 to 0.99. For DUxDU, a highly significant ($p<0.01$) correlation was obtained between CG and LHL (0.91), LHL and EL (0.95), LHL and ST (0.99), LHL and (0.91), EL and ST (0.99). A significant correlation ($p<0.05$, $p<0.01$) was observed between BW and HG (0.44), BW and LHL (0.65), BW and EL (0.73), BW and ST (0.66), BW and HTW (0.85) BL and HS (0.52), BL and LHL (0.84), BL and EL (0.66), BL and ST (0.77), BL and HTW (0.65), HG and EL (0.74), HG and ST (0.84), CG and HTW (0.85), EL and HTW (0.85), ST and HTW (0.87). Other traits measured, although positive and negative but did not show significant correlation ($p>0.05$). A highly significant ($p<0.01$) correlation were obtained between BW and BL (0.92), BL and HG (0.97), BL and ST (0.97), BL and HTW(0.96), HG and

ST (0.99), CG and HTW (0.87), ST and HTW (0.90) while other correlated traits are significant ($p<0.05$) with the exception of BW and EL (0.21), CG and LHL (0.32), HS and LHL (0.29), HS and EL (0.00), LHL and EL (-0.29), EL and HTW (0.32) for NZxCH genotype while the highest correlation coefficient for the same genotype was obtained between CG and ST (0.99) and the lowest correlation coefficient was between HS and EL (0.00).

The high coefficients of correlation suggest possible strong relationship between the traits, and the likelihood of pleiotropic effect of genes operating on them. Therefore, any attempt to select for one trait in a breeding program will automatically result to improvement on those other correlated traits. Previous studies have indicated positive and significant correlations between live weight and body dimensions in farm animals. Body dimensions are good indicators and can be used to predict the body weight of rabbits. The positive and negative phenotypic correlations obtained disagreed with the findings of Okoro *et al.* (2010) who obtained only positive correlations. The authors observed positive relationship between bodyweight and LBMs such as EL, BL, HS, LL, HG and TL in Chinchilla breed at week 3, 6 and 8 weeks of age. The possible reason for this variation may be due to breed or genotype differences, age of the animals and other environmental factors like climate, temperature and feeds.

The positive correlation coefficients simply mean that as one of the traits increases a corresponding increase is expressed in the other while the negatively correlated traits are the reverse. The moderate to high correlation coefficients obtained corroborates the work of (Akano and Ibe 2005) in various breeds of rabbits.The current results obtained are similar with the findings of Tiamiyu *et al.* (2000) who reported both positive and negative correlation coefficients among medium breed rabbits.

CONCLUSION

It can be concluded that bodyweight and LBMs for Dutch × Dutch and New Zealand White × Chinchilla genotype of rabbits are positively and negatively correlated.

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Influence of Breed and Egg Weight on Fertility and Hatchability of Sasso, Shika Brown Chicken and Their Crosses

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Abstract: The effect of breed and egg weight on hatchability and fertility in Sasso, Shika brown and their crosses was studied. A total of one thousand, one hundred and seven (1107) eggs comprising 509 Sasso eggs (46 light, 285 medium, 178 heavy) 392 Shika brown egg (141 light, 97 medium, 154 heavy) and 205 Sasso x Shika brown cross (19 light, 145 medium, 42 heavy) were used for this study. The eggs were collected, weighed and sent to the hatchery. Data on number of fertile eggs, number of fertile eggs hatched, fertile eggs not hatched, eggs not fertile, chicks dead in shell, deformed chicks and total number of eggs were collected and analyzed by SAS (2001) using analysis of variance (ANOVA). Significant means were separated using Duncan Multiple Range Test. The results revealed a significant ($p<0.05$) effect of breed on the number of fertile eggs, number of fertile eggs hatched, fertile but not hatched eggs, eggs not fertile, dead in shell chicks, deformed chicks and total number of eggs. Sasso and Shika Brown had more number of fertile eggs as compared to Sasso x Shika Brown cross. For number of fertile eggs hatched, Sasso had the highest mean number of fertile eggs hatched (19.55). Also, considering fertile but not hatched eggs, the highest value was seen in Shika brown (8.77). Sasso had the highest number of eggs not fertile (35.55). The number of deformed chicks was highest in Shika brown (0.66). Total number of eggs was highest in Sasso (56.55). There was also a significant ($p<0.05$) effect of egg weight on the number of fertile eggs, fertile number of eggs hatched, fertile but not hatched eggs, eggs not fertile, deformed chickens and total number of eggs. Chicks dead in shell were not significantly affected by egg weight. From the interactive effect of breed and egg weight on hatchability and fertility, the highest value of fertile eggs was observed in medium weight eggs of Sasso and the least in heavy weight of Sasso x Shika brown crosses. The highest value of fertile eggs hatched was observed in medium weight eggs of Sasso (41.00). Furthermore, the highest number of eggs not fertile was observed in medium weight eggs of Sasso (50.00). Deformed chicks were only observed in light weight eggs of Shika Brown (2.00) and heavy weight eggs of Sasso x Shika brown. In conclusion, it is observed in this study that fertility and hatchability in chicken is affected by the breed and the weight of the egg.

Keywords: Single Nucleotide Polymorphism, Hatchability, fertility, Sasso, Shika brown

INTRODUCTION

Domestic chickens (*Gallus gallus* domestica) are non-descriptive and heterozygous birds that are different in size, colour, shape and production ability depending on their genetic makeup. In Nigeria the population of local chickens accounts for 80% (Ajayi and Agaviezor, 2012) and are of great importance to man both nutritionally, culturally and economically (Peters *et al*., 2008). Selection for production traits in the poultry industry (broiler and layer) has resulted in a rapid improvement in animal performance. For broilers, the main selection pressure has been on growth rate, feed efficiency, and carcass traits, and in layers, the focus has been to increase egg production and quality (Fulton, 2012). However, although several traits have been genetically improved, phenotypic and genetic variations still exist among chicken populations due to differences in selection practices imposed by different breeding programs; therefore, improvements are required in this regard (Rönnegård and Valdar, 2011).

In poultry production, different factors ranging from environmental to genetic factors do affect egg production, fertility and hatchability of the eggs. Some of such factors include storage time, position of the eggs, relative humidity, temperature and feed variation (Mussaddeq *et al*., 2002; Al-Bashan and Al-Harbi, 2010). However genetic factors such as breed type, genetic makeup of the embryo, shell quality, egg size and disease also affect fertility and hatchability (King'ori, 2011). The productive value of animals is determined by its ability to meet

production demand and the production potential of domestic fowl is controlled by several parameters including those related to its reproductive potential (fertility and hatchability of eggs). This study was therefore designed to assess the influence of breed and egg weight on hatchability and fertility in Sasso, Shika Brown and their crosses in the South - South region of Nigeria.

MATERIALS AND METHODS

This study was carried out at the University of Port Harcourt Demonstration Farm, Choba, Port Harcourt, Nigeria. Ten (10) males and 100 females of Sasso and 5 males and 50 females of Shika brown donated by African Chicken Genetic Gains (ACGG) for capacity building were artificially inseminated to generate a total of one thousand, one hundred and seven (1107) eggs comprising 509 Sasso eggs (46 light, 285 medium, 178 heavy) 392 Shika brown egg (141 light, 97 medium, 154 heavy) and 205 Sasso x Shika brown cross (19 light, 145 medium, 42 heavy) were used for this study. The egg weights were classified as light <50g, medium 50 – 59g and heavy 60- 69g. The eggs were collected, weighed and sent to the hatchery. Data on number of fertile eggs, number of fertile eggs hatched, fertile eggs not hatched, eggs not fertile, chicks dead in shell, deformed chicks and total number of eggs were collected and analyzed using SPSS version 16 using analysis of variance (ANOVA). Significant means were separated at $p<0.05$ using Duncan Multiple Range Test of the same package.

RESULTS

Table 1 shows the effect of breed on fertility and hatchability parameters of the chickens studied. The results revealed a significant ($p<0.05$) effect of breed on the number of fertile eggs, number of fertile eggs hatched, fertile but not hatched eggs, eggs not fertile, chicks dead in shell, deformed chicks and total number of eggs. Sasso and Shika Brown had more number of fertile eggs as compared to Sasso x Shika Brown cross. For fertile number of eggs hatched, Sasso had the highest mean number of fertile eggs hatched (19.55). This was followed by Shika brown (14.88) and the least value was seen in Sasso x Shika brown cross (8.22). Also, considering fertile but not hatched eggs, the highest value was seen in Shika brown (8.77). This was followed by the Sasso and Sasso x Shika brown cross having the same value of 1.44. Sasso had the highest number of eggs not fertile (35.55). This was followed by Shika brown (19.88) and the least was observed in Sasso x Shika brown (13.22). Chicks dead in shell also varied significantly. The highest number was observed in Shika brown (1.77). Sasso had 1.11 and the least was observed in Sasso x Shika brown cross (0.33). The number of deformed chicks was highest in Shika brown (0.66). Sasso and Sasso x Shika cross had no deformed chicks. Total number of eggs was highest in Sasso (56.55) and was followed by Shika brown (43.55) and the least was observed Sasso x Shika brown cross (22.88).

Table 1: Effect of breed on hatchability and fertility of Sasso, Shika brown and their cross

Breeds	Fertile eggs	Fertile eggs hatched	Fertile eggs not hatched	Eggs not fertile	Chicks dead in shell	Deformed chicks	Total number of eggs
Sasso	21.00^{a}	19.55^{a}	1.44^{b}	35.55^{a}	1.11^{b}	0.00^{b}	56.55^{a}
Shika brown	23.66^{a}	14.88^{b}	8.77^{a}	19.88^{b}	1.77^{a}	0.66^{a}	43.55^{b}
Sasso x Shika brown	9.66^{b}	8.22^{c}	1.44^{b}	13.22^{c}	0.33^{c}	0.00^{b}	22.88^{c}
Standard Error	0.00	0.30	0.30	0.36	0.21	0.11	0.36

a, b, c: Means in the same row having different superscripts are significantly different ($p<0.05$)

Table 2 shows the effect of egg weight on fertility and hatchability parameters of the chickens studied. There was also a significant ($p<0.05$) effect of egg weight on the number of fertile eggs, fertile number of eggs hatched, fertile but not hatched eggs, eggs not fertile, deformed chickens and total number of eggs. Number of chicks' dead in shell were not however significant. Shika brown had the highest number of fertile eggs and the least was observed in Sasso. Fertile numbers of eggs hatched were highest among medium weight (28.55). This was

followed by the heavy weight eggs with a value of 13.66 and the least was observed among the light weight eggs (9.33). For fertile but not hatched eggs, the light weight eggs had the highest value of 4.88. This was closely followed by the heavy weight eggs with a value of 4.00. The least was seen in the medium weight eggs with a value of 2.77. However, there was no statistical difference ($p>0.05$) between the light and heavy size eggs. For eggs not fertile, the highest significant value was observed in heavy weight eggs (27.88). This was followed by the medium weight eggs having a value of 27.22 and the least was seen in the light weight eggs (13.55). Chicks dead in shell were not significantly affected by egg weight. However, the medium and heavy weight eggs had equal value of 1.11 as compared to the light size egg with a value of 1.00. For deformed chicks, the highest significant number was seen in the light weight eggs with a value of 0.66. There were no deformed chicks in the medium and heavy weight eggs. For the total number of eggs hatched, the medium weight eggs had the highest value of 58.55. This was followed by the heavy weight eggs with a value of 41.55. The least was observed in the light weight eggs with a value of 22.88.

Table 2: Effect of egg weight on fertility and hatchability of eggs

Egg size	Fertile eggs	Fertile eggs hatched	Fertile eggs not hatched	Eggs not fertile	Chicks dead in shell	Deformed chicks	Total number of eggs
Light	9.33^{c}	4.44^{c}	4.88^{a}	13.55^{b}	1.00	0.66^{a}	22.88^{c}
Medium	31.33^{a}	28.55^{a}	2.77^{b}	27.22^{a}	1.11	0.00^{b}	58.55^{a}
Heavy	13.66^{b}	9.66^{b}	4.00^{a}	27.88^{a}	1.11	0.00^{b}	41.55^{b}
Least Square Mean	0.00	0.30	0.30	0.36	0.21	0.11	0.36

a, b, c: Means in the same row having different superscripts are significantly different ($p<0.05$)

DISCUSSION

The results of this study show that difference in breeds has a significant effect on different hatchability parameters. The findings of this study is thus in line with the fact that hatchability and fertility performance of eggs depends on genetic factors (Islam *et al.*, 2002). Fertility and hatchability are interrelated heritable traits and they vary among breeds, variants and individuals within breeds and variants. However, Ashart *et al.* (2003) reported that there was no significant difference ($p>0.05$) in the fertility between Lyallpur silver black and Rhode Island Red interaction but between the hatches, significant ($p<0.05$) differences were observed. From this study, higher hatchability results were achieved in medium egg weight. This shows that jumbo size eggs and light weight eggs should not be set in the hatchery. However, maximum fertility was observed in the light weight eggs. Similarly Hassan *et al.*, (2005) reported that medium size eggs yield at least 75% hatchability compared to 50% and70% hatchability of small and large eggs respectively. However in contrast Dewilt and Schwalbach (2004) observed that large eggs recorded higher percent hatchability in New Hampshire and Red Rhode Island chicken breeds. Another study also showed that large size eggs of indigenous Venda chickens had a higher hatchability than medium and small size eggs (Mbajiorgu, 2011). A negative correlation between egg size and hatchability in crossbred chicken was observed and heavier eggs resulted in low hatchability than medium size eggs (Farooq *et al*., 2001). Similarly, Wondmeneh *et al*. (2011) reported that medium size eggs of Potchefstroom keokeok chicks had the highest hatchability than large and small eggs size group. The results of this study is also supported by that of Durmus *et al.*, (2010) who reported that fertility, late embryonic mortality (dead in shell), and hatchability differs between genotypes.

CONCLUSION

In conclusion, genetic and non-genetic factors influenced hatchability and fertility in Sasso, Shika brown and Sasso x Shika brown cross. A significant effect of breeds and egg weight on fertility and hatchability parameters was observed. The use of Sasso and Shika brown as well as medium weight eggs should be encouraged for better percentage of fertility and hatchability. However, understanding these factors and how they affect

chickens reproductive or productive traits will help to develop practices to regulate hen productive performance at a profitable level.

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Correlations between Live Body Weight and Linear Body Measurements of Chickens in Borno State, Nigeria

Abstract: Phenotypic data from 665 indigenous chickens were collected and subjected to multivariate analysis of General linear model and correlation. Body weight, comb length, shank length, shank circumference, spur length, wing length and wattle length all varied significantly between sexes with the males being superior to the females in all the measurements. Similarly, between agro-ecological zones, only shank circumference, wing length and wattle length were significantly different with shank circumference favouring chickens from the Sahel savannah and the last two traits favouring chickens from the Sudan savannah. Linear, measurements however had significantly moderate ($P<0.001$) and positive relationship, with spur length, shank length and shank circumference (0.412, 0.130, and 0.177 respectively).

Keywords: Local, Native, chicken, Phenotype, Characterisation

INTRODUCTION

In their observations, (1) reported that the native chickens constitute about 80% of the poultry birds in Nigeria. Free range chicken production represents an important system for supplying the fast growing human population and providing additional income to resource-poor small farmers, especially women. Its importance therefore cannot be over emphasized as it has become popular industry for the small scale holders that have great contribution to the economy of the country. Indigenous chickens are the most commonly distributed across every corner of the tropical countries of Africa where they are kept by rural poor (2). Moreso, as a consequence of natural selection indigenous chickens have shown to be more disease resistant. Due to their development, they might be better adapted to survive under harsh conditions without proper management programs and under limited supply of resources. Identification and characterization of the chicken genetic resources generally requires information on their population, adaptation to a specific environment, possession of traits of current or future value and socio-cultural importance, which are crucial inputs to decisions on conservation and utilization (3).This study therefore aims to.Characterize and describe the phenotypic variations of the indigenous chicken population in Borno and .Evaluate the correlations existing between live weight and linear body measurements in the indigenous chicken population in Borno.

MATERIALS AND METHOD

Description of the Study Region: The study area (Borno State) lies in the north-eastern part of Nigeria. The study covered six (6) local government areas namely: Mobbar, Gubio, Marte, Gwoza, Chibok and Kwaya-kusar out of the 27 local governments and the metropolis. Temperature ranges between 32^{o}C-38^{o}C during the hot dry seasons and below 10^{o}C during the cold dry period with an average of 34^{o}C and an average minimum temperature of 20^{o}C (4).

Data Collection: Information on the phenotypic characteristics of local chicken types was recorded. Visual appraisal of the appearance of the local chicken types and their typical features were collected from a total of about 665 individual chickens (5).

Statistical Analysis: Data collected from the quantitative variables such as body weight, shank length, shank circumference were analyzed using General Linear Model (GLM), multivariate analysis and correlation analysis of the Statistical Package for Social Sciences (6).

RESULTS AND DISCUSSION

TABLE 1: Least significant Square means of body weight, comb length, shank circumference, shank length, wing length and wattle length.

	Local Government Area						Agro-ecological Zones			Sex		S
	Gubio	**Marte**	**Mobbar**	**Chibok**	**Gwoza**	**Kwaya k.**	**Sahel**	**Sudan**	**Mean**	**Cock**	**Hen**	**Cold d**
(g)	1025	974.67	1046.9	1043.9	969.84	1028	1015.25	1013.91	1014.72	1253.7^{a}	879.2^{b}	1025.7
(cm)	3.69^{ab}	2.77^{b}	2.77^{b}	3.18^{ab}	2.85^{ab}	3.93^{a}	3.22^{b}	3.32^{a}	3.27^{ab}	4.98^{a}	2.35^{-b}	3.40
(cm)	7.68^{a}	7.58^{ab}	8.01^{a}	7.57^{ab}	7.09^{b}	7.97^{a}	7.56	7.54	7.65^{a}	7.40^{a}	7.28^{b}	7.73
ference(cm)	1.42^{ab}	1.32^{b}	1.57^{a}	1.38^{ab}	1.29^{b}	1.27^{b}	1.43^{a}	1.31^{b}	1.38^{ab}	1.68^{a}	1.20^{b}	1.40
cm)	0.34^{b}	0.27^{b}	0.50^{a}	0.46^{ab}	0.28^{b}	0.40^{ab}	0.26	0.38	0.39^{ab}	0.47^{a}	1.20^{b}	0.40
(cm)	12.38^{b}	12.28^{b}	12.30^{b}	14.07^{a}	11.41^{b}	12.13^{b}	11.98^{b}	12.44^{a}	12.43^{b}	13.53^{a}	12.06^{a}	12.66
(cm)	2.26^{bc}	1.89^{c}	2.62^{b}	2.49^{b}	2.11^{bc}	3.30^{a}	2.13^{b}	2.63^{a}	2.45^{b}	3.62^{a}	2.84^{b}	2.28^{a}

Means with different superscripts (^{abc}) in a row differ significantly (P<0.05); seasons include the cold dry and hot dry seasons respectively

TABLE 2: Correlation coefficients between live weight and linear body measurements

	Wing length	Spur length	Shank length	Shank Circumference	Comb length	Wattle length
Live weight	0.044^{ns}	0.412***	0.130***	0.177***	0.118**	0.080*
Wing length		-0.064^{ns}	0.064^{ns}	-0.044^{ns}	0.001^{ns}	0.028^{ns}
Spur length			0.011^{ns}	0.187***	0.044^{ns}	0,001**
Shank length				0.085**	0.152***	0.223***
Shank circumference					0.112**	-0.020^{ns}
Comb length						0.207***

ns=not significant

*=P<0.05, **=P<0.01, ***=P<00

Variations in body weight and linear body measurements

Effects of sex and seasons on body weight and body measurements are shown in Table 1. Body weight, comb length, shank length, shank circumference, spur length, wing length and wattle length all varied significantly between sexes with the males being superior to the females in all the measurements. Similarly, between agro-ecological zones, only shank circumference, wing length and wattle length were significantly different with shank circumference favouring chickens from the Sahel savannah and the last two traits favouring chickens from the Sudan savannah. However, there was no significant ($P>0.05$) difference between seasons in all the measurements except in wattle length where birds measured during the hot dry season had longer wattles (2.84cm) than those measured during the cold dry season (2.28cm). In natural conditions, the variation in wattle sizes could be due to many factors of which ambient temperature is the most important (7). Wattles are meatyred growths located under the chin and have an important function of heat dissipation to cool the chicken's body temperature. This happens when the blood circulates from the comb to the wattles. The circulating blood lowers the temperature of the chicken during the hot weather and during cold weathers the wattle constricts to maintain body heat (8). The longer wattles recorded during the hot season than the cold season in this study enables the chicken to dissipate body heat in order to regulate their body temperature.

Correlations between live weight and linear body measurements

Table 2 shows the coefficients of correlation between live weight and linear body measurements. The Table shows no significant relationship between wing length, and all other measurements. Linear, measurements however had significantly moderate ($P<0.001$) and positive relationship, with spur length, shank length and shank circumference (0.412, 0.130, and 0.177) respectively. This is clearly evident among chicken form Mobbar LGA among all the other LGA's. The chickens had the highest body weight recorded in this study, perhaps since they equally had the longest spur length (0.50cm), widest shank circumference (1.57cm) and longest shank length (8.01cm)so these corresponds to the heaviest live weight (1046.9g). Relationship between live weight and wattle length was low (0.080). Spur length was moderately ($P<0.001$) correlated with shank circumference (0.187), but was averagely ($P<0.01$) correlated with Wattle length (0.101).

According to (9) "Pairs of parameters with high and significant phenotypic correlations could be used in selection assuming also a similar genetic relation, this would mean the parameters involved must be controlled by genes that are linked or those that exhibit pleiotropy since genetic and environmental causes combine together to give the phenotypic correlation. He reported that, under such conditions selection of a parameter in the pair could bring about reasonable improvement in the other partner. Live weight can therefore be selected for by simply observing correlated characteristics. This will provide a less expensive and a less cumbersome breeding strategy, since they require visual appraisal and not measurement. Thus it is possible with simple accurate assessment procedure to identify birds of high growth potential.In this study therefore, selection for spur length, shank length, and shank circumference could conveniently be used to improve live weight indirectly because of the positive correlation between them. Similar results between live weight and linear body measurements have been reported in local chicken in Edo state Nigeria by (10). The moderate, positive and significant ($P<0.05$) association between live weight and these parameters is also an indication that absolute measurements of these parameters can serve as reliable predictors of live weight. This has been found to be true in local chickens (11), commercial broiler chickens (12), goats (13) and cattle (14).

CONCLUSION AND RECOMMENDATION

Chickens in Borno State showed a rich diversity for qualitative traits. It is possible to improve the local chickens through selection and other relevant breeding strategies especially birds with developing spurs, longer shanks, wider shank circumference and to an extent birds with longer combs and wattles, thereby increasing the productivity of the birds.

Significant relationships established between live body weight and the other quantitative traits especially spur length, shank length and shank circumference depicts that these traits serve as indicators for a chicken with a good genetic potential for growth and can be utilised in selection programmes.

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The Phenotypic Variation of a Commercial Broiler Breed as a Tool for Repeatability Estimate and Genetic Improvement of Chicken

Abstract: The aim of this study was to estimate repeatability of body weight and linear body measurements traits of some commercial broiler chickens reared in Nigeria. A total number of two hundred and eighty (280) broiler chickens were used in estimating the repeatability of body weight and linear body measurements of broiler chicks from 2 to 8 weeks of age. Body weight (BW) and linear body measurement parameters such as body length (BL), keel length (KL) and breast girth (BG) were measured every week. The mean values for body weight and linear body measurement parameters revealed an increase for BW (0.77kg-2.28kg), BL (13.61cm-21.52cm), KL (9.81cm-14.17cm) and BG (5.29cm-10.89cm) at 4thand 8th weeks of age respectively. The study revealed that repeatability estimates for body weight was highest at 4 weeks of age, while BL and BG had the highest repeatability estimates at 6 weeks of age. The high repeatability estimates for body length and breast girth recorded in this study means that breeding decision based on 4 weeks body weight and 6 weeks body weight and breast girth could enhance breeding efficiency among commercial broilers raised in Nigerian.
Keywords: Variation, Broiler, Repeatability, Genetic and Improvement

DESCRIPTION OF PROBLEM

Malnutrition has caused increased demand in the production of poultry, micro livestock and pigs [1]. Poultry species, especially broiler birds are by far the largest group of livestock species[2,] contributing about 30% of all animal protein consumed in the world[3]. Unfortunately, the Nigerian broiler production is still relatively low in output and scope. Corollary, its contribution to protein consumption in Nigeria is astonishing. Broiler industry contributes only 1.4kg/capita/yr[4]. This value is equivalent to 3.8g/caput/day and less than 10% of the Food and Agriculture Organization (FAO) minimum recommendation of 40g/caput/day of animal protein[5].

The population of Nigerian chickens is about 180 million, comprising 120 million (72%) rural poultry in backyards and 60 million (27%) commercial poultry[6]. However, its output in meat and egg production is far below the growing need of its human population, which is over 178.5 million people[7]. Ranking foremost in the reason for very low productivity of the Nigerian poultry sector is the genetic composition of the chicken population. Majority of the population is rural poultry, which are slow growing birds reared in backyards, while only 27% are commercial poultry in formal poultry outfits. These commercial birds are imported breeds. Conversely, the costs of day old chicks are high due to import tariff. Again the maximum production of commercial chickens reared in Nigerian are not up to their maximum genetic make due to several environmental factors. Enormous difference in the temperate environment where they were bred and the tropical environment in Nigeria constitute a major reason for under performance of these commercial chickens.

The recent devaluation of naira and economic recession in Nigeria has further advanced the cost of poultry chicks and feed in Nigeria thereby making broiler business unprofitable. One pragmatic step to increase profitability of broiler production is to produce birds that would consume less feed in the shortest possible time and reach table meat in five or six weeks of age instead of eight weeks. This involves improving the genetic performance of the present commercial broilers in Nigeria like most developed world, where their broiler reach table meat (2kg) at 5 weeks of age. Variation is an excellent tool for improvement of the genetic make-up of the commercial broilers and highly essential to achieve the desired goal. Fortunately, there still exist appreciable observably variation in body size and body weights of commercial broilers reared in Nigeria. This may serve as excellent means to improve the Nigerian broiler breeds genetically. The broad objective of the study is to determine the phenotypic variation of some commercial broiler breeds as a tool for repeatability estimate and genetic improvement of chicken.

Materials and methods

Study site and duration of study

The study was carried out at the poultry unit of the Department of Animal science Teaching and Research Farm, University of Nigeria Nsukka. Nsukka is located on latitude 05 22^0N and longitude 07 24' East with annual rainfall ranging from 986-2098mm.The study lasted for 56 days (8 weeks).

Experimental birds and management

A total of 280 day-old chicks of commercial broiler strain were purchased from a reputable farm and all routine vaccinations and treatments were given to the birds. The chicks were managed on deep litter system. Clean drinking water was provided *adlibitum*. A standard broiler starter ration containing 24% crude protein and 2900 kcal/kg ME were used for four weeks followed by a finisher diet containing 21% crude protein and 3000kcal/kg ME, which were used from four week to the end of the experiment at eight weeks.

Data were collected on body weight using weighing balance calibrated in grams, while linear measurements were determined using tailors tape (cm) as follows; body length was measured from the base of the neck down to the lower region of the tail end leaving out the feather; breast girth was measured around the deepest region of the breast from the right shoulder to the left shoulder and keel length was measured from the chest bone to the end towards the abdominal region. Data collected were subjected to one way analysis of variance (ANOVA) using general linear model[9]. Repeatability (R) was estimated using the expression[10]

$$R = \frac{\sigma_B^2}{\sigma_B^2 + \sigma_W^2}$$

Where, σ_B^2 = individual variance component; σ_w^2= variance error.

The standard error was calculated using the formula described by Becker

$$\mathbf{S.E} = \sqrt{2\left(1 - R^2\,\frac{(1+(K-1)R)^2}{K(K-1)(n-1)}\right)}$$

Where,

k=Number of measurement; n= Number of birds and R= Repeatability

Results and Discussions

Table 1: Means and standard error for the body weight and linear body measurement parameters at different ages for commercial broiler chickens

(WK)	BW(kg)	BL (cm)	KL(cm)	BG(cm)
2	0.26±0.16	-	-	-
4	0.77±0.15	13.61±0.16	9.81±0.15	5.29±0.50
6	1.43±0.11	14.51±0.15	12.29±0.15	9.36±0.14
8	2.28±0.03	21.52±0.14	14.17±0.16	10.894±0.15

BW = Body weight, BL = Body length, KL = Keel length, BG = Breast girth

Table 1 shows the means and standard error for the body weight and linear body measurements at different ages for commercial broiler birds. The mean BW, BL, KL and BG of commercial broiler birds at week 2, 4, 6 and 8 were 0.26 ± 0.16, 0.77 ± 0.15, 1.43 ± 0.11 and 2.28 ± 0.03; 13.61 ± 0.16, 14.51 ± 0.15, and 21.52 ± 0.14; $9.81 \pm 0.15, 12.29 \pm 0.15,$ and 14.17 ± 0.16 and $5.29 \pm 0.50, 9.36 \pm 0.14, 10.89 \pm 0.15$ respectively. The mean BW, BL, KL and BG ranged from 0.26±0.16kg to 2.28±0.03kg; 13.61cm to 21.52cm; 9.81cm to 14.17cm and 5.29cm to 10.94cm at 4 and 8 weeks of age respectively.

The results on BW, BL, KL and BG expectedly showed an increase in the live body measurements as the birds mature signifying a direct positive relationship between body weight and age. However, the values presented in this study are lower than the findings for BW (37.22±0.32g to 2,428.1±14.61g)in naked necked broiler chickens[12], and slightly lower than the values (13.89)cm reported for breast girth[13]. The reason for this disparity may be as a result of differences in the non-additive genetic variances in the growth traits ensuing from environment factors

Table 2: Repeatability estimate for body weight and linear body measurements parameters of commercials broiler chickens

(WK)	BW(kg)	BL(cm)	KL (cm)	BG(cm)
2	0.14	-	-	-
4	0.325	0.198	0.227	-0.022
6	-0.049	0.899	0.165	0.721
8	-0.049	0.487	0.019	0.229

BW= Body weight, BL = Body length, KL= Keel length, BG= Breast girth

Table 2 shows the repeatability estimates for BW, BL, KL and BG at 2, 4, 6 and 8 weeks of commercial chickens. The repeatability estimates for BW ranged from -0.049 to 0.325 at 8 and 4 weeks. The repeatability estimates for BW were low at weeks 2, 6 and 8 (0.14, -0.049 and -0.049), but moderate (0.325) at week 4.
The repeatability estimate for BL ranged from 0.198 to 0.899 at 4 and 8 weeks, however the estimates for BL were high at weeks 6 and 8 (0.487and 0.899), but low at week 4(0.198). The repeatability estimate for KL varied from week 8 (0.019) to week 4 (0.227). The repeatability estimates for KL of commercial chickens used in this study scored low values at 6 and 8 weeks of age, but moderate at 4 weeks of age. The repeatability estimates for BG ranged from -0.022 at 4 weeks to 0.721 at 6 weeks. The repeatability estimates for BG were high at week 6, moderate at week 8 and low at week 4. The study revealed that repeatability estimates for body weight was highest at 4 weeks of age, while BL and BG had the highest repeatability estimates at 6 weeks of age.

Researchers[14,15] have observed highly significant correlation between body weight and chest girth, body weight and body length, in male and female local birds. High and positive correlations reported earlier among the traits considered under this study suggest that selection for BW at 4 weeks of age could bring about appreciable genetic gain for BL and BG.
It was reported also that between body weight and zoometric measurements, breast or chest girth and body length had the highest correlation value of 0.87 and 0.85 respectively[16]. This indicates that breeding decision based on BL information at 6 weeks of age could bring about genetic gain and improve the overall meat yield of these commercial chickens. Also, it implies that mass selection based on 4 weeks BW traits may be so useful in improving overall body growth, while index selection based on 6 weeks BW, BL and BG could be useful in improving the overall body growth of the Nigerian commercial chickens.

CONCLUSION AND APPLICATION

The high repeatability estimates for body length and breast girth recorded in this study means that breeding decision based on 4 weeks body weight, 6 weeks body length and breast girth or 8 weeks body weight and breast girth could enhance breeding efficiency among commercial broilers raised in Nigerian. Breeders should adopt mass selection (4 weeks body weight) or index selection (body weight, body length and breast girth at 6 weeks) for improving the meat yield of the commercial broilers

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Haematology and External Egg Quality Parameters of Three Nigerian Indigenous Chicken Genotypes

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Abstract: The study was conducted to determine the haematology and external egg quality parameters of three Nigerian indigenous chicken genotypes. Three genotypes of 90 pureline indigenous chickens were bred and assigned randomly into three treatments with each treatment replicated thrice with 10 birds per replicate, using standard managemental practices. A total of one hundred eggs were collected from each genotype and external egg quality parameters were evaluated using digital electric balance, micrometer screw guage and Vernier calipers. Haematological examinations such as Packed Cell Volume (PCV), Haemoglobin count (Hb), Red Blood Cell (RBC), White Blood Cell (WBC), Platelets count, Lymphocytes count (Lymph.), Mean Corpuscular Haemoglobin concentration (MCHC), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Volume (MCV), Heterophils count, Monocytes count and Erythrocyte Sedimentation Rate (ESR) were done using standard procedures. Significant differences ($P<0.05$) among the genotypes were observed for PCV, Hb, platelets count, MCH, Lymph. and heterophils count. Only shell thickness was found to be significantly different ($P<0.05$) for external egg quality parameters among the genotypes. Naked neck, frizzle feather and normal feathered chickens were observed to have the heaviest, longest and widest eggs; highest PCV values; and highest heterophils count respectively. The study concluded that, with the haematological and external egg quality parameters of the three genotypes of the Nigerian indigenous chickens studied, improvement programmes may be carried out for commercial egg and meat production in Nigeria, using these three genotypes.

Keywords: Genotypes, Haematological Parameters, Egg Quality

DESCRIPTION OF PROBLEM

In many species of birds especially chicken, normal values for haematological parameters were measured and a comprehensive data base was established of their blood profile. The Nigerian indigenous chickens have been reported to have many advantageous gene complexes that could be harnessed in the development of meat or egg type chicken suitable for use in the tropics (Machebe and Ezekwe, 2004). Among these major genes are the naked necked, Frizzled and Normal feathered (Ibe 1998). In the other hand, many researchers have evaluated normal haematological parameters of industrial and commercial hybrid chickens (Melluzzi *et al.*, 1992; Taleb *et al*., 2005). Information about haematological and external egg quality parameters of indigenous chickens are limited therefore, this study was carried out to evaluate the haematological and external egg quality parameters of three strains of indigenous chickens.

MATERIALS AND METHODS

The study was carried out in the Students' Demonstration Farm of the Federal College of Animal Health and Production Technology, Apata, Ibadan, Nigeria. It is situated at Latitude 7^0 22' 39" N and Longitude 3^0 54' 21" E. A total of 90 birds hatched from the pure parent stock of Frizzle feather, Normal feather and Naked Neck local chickens were used for the experiment. Each genotype represented a treatment and each treatment was replicated three times with 10 birds per replicate. All treatments were subjected to routine management practices and their behaviour was fully monitored. Pullets were placed on grower diet and fed at the rate of 80-90g/ bird/ day. The grower feed contained 15% crude protein and 2550 Kcal metabolizable energy (ME) per kg of feed. The chickens were provided with square wooden nesting boxes for laying. Eggs were collected twice a day at 10.00 am and 3.00 pm, respectively.

Data Collection

External Egg Quality Parameters

At the end of the 26th week, eggs were collected from each of the genotypes and external quality parameters were evaluated as described by Fayeye *et al.,* (2005). External egg quality parameters analysed include egg weight, egg length, shell thickness, egg width, percentage weight and shell surface area. These were analysed using digital electric balance, Vernier calipers and micrometer screw gauge, respectively.

Haematological Parameters

At the end of the twenty eighth week, blood was collected from seven birds per replicate. 5 mls of blood was collected from the birds with the aid of sterile syringes via the jugular vein into sample bottles containing EDTA (Ethylene Diamine Tetra Acetic Acid). Samples were thereafter taken to the Main Research Laboratory, Department of Veterinary Medicine, University of Ibadan to determine the packed cell volume (PCV), haemoglobin count (Hb), the red blood (RBC) and white blood counts (WBC), platelets level, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), lymphocytes, monocytes, eosinophils and neutrophils. The ethical standard for handling of live animals was followed as set by Nigerian Institute of Animal Science (NIAS). All data collected were subjected to Analysis of Variance in a generalized linear model (GLM) of the Statistical Analysis System Institute (SAS, 2010).

RESULTS

Table 1: Mean haematological parameters of the Nigerian Indigenous Chickens

Parameters	FF	NF	NN	REFERENCE*
PCV (%)	33.25±2.87[a]	27.67±3.50[b]	29.44±6.62[ab]	35.90-41.00
Hb (g/dl)	10.96±0.96[a]	9.06±1.22[b]	9.39±2.46[ab]	7.00-13.00
RBC ($\times10^{12/l}$)	4.49±1.47	5.07±1.13	4.61±1.44	4.21-4.84
WBC ($\times10^{9/l}$)	7.20±2.74	8.71±3.00	8.67±3.07	4.07-4.32
Platelets ($\times10^{9/l)}$	10.00±0.00[a]	7.78±1.56[b]	7.78±2.54[b]	1.50-3.60
MCV (FL)	30.00±0.00	30.11±0.33	30.00±0.00	81.60-89.10
MCH (Pg)	25.13±6.01[a]	18.22±4.68[b]	22.44±7.65[ab]	27.20-28.90
MCHC (%)	33.00±0.00	33.00±0.00	33.00±0.00	32.41-33.37
Lymph. (%)	32.88±4.58[b]	26.67±11.60[b]	44.33±2.24[a]	20.00-50.00
Heterophils (%)	66.63±4.90[b]	75.56±9.68[a]	56.89±6.62[c]	40.00-75.00
Monocytes (%)	0.63±0.52	0.78±0.44	0.89±0.33	5.00-10.00
ESR (mm/hr)	4.25±2.05	4.33±3.84	4.89±2.03	8.00-12.00

[a,b,c]: Means in the same row with different manuscripts are significantly different (P<0.005)

Key:FF= frizzled feathered; **NF**= normal feathered; **NN**= normal feathered, **PCV**= Packed Cell Volume; **Hb=** Haemoglobin count; **RBC=** Red Blood Cells count, **WBC=** White Blood Cells count; **MCV**= Mean Corpuscular Volume, **MCH**= Mean Corpuscular Haemoglobin; **MCHC=** Mean Corpuscular Haemoglobin Concentration, **ESR=** Erythrocyte Sedimentation Rate

(*Mitruka and Rawnsley, 1977; Jaine, 1998; Purves *et al*., 2004; Adeyemo, 2012).

Table 2: Mean external egg quality parameters of the Nigerian Indigenous Chickens

Parameters	FF	NF	NN
Egg weight (grams)	38.00±4.06	37.38±2.33	38.33±3.08
Egg length (mm)	50.30±1.74	50.34±2.06	51.00±7.05
Shell thickness (mm)	0.43±0.03[a]	0.47±0.02[b]	0.40±0.04[a]
Shell weight (grams)	3.44±0.53	3.63±0.52	3.44±0.53
Egg width (mm)	37.00±1.50	37.08±0.83	38.31±3.35
Haugh unit	16.88±8.16	15.41±5.26	18.15±5.63
Shell weight (grams)	9.12±1.51	9.20±1.17	8.98±1.29
Shell surface area (mm^2)	51.46±3.65	52.72±2.05	51.78±2.71

[a,b:] Means in the same row with different manuscripts are significantly different (P<0.005)

The mean haematological parameters of three genotypes of the Nigerian local chicken (Frizzled feather chicken, Normal feather and Naked neck) are presented in Table 1.

There are significant differences (P<0.05) in haematological parameters among genotypes for PCV, Hb, platelets, MCH, lymphocytes count, and neutrophils count. Value of PCV ranges between 29.44%- 33.25% and that of Hb ranges between 9.06g/dl. and 10.96g/dl. RBC ranges between $4.49\times10^{12/l}$ and $5.07\times10^{12/l}$, Platelets

ranges from $7.78\times10^{9/l}$ to $10.00\times10^{9/l}$; MCH ranges from 18.22Pg to 25.13Pg; Lymphocytes count ranges between 26.67% to 44.33% while heterophils count ranges from 56.89% to 75.56%, respectively. However, significant differences ($P<0.05$) were not observed in WBC, MCV, MCHC, Monocytes count and ESR.

The mean external egg quality parameters of three genotypes of local chicken (Normal feather, Naked neck and Frizzled feather chicken) are presented in Table 2.. No significance differences ($P<0.05$) were observed among the three genotypes in all parameters except for shell thickness. Shell thickness ranged between 0.40mm and 0.47mm and was highest in the Normal feathered chickens.

DISCUSSION

Although the reference values of avian haematological indices have been recorded by Mitruka and Rawnsley (1977), only a few studies on haematology for the local Nigerian chickens have been published so far. Haematological parameters were used extensively in avian medicine as physiological indicators and disease diagnostic tools (Quintavalla *et al*., 2001). Sex, age and nutrition are the major factors affecting avian haematology (Fudge, 2000; Islam *et al*., 2004), although the variation in this study might be due to genotypic differences since all the hens were fed same feed and were of the same age.

The differences in haematological values among local chickens reared in different regions potentiate its investigation to diagnose the health status of the birds (Abdi-Hachesoo *et al*., 2011). The information gained from investigation of haematological values, disease diagnosis and managerial factors are the main tools for developing new lines of birds which are genetically able to resist different diseases [Abdi-Hachesoo *et al*., 2011).

Results of PCV in the three genotypes were lower than the normal range of 35.90-41.00 proposed by Purves *et al.,* (2004). These results are indicative of anaemia in the chickens of the three genotypes. Frizzled feather had the highest mean value (33.25%), followed by naked neck and normal feathered with corresponding values of 29.44% and 27.67% respectively. The result obtained in this study partially agreed with that reported by Solomon and Udoh (2017) who reported the superiority of the naked neck gene in PCV compared to that of the fully feathered. The author further stated that this could be a boost to the growth and productive life of the former.

Results in Table 2 show that Hb concentration of chickens in the three genotypes were within the normal range of 7.0-13.0g/dl for healthy chickens (Mitruka and Rawnsley, 1977) and the range of 4.0-14.0g/dl by Lewis (1998). Normal feathered chickens had the lowest Hb concentration (9.06g/dl), followed by naked neck (9.39g/dl) while frizzled feathered chickens had the highest value (10.96g/dl). The value for Hb concentration obtained for frizzled feathered chickens was within the normal range of 11.4±2.75g/dl for healthy frizzled feather chickens (Durotoye *et al.,* 2004). The values obtained in this study, however slightly differ from those obtained by Solomon and Udoh (2017). They reported mean Hb concentration values of 9.24 g/dl, 8.91 g/dl and 8.05 g/dl for normal feather, naked neck and frizzled feather respectively.

Ologhobo *et al*., (1986) observed that an increase in WBC count above the normal range is an indication of the presence of exogenous substances and foreign bodies in the body of an animal. In this study, there was no case of such abnormal rise in the values of WBC. The WBC obtained in this study were within the normal range of $3.0\text{-}60\times10^{6/l}$ opined by Mitruka and Rawnsley (1977) and Lokhande *et al.,* (2008). Results reveal that normal feathered chickens had the highest count ($8.71\times10^{6/l}$), followed by naked neck ($8.67\times10^{6/l}$) and frizzled feather ($7.20\times10^{6/l}$). The results suggest greatest ability of the normal feathered chickens in fighting infections, compared to other genotypes. This may be responsible for their highest population and adaptability amongst the three genotypes across Nigeria.

Lymphocytes are important in forming barriers against local disease conditions and may be involved in antibody formation (Frandson, 1981). In this study, normal feathered chickens had the least lymphocytes value (26.67%) while the naked neck chickens had the highest value (44.33%) and these values fall within the range values for normal birds (Mitruka and Rawnsley, 1977) which suggested that the birds had strong immune system.

Many authors have reported a large variation mainly in lymphocytes due to age and nutritional conditions of animals (Albritton, 1961; Schlam and Jain, 1974). But the results obtained from this study disagree with these reports since all birds used were of the same age and were subjected to the same feeds. The difference in

lymphocytes count across the three genotypes in this study might be due to genotypic variation (Quintavalla *et al*.,2001).
The heterophil is the most common granulocyte found in birds. The normal range of heterophils is between 40%-75% (Mitruka and Rawnsley, 1977). Its changes in number and characteristics can occur with consideration to the bird's state of health since even subtle problems such as stress, low grade infection and mild inflammation can occur (Adeyemo, 2012). The values of heterophils obtained in this study fell within the range values of normal birds and were in accordance with those previously reported by Adeyemo (2012) for laying birds.
RBC varies depending on whether the birds are juveniles or adults and the genotype of the birds being examined and the results obtained in all treatments in this study fell in the range of values for normal birds (Mitruka and Rawnsley, 1977). Monocytes which closely resembles neutrophils in that they are actively motile and phagocytic in action, leaving the blood stream to ingest micro-organisms and other foreign materials which have been introduced into the tissues, had values way lower than the range for normal birds (Mitruka and Rawnsley, 1977). This result totally differs from that obtained by Adeyemo (2012), who observed that values obtained were slightly above the range values for normal birds. The lower values obtained for monocytes might be due to genetic and/ or seasonal variations.
The ESR in the naked neck was the highest and differed statistically from the rest of the two genotypes.
MCHC values were the same across the genotypes and nearly the most of the previous research supported this present study (Simaraks *et al*., 2004; Talebi *et al*., 2005; Abdi-Hachesoo *et al*., 2011; Kececi and Col, 2011).

External Egg Quality Parameters

The shell thickness of the eggs laid by the normal feathered was significantly higher than those laid by the frizzled feather and naked neck chickens. Mean shell thickness were 0.47mm, 0.43mm and 0.40mm respectively. There were no significant differences in the mean values of shell thickness for frizzled feathered and naked neck chickens.
Fraga *et al.,* (1989) reported that egg shell quality of naked neck could be related to a higher Cholecaicipherol synthesis from 7-dehydrocholesterol deposit on these birds in an area of the body without feather, thus being the receptor of the indirect solar radiation. Also, the values fall within range according to Babangida *et al.*, (2006) and Olomu, (2003).
Shell thickness did not show significant difference among the genotypes studied. However, eggs with thick shell wall are desirable to withstand externally applied force, thus preventing breakage of egg and this is an economic indicator for commercial poultry producers and consumers. The result obtained in this study is higher than the values reported by Padhi *et al*., (1998); Yakubu *et al*., (2008); Momoh *et al*.,(2010). In their various studies, naked neck produced heavier shell weight than the remaining genotypes. The result obtained in this study is comparable to the light ecotype reported by Momoh *et al*., (2010) and Nonga *et al*., (2010) but slightly lower than values produced by heavy ecotypes (Momoh *et al.*, 2010).
Significant positive correlation between egg length and egg weight, egg width and egg weight, shell weight and egg weight, shell weight and egg width, egg index and egg width, in all the three phenotypes compares favorably with (Yakubu *et al*., 2008; Olawumi and Ogunlade, 2008). In this study egg width is indicated to be a good estimator of egg shape index. Omeje and Nwosu, (1988) reported that egg shape index could be used as a criterion for determining stiffness of eggshell. Furthermore, the values between egg width and egg length in naked neck and frizzle feathered chickens agreed with (Yakubu *et al*., 2008; Olawumi and Ogunlade, 2008).

CONCLUSION AND RECOMMENDATION

The study concluded that genotypic differences ($P<0.05$) slightly affected both haematological and external egg quality parameters and these parameters are not far from the standard ones we have for the exotic genotypes currently used for commercial poultry production. The influence is as result of genetic variability across the genotypes of Nigerian local chickens studied.
It is therefore recommended that these three genotypes of local chickens in Nigeria can be improved upon and especially the Naked neck gene can be incorporated in poultry production programmes so as to harness and

utilize the potential effects of this gene. This will aid in planning breeding programmes for selection of economic traits in general (meat and egg) poultry production.

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Polymorphism in Insulin-Like Growth Factor 2 Gene and its Association with Body Weight of Nigerian Indigenous Turkeys

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Abstract: IGF2 is one of the members of the somatotropic axis which controls the growth and development of animals. The IGF2 gene provides instructions for making a protein called Insulin-like growth factor 2 which plays an essential role in growth and development before birth. Several genes have been used as candidate genes for marker assisted selection for improved production performance of animals. IGF2 gene is one of such genes. Therefore, this study was aimed at assessing IGF2 gene polymorphism and its associations with body weights in Nigerian indigenous turkeys using PCR-RFLP method. Fifty poults were randomly selected for DNA assaying at 12 weeks by collecting blood from their jugular veins into heparinised bottles.529bp fragment of this gene was amplified and Mspl enzyme was used for digestion. The genetic constitution of the population was analysed using POPGENE 32 software. Association of the genotypes with body weight was evaluated using the General linear model of SAS 9.2. The enzyme digested products revealed A, B and C alleles controlling four genotypes AA, AB, AC and CC with 0.442, 0.385, 0.115and 0.058 frequencies respectively. Chi-square test for Hardy-Weinberg equilibrium showed that the sampled population were not at equilibrium. There was no significant association of IGF2 polymorphism with body weight at 4, 8 and 12 weeks in Nigerian indigenous turkeys. From the results obtained, IGF2 gene has moderate to high degree of polymorphism and can be used as marker assisted selection in Nigerian indigenous turkeys.

Keywords: Hardy-Weinberg equilibrium, PCR-RFLP, Restriction enzyme, DNA, Performance.

DESCRIPTION OF PROBLEM

Poultry production is an important and diverse component of agriculture all over the world. Indigenous poultry play very important role in strengthening the economy of third world countries like Nigeria as they are a source of food and employment for small poultry keepers without investing so much on the management, disease control and nourishment (Ekue *et al.,* 2002). Turkey production in Nigeria has grown in recent times. This fast growth is due to intensification of production and the need to develop large breeds and varieties because the indigenous varieties are characterized by small body weight, small size and fewer number of eggs (Adebambo *et al*., 1999). In order to make indigenous poultry commercially viable, both genetic and nutritional interventions are required. The use of DNA markers to define the genotype and predict the performance of an animal is a powerful aid to animal breeding (Niknafs *et al.,* 2014). The molecular and genetic basis of these traits are being revealed by functional genomic methods which gives insight on how to harvest and harness their genetic potentials in a short time (Mazurowski *et al*., 2014). One of the methods to identify genetic polymorphisms in several animal species devise the use of Polymerase Chain Reaction – Restriction Fragment Length Polymorphism (PCR-RFLP) (Herman, 2004; Sartika, 2007). This is a technique in which organisms may be differentiated by analysis of patterns derived from cleavage of their DNA by exploiting variations in homologous DNA sequences. Therefore, the candidate gene approach has become a powerful technique for genetic improvement in the poultry breeding program. Applying a candidate gene may result in higher efficiency in detecting the desired traits necessary to improve production performance. Several genes have been used as candidate genes for marker assisted selection for improved production performance of animals. These genes include growth hormone (GH), growth hormone receptor (GHR), IGF1, IGF2 and Myostatin among others.

IGF2 is one of the members of the somatotrophic axis which controls the growth and development of animals. It provides instructions for making a protein called Insulin-like growth factor 2 which plays an essential role in

growth and development before birth. This study was carried out to investigate the IGF2 gene polymorphism and to associate the polymorphic variants of the gene with body weight in Nigerian indigenous turkey.

MATERIALS AND METHODS

Experimental location and management of experimental birds: Blood samples were collected from the jugular vein of 50 poults raised under intensive system into heparinized bottle and were stored at -20^{0}C prior DNA extraction. Data pertaining to their bodyweight was collected weekly.

Extraction of DNA: Genomic DNA was extracted using Zymo Miniprep kit following the manufacturer's protocol. The polymerase chain reaction (PCR) was performed in a 25µL mixture containing 5 µL genomic DNA, 10 µL of PCR buffer, 1 µL each of the corresponding forward and reverse primers of IGF2 and 8 µL of distilled water:
Forward: 5´-CTCCATGTGGCTTCCCTGTA-3´
Reverse: 3´GGCTTCTTGGCTAGTTGCAGT- 5´

PCR-RFLP for IGF-2 gene: PCR amplification was conducted under the following conditions: Initial denaturation at 94 °C for 5 min, followed by 35 cycles consisting of denaturation at 94 °C for 45 seconds, annealing at 60°C for 45 seconds, extension at 72 °C for 50seconds and a final extension at 72 °C for 5 min.
The PCR products were digested in a total volume of 50 µl of solution; containing 12µl of PCR product, 1µl of restriction enzyme (MSPL), 5 µl of restriction enzyme buffer and 32µl of distilled water. The sample was then incubated at 37^o C for 15 minutes and inactivated at 80^{o}C for 20 minutes. The digested products were electrophoresed for 20 minutes at 100V on a 2.5% agarose gel and the bands signifying their monomorphic or polymorphic states were viewed under a Transilluminator (an ultraviolet light box

Statistical analysis: The genotype and allele frequencies were determined by direct gene counting method (Falconer and Mackay, 1996) and the frequencies were tested for Hardy-Weinberg equilibrium (HWE) using POPGENE 1.32 software package (Yeh*et al.,* 1999). The genotype frequency data was then subjected to analysis of variance following GLM procedure of SAS 2012; while Duncan Multiple Range Test (DMRT) was used to separate means.

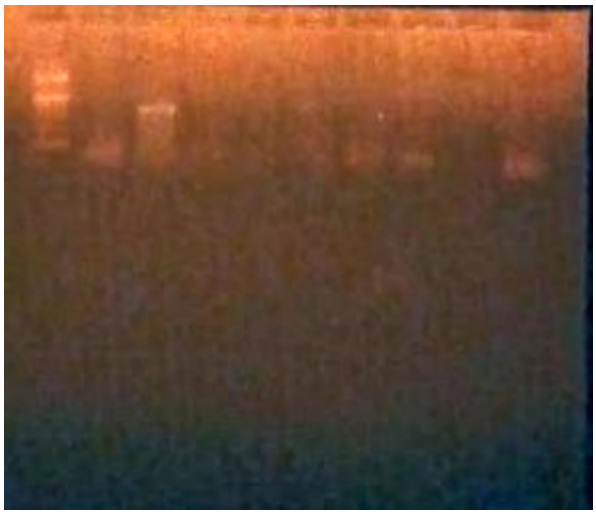
Statistical model: The statistical model used for this study is shown below:
$Y_{ij}=\mu+G_i+e_{ij}$
Where Y_{ij} = observed trait (body weight)
µ= the overall mean,
G_i= fixed effect of polymorphic variant,
e_{ij}= Random error term.

RESULTS AND DISCUSSION

The PCR-RFLP analysis of genomic DNA of Nigerian Indigenous turkey for IGF2 gene locus, detected using 1.5% agarose gel electrophoresis revealed four types of genotypes- two homozygous and two heterozygous namely AA, AB, AC and CC. These are presented in Plates 1 and 2.

Genotypic and Allelic frequencies of the IGF-I gene in Nigerian indigenous turkeys

The allelic and genotypic frequencies for IGF2 gene locus in Nigerian Indigenous turkey were calculated using direct counting method of bands obtained from electrophoretic examinations of the amplified and digested genomic DNA of the turkeys. The frequencies are presented in Table 1. Three alleles (A, B and C) and 4 genotypes (AA, AB, AC and CC) were observed. The frequencies for A, B and C alleles were 0.664, 0.221 and 0.115 respectively; while the genotypic frequencies for AA, AB, AC and CC were 0.385, 0.442, 0.115 and 0.058 respectively. The chi square (X^2) and likelihood test (G^2) for Hardy- Weinberg (HWE) probability were 0.000360 and 0.000276 respectively, indicating a significant ($p<0.05$) deviation from the Hardy-Weinberg expected genotypic frequencies.



1 2 3 4 5 6 7 8 9 10
AA AB AB AB AB AB AB AB
Plate 1: Bands Scoring in PCR Products

1 2 3 4 5 6 7 8 9 10
AC AC AC CC BC BC CC AC AC
Plate 2: Bands Scoring in Digested Products

Table 1: **Allele and genotype frequencies of IGF2 gene in Nigerian Indigenous turkey**

Allele Frequency	Genotype Frequency	X^2	G^2
A (0.664)	AA (0.385)		0.000276***
B (0.221)	AB (0.442)	0.000360***	
C (0.115)	AC (0.115)		
	CC (0.058)		

X^2: Chi-square test for Hardy-Weinberg equilibrium P<0.005
G^2: Likelihood ratio test for Hardy-Weinberg equilibrium

The summary of the genetic variation statistics for all loci for IGF2 gene in Nigerian indigenous turkey is presented in Table 2. The observed number of alleles (Na) is 3.0000, effective number of alleles (Ne) is 1.9904 and the Shannon's information index is 0.8551.

Table 2: Summary of genetic variation of IGF2 gene in Nigerian Indigenous turkey

Locus	Na	Ne	I	Obs_{Hom}	Obs_{Het}	Exp_{Hom}	Exp_{Het}	Nei	Ave_{Het}
IGF2	3.0000	1.9904	0.8	0.4423	0.5577	0.4976	0.5024	0.4976	0.4976

Na : observed number of alleles, **Ne** :Effective number of alleles (Kimura and Crow, 1964) **I** : Shannon's Information index (Lewontin, 1972) **Obs_{Hom} :** Observed homozygote, **Obs_{Het}** : Observed heterozygote, **Exp_{Hom}** : Expected homozygote, **Exp_{Het}** : Expected heterozygote, **Nei** : Nei's (1973) expected heterozygosity, **Ave_{Het}** : Average heterozygosity

Effects of IGF2 genotypes on body weight of Nigerian indigenous turkeys at various ages

The Least significant difference test, means and standard deviations of body weight as influenced by IGF2 genotypes in Nigerian indigenous turkey are shown in Table 3. The result from analysis of variance showed no significant association (p> 0.05) of the body weight of turkeys at 4, 8 and 12 weeks of age with IGF2 genotype.

Table 3: Least squares means of body weights at different age intervals for IGF2 gene in Nigerian Indigenous turkey

Body weight (g)	AA (N=20)	AB (N=23)	AC (N=6)	CC(N=3)	SEM	P-value
4 weeks	310.85±30.58	310.30±58.60	304.17±63.99	276.67±65.51	0.97	0.7299
8 weeks	585.70±72.29	598.78±104.36	588.17±107.35	536.67±115.78	1.79	0.7478
12 weeks	876.40±196.58	830.39±184.12	869.83±186.22	772.67±155.09	3.62	0.7501

SEM: standard error of the means.
AA, AB, AC and CC: observed genotypes.

Genotyping of the indigenous turkey used in this study revealed three alleles A, B and C controlling four genotypes AA, AB, AC and CC. The AB genotype had the highest frequency of 0.44 while AA, AC and CC had frequencies 0.38, 0.12 and 0.06 respectively. The result from this study is slightly different from previous studies on IGFs in chicken that revealed two alleles and three genotypes. Ali *et al.* (2016) reported alleles A and B with three genotypes, AA, AB and BB in Desi Chicken of Pakistan, while Seyedbabayi *et al*. (2014) reported alleles A and C with genotypes AA, AC and CC in west-Azerbaijan Native chicken. The observed differences could be due to specie differences, animal population or enzyme type used in digestion of amplified DNA products. There is however, conformity in the allele that is most common in this study and previous studies. The most common allele in this study was allele A with a frequency of 0.66which was greater than allele B (0.22) and C (0.12), meaning that the most abundant allele is A and the rarest allele is C. This is in consonance with the findings of Seyedbabayi *et al*. (2014) and Anh *et al.* (2015).

It was also observed that allele and genotype frequencies in this sampled population deviated from Hardy-Weinberg equilibrium. This could be due to several years of selection in the turkey breeds, occurrence of migration within the population, assortative mating and inbreeding. Hardy-Weinberg probability for chi square (X^2) value of 18.42 analysed for this study was 0.000360. This probability value implies that the IGF2 gene locus in the sampled population had a significant deviation from Hardy-Weinberg and therefore at disequilibrium. This is in line with findings from the works of Yan *et al.,* (2017) who found that the genotype distribution of the IGF2 gene was not in HWE in the Langshan chicken population.

The likelihood ratio test uses models that best fit the population under study. The fitness of the model based on the probability value (0.000276) obtained showed a deviation from Hardy- Weinberg which is in consonance with the result obtained from the chi square result.The numbers of alleles observed in this study was 3 while the effective number of allele is 1.9904; and the observed, expected heterozygosity and Shannon information index were 0.5577, 0.5024 and 0.8551 respectively. This difference between effective and observed allele number is due to more frequency of allele A compared to allele B and C that reduced frequency in any locus. This shows a moderate to high diversity of IGF2 gene in the studied population.

Analysis of the association between the polymorphisms and body weight revealed that AA individuals had highest twelve weeks body weight (g) (876.40±196.58) followed by AC (869.83±186.22) and AB (830.39±184.12) genotypes respectively, while CC genotype had the lowest twelve weeks body weight (g) (772.67±155.09). The differences in mean weight values across the four genotypes were observed over 4, 8 and 12 weeks, with genotype group AA having the highest body weights and CC genotype group recording the least body weight over the 12 weeks period. These differences in mean weight values were however, not statistically significant. This means that there is no significant association between IGF2 gene polymorphism and body weight at 4, 8 and 12 weeks of age. This is in agreement with the work of Seyyedbabayi *et al*., (2014) who reported that there was no significant difference between AA and AC on body weight and live weight gain ($P>0.05$) at 12 weeks in Chickens. However, several studies (Amills *et al*. 2003; Wang *et al*. 2005; Tang *et al*. 2010) have indicated the existence of associations between IGF2 gene polymorphisms and the egg production or growth traits in various chicken breeds. Also, Yan *et al*., (2017) discovered a mutation g.6707C > G in exon

2 of the IGF2 gene which was demonstrated to have significant effects on body weight and egg production traits in Langshan chickens.

CONCLUSION

The results obtained in this study indicates that IGF2 gene has moderate to high degree of polymorphism in the Nigerian indigenous turkey, and thus could be considered as a candidate gene for marker assisted selection (MAS) in turkey.

RECOMMENDATION

There is need for further research into the validation of non-associations found and the physiological significance of the polymorphic variations at exon 3 of IGF2 gene.

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Preliminary investigation of gut bacteria found in *ileum digesta* samples in broilers using 16s RNA sequence

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Abstract: This study applied molecular techniques to identify gut bacteria of broiler birds using 16S RNA sequence of ileum digester samples. To achieve this aim, day-old broiler chicks were subjected to a six-week feeding trial. The experimental diet consisted of maize/soybean meal formulation with enzyme (Roxazyme G2 G ®) supplementation. Bacterial DNA was extracted from ileal digesta samples from the broiler chicks at six weeks, sequenced and the resulting nucleotide sequences were compared to sequences generated from GenBank by Blast Analysis with a view to identifying the bacteria present in the gut of broiler birds. The results revealed the presence of *Lactobacillus mucosae* of different strains. However, there were numerous uncultured bacteria which indicates the presence of bacteria that are yet to be successfully characterized.
It is recommended that target research be carried out with the view of successfully isolating and characterizing more bacteria in broiler gastro intestinal tract which will immensely contribute to the improvement of poultry farming and its produce.

Keywords: Broiler Birds, Gut Bacteria, 16s RNA Sequence

DESCRIPTION OF PROBLEM

The chicken gastrointestinal tract (GIT) harbours complex communities of bacteria [1]; [2]. These bacterial cells by far outnumber the host cells harboring millions of genes, and so forms a microbial community termed the *microbiome* [3]. The development of this community begins on hatching, following contacts with bacteria from the environment, feed, water, and the people handling the chicks post-hatch. These are areas that significantly affect gut microbiota development [4].
Gut bacteria play a significant role in modulating the development of the digestive tract, influencing the production of bile acids and digestive enzymes; and consequently, nutrient digestion and absorption [5]; [6]. It positively influences the host's biochemistry, immunology, physiology, and nonspecific resistance to infection [7]. The nature and activities of gut microbiota lining various sections of the gastrointestinal tract determines the overall gut health, feed interactions and assimilation, energy uptake, and consequently the quality of broiler production. Hence, investigation of the microbial flora of the gastrointestinal tract has a significant role to play in ensuring the health and safety of poultry products submitted for human consumption [8].

The detection, differentiation and identification of microorganisms have recently been accomplished through methods such as phenotypic measurement, biochemical assays, immunological assays and molecular methods [9]. Methods based on phenotypic and biochemical assays are typically vague and inaccurate [9], since many bacteria remain unidentified due to lack of knowledge in appropriate culturing conditions, and a misclassification of some bacteria [10]. Hence the need for non-cultural method for identification of bacteria in poultry birds. This study was to identify bacteria in broiler birds fed enzyme supplemented diet using the 16s RNA sequence of ileum digester samples.

MATERIALS AND METHODS

Experimental location: This experimental work was performed at the poultry unit of Niger Delta University Teaching and Research farm, Niger Delta University, Wilberforce Island, Nigeria.

Experimental Birds: A total of two hundred and forty (240) day-old Broiler chicks (ANAK, 2000) were used for the growth Experiment previously published [11]. Digesta samples were collected from the ileum at six (6) weeks of age for DNA extraction, amplification and sequencing.

Experimental Diet: The experimental diet was Maize – soybean meal based and supplemented with Roxazyme G2 G ®. Below is the gross and nutrient composition of the experimental diet.

Genomic DNA Extraction: Genomic DNA Extraction from chicken ileum samples was performed using ZYMO Quick-gDNA™ MiniPrep (D3006) (Inqaba Biotec. SA) Genomic DNA extraction Kit according to the manufactures. Genomic DNA was extracted by adding 400 µl of Genomic lysing buffer to 100 µl of ileum samples, using a sterile micropipette. The content of the 2 ml tube was disrupted by mixing in a vortex mixer at maximum speed for 4 – 6 seconds and allowed to stand for 5 minutes at room temperature. The mixture was transferred into Zymo-Spin™ Column in a collection tube and centrifuged at 10,000 x g for one minute. The collection tube with the flow through was discarded and the Zymo-Spin™ Column transferred into a new Collection Tube. This was followed by the addition of 200 µl of DNA Pre-Wash Buffer into the spin column and this was centrifuged at 10,000 x g for one minute. 500 µl of g-DNA Wash Buffer was then added to the spin column and centrifuged at 10,000 x g for one minute. The spin column was transfer to a clean micro centrifuge, followed by the addition of 50 µl DNA Elution Buffer. The mixture was incubated for 2 – 5 minutes at room temperature and then centrifuge at top speed for 30 seconds to elute the DNA. The eluted DNA was stored at -20ºC prior to DNA sequencing.

Amplification and Sequencing: Amplification reactions were prepared with 100 ng of DNA, 1.5 mM MgCl2, 2.5 U Taq Polymerase, 200 µM of dNTPs, and 0.1 µM for the primer pairs-16S: 27F: 5'-GAGTTTGATCCTGGCTCAG-3' and 518R: 5' ATTACCGCGGCTGG-3' [12]. The PCR amplification was performed with denaturation for 3 min at 95°C; 30 cycles of 95°C for 60 s, 45°C for 120 s, 72°C for 90 s, and an extension at 72°C for 15 min. The PCR products of gene fragments were visualized on 1.3% agarose gel and purified using a QIAGEN PCR purification kit. The most intense fragment samples were introduced as three sub sample for sequencing (by INQABA, Republic of South Africa) using forward primer. For comparison, Basic Local Alignment Search Tool (BLAST) from the National Center for Biotechnology Information (NCBI) platform was used to interrogate bacterial isolates database [13].

RESULTS AND DISCUSSION

Table 1: Gross and analyzed nutrient composition of experimental diet (g/kg DM unless otherwise stated)

Ingredients	**M / SBM diet + enzyme**
Maize	550
Soybean meal	330
Fish meal	40
Cassava starch	42
*Constant ingredients	38
Total (1000gm)	1000
M.E. (Kcal/kgDM)	3024
C.P	214.94
Nutrients	
Dry matter (g)	651.5
Ash	170.2
Crude protein	256
Ether extract	49.1
Crude fibre	70.6

***:** mineral vitamin premix (2.5g), DL Methionine (1.5g), bone meal (21g), oyster shell (10g) salt (3g).
M.E.: metabolisable energy, C.P.: crude protein, M: maize, SBM: soybean meal.

Table 2: Various Bacteria Identified from BLAST Analysis

S/No	Bacteria Identified	Bacteria Count
1	Uncultured bacteria (different strains)	70
2	Uncultured microorganism isolate	1
3	Uncultured Lactobacillus sp. Clone	1
4	Lactobacillus vaginalis (different strains)	19
5	Lactobacillus mucosae (different strains)	7
6	Lactobacillus sp. (different strains)	2
	Total Bacterial Sequence	**100**

Table 3. *Lactobacillus mucosa* Identified from BLAST Analysis

S/No	Bacteria	Strain	Sequence	Genome	No
1	L. mucosae	LM1		Complete Genome	1
2	L. mucosae	LAB87	Partial Sequence		1
3	L. mucosae	IMAUFBO31	Partial Sequence		3
4	L. mucosae	RA2071	Partial Sequence		1
5	L. mucosae	S32	Partial Sequence		1

A total of 72 uncultured bacteria and *28 Lactobacillus* Species were identified by BLAST analysis of sequenced DNA. Uncultured bacteria represented uncharacterized bacteria present in the gastrointestinal tract of the broiler. Their characterization into specific taxon is pending successful isolation through advances in scientific research. The current study identified two strains of *Lactobacillus species*. *Lactobacillus* EG12 gene and *Lactobacillus* oral clone. The latter is often found in the mouth and in the GIT of host organism. In the diet study, the birds fed enzyme supplemented Maize/soybean diet appeared to have much improved intestinal health which was accompanied with an increased presence of *Lactobacillus sp* [11]. The increased presence of these bacterial species could be explained by the nature of the diet as soybean meal has increased fibre which would act as a prebiotic promoting the growth of beneficial bacterial species such as *lactobacilli* and *bifidobacteria* which use these as substrates. And subsequently there would be increased fermentation [4].

The BLAST results produced a number of uncultured bacteria; which indicated that a greater percentage of organisms tightly associated with the intestine were either not viable or were unable to grow in particular growth medium. Uncultured bacteria are bacteria which have hitherto not been successfully cultured or even cultured at all and thus not yet characterized. They may be present in an organism but pending their full isolation and characterization through advances in science, they do occur in sequence results as uncultured bacteria. In this work uncultured bacteria were found to be more than other bacteria identified. It is indicative of the fact that several other bacteria are present in the GIT of broiler birds whose activities may not be fully ascertained.

Likewise, a number of bacteria known to function in the absorption of feed nutrients and in overall health of broiler birds were identified in this study (Table 2). They consisted of *L. vaginalis, L. mucosae* and *L. Sp. Oral clone*. Of these, the most interesting is *Lactobacillus mucosae* Differences in the abundance of different *Lactobacillus* species were expected especially in crop content. However, these species were found to have a negligible abundance (0.3% in all GIT segment) or were not identified at this location [14]. It is however worthy of note, that *Lactobacillus mucosae*, a rod-shaped species of lactic acid bacteria was first isolated from pig intestines [15], was found to be conspicuously present in our study. This organism is Gram-positive, non-motile, non-spore-forming, catalase negative rods that range from

2 – 4μm in length; which has mucus binding activity [15]. The various strains of *L. mucosae* identified from the BLAST Analysis is highlighted in Table 3. There were several strains of *L. mucosae* that was identified; of these, only one strain was identified with a complete genome (Table 2) - *Lactobacillus mucosae* LM1. This strain is known to produce significant antimicrobial activity to protect against pathogens [16].

CONCLUSION AND APPLICATION

The following *lactobacillus* species were identified from the sequence results obtained viz: *Lactobacillus vaginalis, Lactobacillus mucosae* and other *Lactobacillus species*; of these, the most interesting is *L. mucosae*. In line with the aim of this study, the molecular method was employed successfully using 16s RNA sequences to identify bacteria such as *L. vaginalis, L. Mucosae* which were present in the broiler chicks.

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ANIMAL PHYSIOLOGY AND REPRODUCTIVE HEALTH/ ANIMAL WELFARE

Haematological Parameters of Heteroclarias Fingerlings Exposed to Different Temperature Levels Under Laboratory Conditions in Minna, Nigeria

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Abstract: The study was conducted to investigate the effects of different water temperatures on the haematological parameters of Heteroclarias fingerlings under laboratory conditions. A total of one thousand eight hundred fingerlings, four weeks' old were randomly distributed to four water temperature levels: 26.91 (control), 28.0, 30.0 & 32.0^{o}C) respectively in a complete randomized design. Blood was collected from pooled samples in triplicate from an average of three fingerlings from each experimental treatment. The haematological and the physicochemical parameters were determined at the end of the study based on standard experimental procedures. Results showed that water temperature did not significantly (P> 0.05) affect the haematological parameters except the MPCV (26.50±2.10%) that was significantly (P< 0.05) lowest in the fingerlings maintained at 30.00℃. The findings revealed that the dissolved oxygen concentration ranged from 6.16 ± 0.91 mg/L at control temperature to 4.58 ± 0.97 mg/L at 320^{o}C and decreased significantly (p<0.05) with increase in water temperature, while other physicochemical parameters of the water were not significantly (P> 0.05) affected. Water pH, Ammonia concentration and Dissolved oxygen concentration were within the optimum range for fish culture in the tropics. The conclusion of this study showed that water temperature had effect only on MPCV and dissolved oxygen concentration at higher temperature levels.

Keywords: Water temperature, Heteroclarias, Haematological parameters and physicochemical parameters.

INTRODUCTION

Water temperature is known to affect the functional immunology response in ectothermic animals like fishes (1). Acclimation is the sum total of the adjustment which in all organisms such as fish adapt to long term changes in environment. The changes are most frequently thought in terms of seasonal or other temperature changes but can also occur in response to changes in oxygen level, salinity or other environmental factors. The changes are complex mixture of adjustment of hormones, metabolic pathways, enzymes and behaviour which occur at functional levels from the molecular and cellular to the whole organism and population (2). In ectothermic organisms, physiological rate can be adjusted to compensate for some changes in temperature. In fish, thermal acclimation is generally determined by blood parameter changes, during which an initial period of thermal stress is followed by gradual compensation. When a stable blood parameter level that is consistent between the old and new thermal state is reached the animal is considered to be fully acclimated (3). Adeyemo *et al*. (2) documented in his works on haematological response of *Clarias. gariepinus* to changes in acclimation temperature and revealed a decrease in Haematocrit (Ht), Haemoglobin (Hb) and Total Plasma Protein (TPP) at 23±1^{o}C and 41±1^{0}C relative to control (29±1^{0}C).

It is well known that a reduced quantity and quality of erythrocytes and a decreased haemoglobin level lead to a deteriorated oxygen supply. In addition to the transport of oxygen, erythrocytes have other functional tasks in the body, an insufficient quantity and quality of red blood cells would therefore consequently have several additional effects on metabolism beyond the simple oxygen supply for tissue metabolism, decreased TPP has also been reported to be suggestive of malabsorption of nutrients (4). Fish differ in their tolerance to extremes of temperature depending on the species involved, stage of development, environmental temperature, Dissolved Oxygen (D.O), pollution, season and extent to which the environment is heated and that temperature fluctuations affect feeding rate, spawning, dissolved oxygen uptake, pH level and other water quality parameters, which would affect the well-being of the fish. Studies have shown that when the water quality is affected by toxicants, any physiological changes will be reflected in the values of one or more of the haematological parameters (5).

Therefore, the present study was carried out to investigate the influence of different levels of water temperature on the haematological and physicochemical parameters of Heteroclarias fingerlings under laboratory conditions.

MATERIALS AND METHODS

Experimental Site: The study was conducted at the Biology laboratory of the School of Life Sciences, Bosso Campus, Federal University of Technology, Minna. Niger State.

Source of the Experimental Fish: A population of one thousand eight hundred old Heteroclarias fingerlings with average weight of 1.01 g were purchased from a private fish farm in Lagos, Lagos state, Nigeria.

Acclimatization of the Fingerlings: The fingerlings were acclimatized in rearing tanks for a period of seven days to allow them to recover from transportation stress, fed on a commercial diet (the feed size ranged from 0.3 – 0.5mm (Coppens) to satiation, morning and evening. Water exchange was done twice in a week (6).

Experimental Set-Up: The experiment consisted of four treatments with three replicates per treatment, each with stocking density of four hundred and fifty fingerlings. Treatment 1 was the control (26.91°C), while treatments 2, 3 and 4 had water temperature maintained at 28ºC, 30ºC and 32ºC respectively using thermo-regulator. Constant power supply was achieved with the aid of inventer (3.0KV). Twelve plastic indoor aquaria tanks, 25 litres capacity ($55\times35\times35cm^3$) filled with borehole water up to 20 cm level were stocked with 150 fingerlings each. The fingerlings were fed on a commercial diet (Coppens) to satiation, morning and evening following the method of Ayanwale *et al.* (6).

Determination of Physicochemical Parameters: Water temperature of the control treatment was determined weekly with mercury in bulb thermometer ($10\text{-}110^0$C range), while other treatments were fixed with thermoregulators. Dissolved Oxygen, Hydrogen Ion Concentration (pH) and Ammonia (NH_3) were determined weekly based on standard methods (7).

Haematological Analysis: The haematological analysis was done at Pathology Department General Hospital, Minna, Niger state. Blood samples were taken from three fingerlings per replicate. The fingerlings were bled from the ventral region near the heart by using a sterilized razor blade according to the method of Adeyemo *et al*. (2). The blood was allowed to flow freely into sample bottles containing 6 % EDTA (Ethylene Diamine Tetra Acetic Acid) solution, an anticoagulant and to the other plain sample bottles (without EDTA) according to the method of Haruna and Adikwu (8). Owing to insufficient amount of blood, from each experimental treatment, blood was collected from pooled samples in triplicate (from an average of three fish each; (9). The blood sample collected in the EDTA bottles were used for the determination of Mean Packed Cell Volume (MPCV), Mean Total Erythrocyte Count (MTEC) and Mean Total Leucocyte Count (MTLC). Serum was obtained from samples without EDTA by centrifugation and then transferred into non-heparinised bottle and stored in a refrigerator and later used for the determination of Mean Blood Protein Level (MBPL) and Mean Blood Glucose Level (MBGL) (8).

Data Analysis of the Experiment: The data collected were analysed for significant differences ($P < 0.05$) by the analysis of variance (ANOVA) using a Computer Statistical Package for Social Sciences (SPSS). Duncan Multiple Range Test (Post Hoc), (10) method was used to separate the means where there were statistically significant differences ($P < 0.05$).

RESULTS AND DISCUSSION

The results of haematological parameters of Heteroclarias fingerlings exposed to different water temperature levels for a period of 12 weeks are shown in Table 1. Generally, there were no significant differences ($p>0.05$)

in the MTEC (3.00± 0.75 x 10^{12}/L at 26.91 °C to 3.25 ± 0.35 x 10^{12}/L at 32.00°C , MTLC (4.35 ± 0.25 x 10^{9}/L between 30.00 & 32.00°C to 5.30 ± 1.40 X 10^{9}/L at 28.00°C, MBGL (81.08 ± 0.30 mMol/L at control temperature to 81.98 ± 0.55mMol/L at temperatures of 28.00 & 30.00°C) and MBPL (6.65 ± 0.65/dL at 28.00°C to 7.70 ± 0.10g/dL at 32.00 °C) respectively at the end of the study period. However, the MPCV (26.50± 2.10 %) was significantly lowest ($p < 0.05$) among fishes maintained at 30.0 °C. The results of physicochemical parameters of the water medium in which the Heteroclarias fingerlings were exposed to different temperature levels are presented in Table 2. The oxygen consumed (6.16 ± 0.91 mg/L) by the fingerlings under control treatment was significantly higher ($P <0.05$) than those of higher temperature levels.

Table 1: Mean (±SD) of Haematological Parameters of Heteroclarias Fingerlings Exposed to Different Water Temperature Levels for a Period of 12 Weeks

Haematological Parameters	Temperature Levels (°C)			
	26.91 (control)	**28.00**	**30.00**	**32.00**
Mean Packed Cell Volume (%)	31.30±7.67^{b}	29.50±1.30^{ab}	26.50±2.10^{a}	28.80±2.10^{ab}
Mean Total Erythrocyte Count (x10^{12}/L)	3.00±0.75^{a}	3.10±0.20^{a}	3.05±0.15^{a}	3.25±0.35^{a}
Mean Total Leucocyte Count (x10^{9}/L)	4..60±0.20^{a}	5.30±1.40^{a}	4.35±0.25^{a}	4.35±0.85^{a}
Mean Blood Glucose Level (mMol/L)	81.08±0.30^{a}	81.98±0.55^{a}	81.98±0.15^{a}	88.29 ± 0.00^{a}
Mean Blood Protein Level (g/dL)	6.85±0.25^{a}	6.65±0.65^{a}	7.05±0.25^{a}	7.70.±0.10^{a}

Values followed by the same superscript(s) in the same row, are not significantly different at ($p>0.05$) tested by DM

Table 2: Mean (±SD) Of Physicochemical Parameters of Heteroclarias Fingerlings Exposed to Different Water Temperature Levels for a Period of 12 Weeks

Temperature levels (^{0}C)	Dissolved oxygen concentration (mg/L)	Ammonia concentration (mg/L)	pH
26.91 (control)	6.6 1 ± 0.91^{b}	0.17 ± 0.09^{a}	6.78 ± 0.89^{a}
28.00	5.57 ± 0.73^{ab}	0.15 ± 0.09^{a}	6.95 ± 0.37^{a}
30.00	4.85 ± 1.01^{a}	0.16 ± 0.08^{a}	6.88 ± 0.27^{a}
32.00	4.58 ± 0.97^{a}	0.15 ± 0.09^{a}	6.82 ± 0.27^{a}

Values followed by the same superscript(s), in the same column, are not significantly different at ($P > 0.05$) tested by DMR

Table 1 also revealed that there were no significant differences ($P > 0.05$) in the ammonia concentration and water pH of the fingerlings in all the treatments. The low MPCV value in the controlled fishes may be attributed to feed or water temperature (11). Water temperature indicated no significant effect on other haematological parameters because the fingerlings had a high adaptive ability and were not under thermal stress (3, 2). This finding was contrary to the works of (12) who reported that red blood cell level increased at 32°C and decreased at 15°C when compared to control (22^{0}C) and had significant ($P<0.05$) difference; while haemoglobin (HB), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) and Red Blood Cell (RBC) were changed but haematocrit was unchanged at 12 hours. The higher value of concentration of dissolved oxygen recorded at control temperature (26.91^{0}C) suggested that the fingerlings were not under any physiological stress. This is because the concentration of dissolved oxygen (6.16 ± 0.91mg/L) was above 5.00mg/L recommended as minimum dissolved oxygen required for fish growth (6). The authors also noted that temperature accelerated metabolic activities of the fingerlings thereby, resulting into decrease in the concentration of oxygen available at high temperature levels. The ammonia concentration was not influenced by temperature because of daily removal of left over feed, and faecal samples and thus, preventing or reducing the risk of build-up of ammonia in the treatments (6). The pH values of water from all the treatments were within the tolerance range of 6.0 to 8.0 documented for juveniles of *Heterobranchus bidorsalis* and *C. gariepinus* (13)**.**

CONCLUSION

Water temperature had effect only on MPCV and dissolved oxygen concentration at higher temperature levels. Water pH, ammonia concentration and dissolved oxygen concentration were within the optimum range for fish culture in the tropics.

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Effects of Cockerel Strains and Transportation Density on Blood Parameters in a Hot Humid Ecological Zone of Nigeria

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Abstract: One hundred and eight (108) 8weeks old Harco (black) and Nera (white) cockerel strains were randomly allotted in2 x 3 factorial design experiment to evaluate blood response to effect of strain x transportation density in hot humid ecological zone of Nigeria. Birds were transported in two ventilated wooden cages with a motorbike on a rough road at 30km/hr for 2hours at three densities [Low density (LD), -0.86m^2, Medium density (MD)-0.64m^2, and High density (HD) - 0.48m^2] and each replicated thrice. Blood samples were collected before loading and transportation (baseline)and immediately after transportationfor heamatological and serum biochemistry parameters. There was significant ($P<0.05$) difference in strain x density interaction on blood parameters except in red blood cell (RBC) and packed cell volume (PCV). The RBC, Heamoglobin (Hb), and PCV values reduced slightly with transportation density for both strains {LD > MD > HD}. White blood cell (WBC), alanine amino transferase (ALT), aspartarte amino transferase (AST), total protein (TP), and glucose had significant ($P<0.05$) strain x density interaction. Values increased with density in this order {HD > MD > LD}. Harco strain had higher values as compared to white strain birds. In conclusion, this study showed that transportation and density affected both strains of birds. White strain birds are relatively resistance to transportation stress as compared to Harco strain. Thus, density is an important factor to be considered during transportation, and adequate measure should be put in place to reduce stress during transportation of both cockerel strains.

Keywords: Strain, Density, Cockerel, Blood parameters, Stress, Transportation

INTRODUCTION

As in most developing countries, the main commercial poultry production system in Nigeria is characterized with small holder's farmers, which are sometimes referred to as family poultry. It is an intensive poultry production, which is very important, and contribute significantly to food security and poverty alleviation in disabled and disadvantaged groups in less favoured areas in Africa. Family poultry was additionally clarified as "small flocks managed by individual farm families in order to obtain food security, income and gainful employment for women and children" [1]. The stocking/replacement of these family poultry at various locations ranging from urban/rural settlements demand transportation of life birds of all age groups across different ecological zones throughout the year.

However, transportation of food animals, including poultry, is associated with stresses which include rough handling, loading and unloading, introduction to a new environment, fear, vehicle motion, vibration and postural instability during the journey, long journey hours, deprivation of food and water, extreme climatic conditions, especially during the hot-dry and the harmattan seasons [2]. These factors acting concurrently on transported animals impair the normal body functions, leading to increased morbidity and mortality, poor meat quality and decreased productivity [3, 4].

It has been shown that changes in haematological values and serum metabolites are good indicator of stress response in animal [3]. The response of animals to stress varied between breeds, strains or genotype [5]. The main commercial strains of Cockerel (Harco -black and Nera- white), which are egg type male chicken component of poultry production, have become an indispensable strain for family poultry production in Nigeria [1]. Information on response of these cockerel strains to stress during transportation in hot humid agro-ecological zone is scarce.

Therefore, the present study was designed to investigate influence of transportation density and strain on blood response of Harco (black) and Nera(white) cockerel birds in hot humid ecological zone, Nigeria. To the best of our knowledge, this report will present first insight to response of this cockerel strains to transportation stress in Nigeria.

MATERIALS AND METHODS

One hundred and eight (108) apparently healthy cockerel birds of Harcoblack and Nera white strain aged eight weeks old, weighing 1.050 ± 0.4 kg served as subjects of the study. The birds were raised in a standard poultry house and fed standard commercial feed from day-old till eight weeks old. Water was given ad- libitum. All necessary medications were administered to the birds. Food and water were withdrawn 12 hours before the journey on the experimental day.

Transporting cage was made from a wooden materials and wire mesh. Itwas partitioned into 3 compartments cells with a wooden plank (Low density, -0.86m^2, medium density-0.64m^2, High density-0.48m^2) floor space. Each compartment was replicated thrice and 6 birds of the same strain wererandomly allotted to each cell. Cages were mounted on two motorbikes and travelled at a regular speed of 30km/h through a rough rural road for 2hrs. The average measured environmental condition during the journey were Temperature (34^{0}C) and Relative humidity (43.2 %). Blood sample was collected before loading and transportation (baseline) and immediately after the end of the journeyfrom the wing vein of each bird. All blood samples were analysed for heamatology and serum biochemical according to [6].

The interaction effect of strains and transportation density on measured blood parameters were subjected to factorial analysis using a General Linear Model (GLM) procedure of [7] with strain and space density as fixed effects. Significant differences between treatment means were assessed using Duncan's New Multiple Range Test option of the same software package at 5% probability level. Statistical model used in this study was:

$Yij = \mu + S_i + D_j + e_{ij}$

Where Y_{ij} = Individual observation

μ = General mean

S_i = Fixed effect of strains (i = 1……2)

S_j = Fixed effect of density (j = 1……3)

e_{ij} = Expected error

RESULTS AND DISCUSSION

The values of haematological and serum biochemical parameters recorded prior-transportation of experimental birds fell within the recommended normal range values established for chicken of the same age and sex group [8]. This indicated that the birds were healthy and therefore, fit for the journey.

Table 1: Effect of strains and density on blood parameters of cockerel birds transported in hot humid ecological zone of Nigeria

Treatments	Harco			White			
Parameters/Space	**LD(0.86m^2)**	**MD(0.64m^2)**	**HD(0.48m^2)**	**LD(0.86m^2)**	**MD(0.64m^2)**	**HD(0.48m^2)**	**SEM**
RBC ul/l	3.50^a	3.45^a	3.40^a	3.48^a	3.40^a	3.38^a	0.02
WBC ul/l (10^3)	19.77^b	21.06^{ab}	23.96^a	16.98^{cd}	18.73^c	20.66^{bc}	4.13
ALT (IU/L)	31.50^{ab}	32.67^{ab}	34.83^a	25.17^c	27.00^b	31.00^{ab}	1.12
AST (IU/L) (10^1)	21.18^{bc}	22.85^b	25.01^a	18.85^d	20.01^c	23.18^b	5.10
T. protein (%) g/100l	4.67^{bc}	4.83^{ab}	5.20^a	3.69^{cd}	4.62^{bc}	5.05^{ab}	0.80
Glucose (10^1)	19.85^a	20.45^a	23.65^{ab}	18.72^a	19.25^a	20.37^b	3.18
PCV (%)	32.00^a	31.50^a	31.33^a	31.80^a	31.67^a	31.17^a	0.37
Hb (%)	10.63^{ab}	10.23^{bc}	9.92^c	11.05^a	10.76^{ab}	10.35^{bc}	0.14

^{abc}means along the same row with different superscripts are significantly ($p< 0.05$) different using Duncan's test as post hoc analysis Where: HD- High density, MD- Medium density, LD- Low density, RBC- Red blood cell, WBC – White blood cell, ALT – Alanine amino transferase, AST – Aspartate amino transferase, PCV – Packed cell volume, Hb – Heamoglobin, TP- Total protein.

As shown in Table 1, there was significant (P<0.05) strain –density interaction effect on measured blood parameters except for red blood cell (RBC), and packed cell volume (PCV). However, values of RBC, Heamoglobin (Hb), and PCV reduced slightly with transportation density in this order for both strains i. e{High density (HD) > Medium density (MD) > Low density (LD)}. This can be attributed to short transportation distance covered for the experiment. The result corroborated the reports of researchers who stated that food animals on short transportation distance will experience very mild dehydration as compared to long transportation distance associated with high stress intensity and very low values of RBC, PCV and Hb [4, 9].
The significantly high (P<0.05) strain x density interaction effect of white blood cell (WBC), alanine amino transferase (ALT), aspartarte amino transferase (AST), total protein (TP), and glucose indicated that regardless of the transportation density (low, medium and high), both strains of cockerel (Harco and Nera) are physiologically affected by the induced transportation stress. Although values of measured blood parameters are within the recommended normal range established for birds of same age and sex [10]. The concentration of AST, and ALT may have increased in the blood after tissue damage, poor muscular tissue reperfusion, decreased heat dissipation, hypoxia and fatigue, due to increase in the permeability of muscle membrane induced by capture, loading and transportation stress [10, 4].

Total protein and albumin concentrations are markers for protein homeostasis, which increase with dehydration. Albumin concentrations usually parallel the total protein concentrations[11].Also, the increase in plasma glucose concentration is mainly due to glycogenolysis associated with the increase in catecholamines and glucocorticoids which were released during the stress of transportation [5].The oxygen carrying capacity of the blood was reduced as evidenced with decrease in Heamoglobin (Hb) concentration with rate of density in both strain i.e. (HD > MD > LD) due to transportation stress and congestion during the journey.
Overall, based on the values of measured blood parameters, it was observed that Nera strain birds are more resistant to the induced transportation stress in hot humid environment as compared to Harco strain birds. This may be due to the plumage colour, as black conserved heat.

CONCLUSION AND APPLICATION

The study showed that induced transportation stress affected both strains of birds under consideration at all transportation densities. In addition, we can conclude that Nera strain birds are more resistant to transportation stress in hot humid environment as compared to Harco strain birds. Therefore, adequate measure should be put in place during transportation of both cockerel strains in hot humid environmental condition, with density of transportation an important factor to be considered.

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Testicular Morphometry and Qualitative Assessment of the Ejaculates of ISA White and Barred Plymouth Rock Cocks fed Graded Levels of Dietary Salt

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Abstract*:* Studies on the qualitative assessment of the ejaculates of Isa White and Barred Plymouth Rock cocks fed graded levels of dietary salt were conducted in a twelve-week experiment. Twenty-four cockerels of two strains namely Barred Plymouth Rock (BPR) and Isa White (IW) were used. Four treatment diets were formulated and designated as T1, T2, T3 and T4 in which the levels of dietary salts were varied at 0.25%, 0.50%, 0.75%, and 1.00% for T1, T2, T3 and T4 respectively. Semen samples were collected from the cocks upon attainment of 25 weeks of age and subsequently for the next three weeks during which the cloaca temperature was also taken thrice weekly and recorded. The weekly semen collections were used for the qualitative analysis the ejaculate of the two breeds of cocks. The cocks were all sacrificed at the twelve weeks of the experiment for the determination of their testicular morphometry. The results from the study revealed significant differences in final weight of the cocks. The significant differences observed in left and right testicular weight indicated that dietary salt at the level up to 0.75% had no adverse effect on this parameter. The significant treatment differences observed in percentage live sperm showed improved livability of sperm cells at 0.50% level of dietary salt. Sperm motility was significantly higher in Barred Plymouth Rock cock than Isa White.

Keywords: Barred Plymouth Rock, ejaculates, Isa Brown, morphometry, testicles.

INTRODUCTION

The role of dietary salt (NaCl) is indispensable in the diets of farm animals. This underpins the universal role that dietary salt plays in the nutrition of livestock. Though animals generally have an innate desire to consume salt and would crave it at the risk of their lives, caution must be applied to avoid its intake in excess. Much as its deficiency could lead to decline in production and manifestation of certain vice habits like feather pecking in poultry, its consumption in excess could also provoked some management problems like wet litter and increased rate of the release of the green house gases to the surrounding and thus a negative carbon footprint in the environment (Aro *et al.,* 2018).

Much have been known and reported on the nutritional role of dietary salt in the nutrition of livestock. However, its role in the aspect of livestock reproduction has not been given the same level of research focus as has been given its nutritional roles. Its roles in reproduction have only been mentioned in rats or mice studies to model its risk factors in human ailments like hypertension and other cardiovascular diseases (Sofola *et al.,* 2003; Adekunbi*et al.,* 2016). This experiment was therefore conducted to provide information on the effect of dietary salt on the testicular morphometry and ejaculate parameters of two breeds of domestic chickens. Its effect on the body temperature was also investigated as part of this current study.

MATERIALS AND METHODS

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm (Livestock Section) of the Federal University of Technology, Akure, Nigeria. Twenty-four (24) cockerels comprising 12 Barred Plymouth Rock and 12 ISA White were procured at sixteen weeks of age and kept singly in battery cages. They were fed with four treatment diets in which the dietary salt was included at 0.25% (T1), 0.50% (T2), 0.75% (T3) and 1.00% (T4). The cockerels were each given 150g of the diets daily while water was given *ad libitum;* the feeding trial lasted for twelve weeks. Table 1 shows the gross composition of the cockerels' diets.The cocks

were fed with the experimental diets for 12 weeks and were trained to respond to the abdominal massage technique prior to semen collection for three weeks. Single ejaculate of semen was collected from each cock twice a week between 4:00 pm and 5:00 pm by abdominal massage method for seminal analysis. Semen samples were collected at the cocks' body temperature in graduated semen collection tubes and maintained at 42°C in a warm bath, until microscopically evaluated for quality.

Table 1: Gross composition (g/100g) of the Cocks' diets

Ingredients	T1	T2	T3	T4
Maize	55.10	55.10	55.10	55.10
Fish meal	1.00	1.00	1.00	1.00
Groundnut cake	9.00	9.00	9.00	9.00
Soybean meal	9.00	9.00	9.00	9.00
Wheat offal	21.00	20.75	20.50	20.25
Bone meal	2.75	2.75	2.75	2.75
Limestone	1.50	1.50	1.50	1.50
Salt	0.25	0.50	0.75	1.00
Premix	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00
Calculated Analysis				
Energy (M.E. Kcal/kg)	2629	2626	2623	2620
Crude protein (%)	17.20	17.20	17.20	17.10
Crude fibre (%)	4.53	4.50	4.48	4.35
Calcium (%)	1.67	1.67	1.67	1.67
Phosphorus (%)	1.01	1.01	1.01	1.01
Sodium (%)	0.16	0.26	0.36	0.46
Chlorine (%)	0.17	0.32	0.48	0.60

T1 = Diet with 0.25% dietary salt; T2 = Diet with 0.50% dietary salt; T3 = Diet with 0.50% dietary salt; T4 = 1.00% dietary salt; M.E. = Metabolizable energy

Parameters like the initial body weight, final body weight and cloaca temperature, were recorded during the course of the experiment. Also ejaculate volume, testicular weight, testicular density, spermatocrit and seminal plasma of the cocks were determined. Other parameters include sperm concentration, motility, percentage live sperm and total sperm count were determined by the methods describe byRekwot (2013).All data collected were subjected to a two-way Analysis of Variance (ANOVA) in a Completely Randomized Design (CRD). The significant differences were separated using Duncan's Multiple Range Test (DMRT) of the Statistical Package for Social Sciences (SPSS) version 17 of 2007.

RESULTS AND DISCUSSION

Table 2 shows the body weight, cloacal temperature and testicular morphometry of Isa White (IW) and Barred Plymouth Rock (BPR) cooks fed diets with graded levels of salt (NaCl). Significant differences ($p<0.05$) were observed in final weight among treatments and interaction between treatments and breeds. Dietary salt at 0.50% level gave the best weight accretion in the cocks under the present study. This showed that feeding breeder cocks with 0.50% dietary salt could promote better growth in this category of domestic chickens beyond which decrease in growth could be recorded as observed in the current experiment. Similar reduction in body weight as a result of high salt intake was also reported in rats (Adekunbi *et al.*, 2016). Dietary salt did not have any significant influence on the cloaca temperature at all treatment levels and in the interactions between breeds and treatment levels. BRP cock recorded higher right testicular weight, left testicular weightand testicular volume

than IW. Cocks fed with 0.5% dietary salt appeared to have higher weight of right and left testes. According to Senger (2003) the larger the size of the testes, the greater the capacity for sperm production.

Table 3 shows the qualitative assessment of the ejaculates of Isa White (IW) and Barred Plymouth Rock (BPR) breeds fed diets with different levels of dietary salt. There were significant treatment and interaction effects ($p<0.05\%$) in ejaculate volume. Dietary salt improved ejaculate volume from 0.28±0.05ml in T1 to 0.46±0.09ml and 0.39±0.08ml in T2 and in T3 respectively. At the interaction between breeds and treatments, ejaculate volume increased with increase in dietary salt level for BPR but did not show any clear-cut trend for IW. Also increase in dietary salt level improved the percentage spermatocrit in both the IW and BPR breeds.

Table 2: Body weight, cloacal temperature and Testicular Morphometry of Isa White and Barred Plymouth Rock Cocks Fed Diets with varied Levels of Salt (NaCl).

Parameters		Initial Weight (Kg)	Final Weight (Kg)	Cloacal Temperature (^{0}C)	Testicular Density (g/ml)	Right Testicular Weight (g)	Left Testicular Weight (g)	Testicular Volume (ml)
Breed								
IW		2.19±0.06^{a}	2.28±0.06	41.38±0.05	1.43±0.09	8.75±0.90^{b}	8.92±1.00^{b}	6.92±1.10^{b}
BPR		1.98±0.06^{b}	2.34±0.07	41.42±0.06	1.39±0.07	10.18±0.78^{a}	10.06±0.82^{a}	7.89±0.61^{a}
T								
	T1	2.16±0.15^{a}	2.35±0.08^{a}	41.39±0.06	1.46±0.13^{ab}	9.89±1.40^{a}	10.08±1.25^{a}	7.38±0.99^{b}
	T2	2.05±0.06^{a}	2.41±0.11^{a}	41.3±0.09	1.39±0.09^{ab}	10.16±1.30^{a}	10.24±1.33^{a}	8.57±1.08^{a}
	T3	1.97±0.07^{b}	2.18±0.04^{c}	41.48±0.04	1.19±0.08^{b}	9.32±0.93^{a}	9.17±1.27^{a}	8.07±1.54^{a}
	T4	2.16±0.07^{a}	2.28±0.09^{b}	41.43±0.10	1.60±0.10^{a}	8.49±1.34^{b}	8.47±1.52^{b}	5.60±1.27^{c}
BxT								
IW	T1	2.45±0.12^{a}	2.48±0.13^{b}	41.45±0.09	1.45±0.22^{b}	7.45±1.59^{c}	8.10±1.50^{b}	6.50±2.02^{a}
BPR	T1	1.87±0.11^{d}	2.23±0.03^{c}	41.33±0.07	1.47±0.18^{b}	12.33±1.16^{a}	12.07±1.28^{a}	8.27±0.13^{a}
IW	T2	2.10±0.12^{b}	2.22±0.14^{c}	41.20±0.17	1.34±0.02^{b}	10.77±2.78^{b}	10.53±2.92^{b}	7.93±2.29^{a}
BPR	T2	2.00±0.00^{c}	2.60±0.06^{a}	41.40±0.06	1.43±0.19^{b}	9.55±0.61^{b}	9.95±0.43^{b}	9.20±0.46^{a}
IW	T3	2.08±0.08^{b}	2.22±0.09^{c}	41.40±0.06	1.12±0.14^{d}	9.33±1.83^{b}	9.93±2.69^{b}	9.23±3.09^{a}
BPR	T3	1.85±0.05^{d}	2.15±0.00^{d}	41.55±0.03	1.26±0.10^{c}	9.30±0.98^{b}	8.40±0.52^{b}	6.90±0.98^{a}
IW	T4	2.13±0.03^{b}	2.20±0.00^{c}	41.45±0.03	1.81±0.08^{a}	7.45±0.43^{c}	7.10±0.52^{c}	4.00±0.46^{b}
BPR	T4	2.18±0.15^{b}	2.37±0.18^{bc}	41.40±0.23	1.39±0.07^{b}	9.53±2.78^{b}	9.83±3.06^{b}	7.20±2.31^{a}
LS								
Breed		*	NS	NS	NS	*	*	*
T		*	*	NS	*	*	*	*
BxT		*	*	NS	*	*	*	*

$^{a, b, c, d}$ = means in the same column but with different superscripts are statistically ($p<0.05$) significant

IW= Isa White; BPR= Barred Plymouth Rock; T1= Diet with 0.25% salt; T2= Diet with 0.50% salt; T3= Diet with 0.75% *salt;* T4= Diet with 1.00% salt; T = Treatment; BxT = Breed versus Treatment; LS = Level of significance.

The BPR had higher seminal plasma value (89.42±1.72%) than IW (88.67±0.89%) while IW had higher sperm concentration (10.91±0.50 X 10^9/ml). Significant breed differences observed in seminal plasma of the cocks could be as a result of their genotype. Seminal plasma serves as a nutrient rich medium for spermatozoa to function and survive (Glenn, 2012). Breed differences could also be adduced to the significant differences observed in sperm concentration. Dietary salt at higher levels of inclusion in the current study did not depress ejaculate volume, spermatocrit, seminal plasma and sperm concentration relative to the control and hence male fertility, since all these parameters are the prime markers of testicular spermatogenesis and epididymal maturation (Bolanle *et al.,* 2013). Dietary salt at 0.50% level improved percentage live sperm in both IW and BPR cocks. Equally, percentage live sperm was not depressed

significantly relative to the control while the total sperm count improved significantly in all the high salt diets as compared to the control. Sperm motility was significantly higher in Barred Plymouth Rock than Isa White cocks. The IW breed was more negatively affected at higher salt concentration than the BPR in term of sperm motility. The mean value for sperm motility however fells within the physiological range for cocks of 50-80% as reported by Rekwot (2013).

Table 3: Qualitative assessment of the ejaculate Parameters of Isa White and Barred Plymouth Rock cocks fed varied levels of dietary salt

Parameters		Ejaculate Volume (ml)	Spermatocrit (%)	Seminal Plasma (%)	Sperm Concentration ($X10^9$/ml)	Live Sperm (%)	Sperm Motility (%)	Total Sperm ($X10^9$)
Breed								
IW		0.39±0.06	11.33±0.89	88.67±0.89^b 88.67± 0.89^b	10.91±0.50^a	95.58±0.19	63.21±1.57^b	4.34±0.73^a
BPR		0.33±0.05	10.58±1.72	89.42±1.72^a	10.18±1.08^b	95.51±0.20	72.57±5.95^a	3.42±0.68^b
T								
T1		0.28±0.05^b	10.67±2.68^b	89.33±2.68^a	9.83±1.70^b	95.47±0.24^b	71.83±7.23^a	2.62±0.66^c
T2		0.46±0.09^a	11.83±0.65^a	88.17±0.65^b	11.47±0.28^a	96.06±0.18^a	60.69±1.13^b	5.12±0.98^a
T3		0.39±0.08^a	9.67±1.82^b	90.33±1.82^a	9.85±1.09^a	95.23±0.36^b	71.93±6.73^a	3.91±1.01^b
T4		0.33±0.09^b	11.67±2.26^a	88.33±2.26^b	11.03±1.34^{ab}	95.42±0.17^b	67.10±8.27^a	3.85±1.24^b
B x T								
IW	T1	0.34±0.01^a	10.00±2.89^b	90.00±2.89^b	9.49±1.62^b	95.25±0.34^c	67.80±4.33^a	3.27±0.66^b
BPR	T1	0.21±0.08^c	11.33±5.21^a	88.67±5.21^b	10.17±3.42^b	95.69±0.34^b	75.86±15.04^a	1.98±1.15^c
IW	T2	0.51±0.17^a	11.67±0.88^a	88.33±0.88^b	11.48±0.32^a	95.89±0.34^b	59.40±1.55^c	5.79±1.76^a
BPR	T2	0.40±0.12^a	12.00±1.15^a	88.00±1.15^b	11.45±0.53^a	96.23±0.12^a	61.97±1.52^b	4.46±1.11^a
IW	T3	0.32±0.10^b	12.67±1.86^a	87.33±1.86^b	11.61±0.80^a	95.44±0.66^c	66.26±1.61^a	3.72±1.30^b
BPR	T3	0.46±0.14^a	6.67±2.03^e	93.33±2.03^a	8.09±1.48^b	95.02±0.43^c	77.60±13.84^a	4.10±1.83^a
IW	T4	0.39±0.17^a	11.00±1.73^a	89.00±1.73^b	11.07±0.78^a	95.73±0.08^b	59.36±0.47^c	4.58±2.16^a
BPR	T4	0.27±0.08^b	12.33±4.70^a	87.67±4.70^b	10.99±2.89^a	95.10±0.21^c	74.84±16.8^a	3.13±1.57^b
LS								
B		NS	NS	*	*	NS	*	*
T		*	*	*	*	*	*	*
B x T		*	*	*	*	*	*	*

^{a,ab,b,c} = Means in the same column but with different superscripts are statistically ($p<0.05$) significant.

IW = Isa White; BPR = Barred Plymouth Rock; T1 = Diet with 0.25% salt; T2 = Diet with 0.50% salt; T3 = Diet with 0.75% salt; D4 = Diet with 1.00% salt; B = Breed; T = Treatment; B x T = Breed x Treatment; LS = level of significance.

CONCLUSIONAND APPLICATION

The inclusion of dietary salt at 0.50% was most beneficial to the growth of the experimental animals. Dietary treatments had no significant effect on cloacal temperature. Dietary salt beyond 0.75% could adversely affect testicular weight. Sperm motility was significantly higher in Barred Plymouth Rock cock than in Isa White. The IW breed showed less resistance to high salt diets than the BPR breed in terms of sperm motility.

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Growth Performance and Gut Histomorphometry Changes in Broiler Chicks Fed at Different Post-Hatch Feeding Days

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Abstract: Many time poultry birds are subjected to different post-hatch feeding days without recourse to their growth and gut integrity. This study therefore evaluates the growth and gut histomorphometryresponse of broiler chicks to different post-hatch feeding days. A total of 216 hatched day-old chicks were weighed and randomly allotted into six (6) treatments with thirty-six chicks per treatment in a completely randomized design. Each treatment had three replicates with twelve birds per replicate. The first treatment (control) was fed with starter diet immediately and the other treatments were fed at 12hours interval, feed (23%CP and 2900MEKcal/kg) and water were given *ad-libitum* at the end of 60hrs. The results were analyzedwith IBM SPSS statistics version 21 and differences among means were separated with the Duncan's multiple range test option of the same package. The results indicated that bird fed 12hrs post-hatch had significantly ($p<0.05$) higher weight gain (472.75g), longer and heavier gut length and weight respectively compared to other groups. Villi Height (µm) were not affected by the treatment and treatment 2 had the highest villi width (330.00µm). Also, the gut photomicrographs were not affected across the six treatments. Therefore, this research concluded that broiler feeding should not be delay more than 12 hrs post-hatched.

Keywords: Gut, Villi, Histomorphometry, photomicrograph and post-hatch

INTRODUCTION

Many time broiler chicks are subjected to different post hatch feeding days without recourse to their health and physiological implications. Broilers are chicken (*Gallus domesticus*) bred and raised specifically for meat production and they are given access to a diet of high protein and this is combined with artificial lightening conditions to stimulate growth, thus the desired body weight is achieved. Newly hatched broiler often experiences a delay before receiving access to feed and water because of time spent in the hatchery and time spent travelling to the farm (1). The amount of time chicks spend in the hatchery is largely due to spread of hatch between early and late hatching eggsplus hatchery processing. On average, it takes approximately 21 days for broiler chicks to completely emerge from their eggs. However, it is estimated that the hatch window (HW), or the span of time from the hatch of the first chicks to the last chicks, may range from 24-48 hours or more (1). In order to minimize loss and for the sake of efficiency, hatchery operators may remove all chicks from the hatchery incubators at one designated time or until most chicks have emerged from their eggs (2). As a result of this common practice, chicks that hatch earlier than others must wait longer periods of time before they receive access to feed and water. The first physiological consequence of delayed access to feed is chick's body weight loss. In the time between hatch and placement (24-48 hours), chicks may lose an average of 8% of their initial body weight (3). Some of the weight loss is due to yolk sac utilization which is the natural feed from the egg but it is estimated that up to two thirds of weight loss is due to reduction in tissue and organ weight (4). In a recent review by (5), it was mentioned that during the hatching process, embryos deplete their glycogen reserves which is a nutrient source for the post-hatch chicks. This is thought to be another reason chick experience weight loss due to post-hatch delayed feeding. Prolonged delayed access to feed often result in significant increase in chick mortality (6), a physiological response due to depletion of feed and water. There are various research works (1,2 3 and 4) on the effect of post-hatch on blood and other parameters but paucity of information on the response of gut to different post-hatch feeding time as necessitated this research. Therefore, this research work was designed to determine the effect of different post-hatch feeding time on the gut histomorphometryof broiler chicks.

MATERIALS AND METHOD

Location of the experiment: The experiment was carried out at the poultry unit of the Teaching and Research Farm, LadokeAkintola University of Technology, Ogbomoso, Oyo state, Nigeria.

Feed and feeding: All the birds were supplied with water *ad-libitum* and the first treatment (control) was fed with starter diet immediately and the other treatments were fed at 12hours interval. After 60hours, all the birds were given free access to feed and water.

Experimental birds and management: A total of two hundred and sixteen (216) recently hatched day-old chicks were immediately selected and purchased from a reputable hatchery were used in the study. Prior to the arrival of the birds; all necessary cleaning and disinfection of the brooding house were carried out. On arrival, the birds were weighed and randomly allotted into six (6) treatments. Thirty-six chicks were allotted per treatment; each treatment consists of three (3) replicates with twelve (12) birds per replicate. Feed (23%CP and 2900MEKcal/kg) and water were given *ad-libitum.* Other routine and daily management were done as reported by (7). At the end of the third week, two birds were randomly selected per replicate and the gut histomophometric analysis was done using tape rule and sensitive scale to measure the length and weigh of each segment fromoesophagus-colon respectively while the USB camera was used to record the photomicrograph of the jejunal part of the gut at 20x magnification.

Jejunal mucosal development assessment and photomicrograph: Five centimeter(5cm) from the jejunal section were taken from two birds per replicate, carefully flushed using distilled water to remove the digesta, fixed in 10% formalin, processed and prepared on permanent slide for each of the bird. The slides were analyzed using a linear measurement (µm). The measurements were carried out with the aid of a binocular microscope with USB camera. Parameters measured include villus height, villus width, and crypt depth. Thirty readings of villus height, villus width and crypt depth were taken per treatment. Villus height was measured from the apical to the basal region, which corresponds to the superior portion of the crypts. Crypts measurement was done from the base until the region of transition between the crypt and the villus. Data generated were subjected to analysis of Variance using IBM SPSS statistics version 21 and differences among means were separated using Duncan's Multiple Range Test option of the same package.

RESULTS

Table 1: Live weight and gut response of broiler to different post-hatch feeding times (Starter phase)

Parameters	Control	12hours	24 hours	36 hours	48 hours	60 hours	SEM
Live weight (g)	441.92^{b}	472.75^{a}	441.25^{b}	441.16^{b}	440.08^{b}	440.67^{b}	2.00
Bled w (g)	431.08^{c}	459.50^{c}	430.75^{c}	430.83^{c}	439.83^{b}	440.33^{b}	1.72
Esophagus (cm)	12.08^{a}	10.75^{b}	10.25^{b}	10.92^{b}	10.20^{b}	6.83^{c}	0.28
Proventriculus(cm)	4.92	4.75	4.75	4.91	4.91	4.83	0.03
Duodenum (cm)	24.08	24.25	24.75	23.08	23.91	23.33	0.17
Jejunum (cm)	77.08^{b}	82.25^{a}	70.75^{c}	70.91^{c}	70.25^{c}	70.16^{c}	0.73
Ileum (cm)	71.08^{b}	74.25^{a}	71.25^{b}	72.08^{b}	71.25^{b}	70.67^{b}	0.21
Caecum (cm)	11.87^{b}	15.25^{a}	10.75^{b}	11.91^{b}	12.08^{b}	12.33^{b}	0.24
Large intestine cm	6.92^{b}	9.25^{a}	8.25^{b}	6.92^{b}	7.91^{b}	7.83^{b}	0.14
WGITL(cm)	205.08^{b}	219.75^{a}	200.75^{b}	200.91^{b}	200.08^{b}	199.33^{b}	1.21
Relative gut weight							
Oesophagus	0.69	0.58	0.81	0.81	1.11	0.71	0.72
Proventriculus	0.92	0.89	0.91	0.92	0.89	0.94	0.01
Duodenum	1.61	1.43	1.52	1.38	1.34	1.62	0.02
Jejunum	2.73^{b}	3.01^{a}	2.88^{b}	2.81^{b}	2.71^{b}	2.91^{b}	0.02
Ileum	3.19^{d}	4.28^{a}	3.27^{d}	3.61^{b}	3.27^{d}	3.71^{b}	0.06
Caecum	0.69^{b}	1.11^{a}	0.85^{b}	0.88^{b}	0.70^{b}	0.64^{a}	0.08
Large Intestine	0.66	0.68	0.70	0.67	0.70	0.71	0.01
Gizzard	4.54	4.71	5.18	5.00	5.21	4.73	0.04

Whole GIT	14.95[b]	16.55[a]	16.15[a]	16.13[a]	15.94[b]	15.89[b]	0.08

[a,b,c, d] : Mean in the same row with different superscripts are significantly (p<0.05) different.12hrs, 24hrs, 36hrs, 48hrs and 60hrs are No of hours after hatching, GIT = Gastrointestinal tract, WGITL= whole GIT length SEM = standard error of means.

Table 1 shows weight (g) and gut morphometric characteristics of broiler fed at different post-hatch feeding day. Nutrient utilization is dependent on digestibility and absorption of feed in gastrointestinal tract (GIT) (8). In this present study, body weight was decreased by those chickens with access to feed immediately and those chickens fed after 24 hours post-hatched while birds fed after 12 hours post-hatched performed significantly (p<0.05) well with higherbody weight (472.75g) thanthe other treatments. This report was not in agreement with the report of (8) which observed decreased weight of bird not exposed to feed immediately after hatching. Thismight be because of the effect of the residual yolk in the intestinal region of the broilersafter hatching thatserves as a source of nutrients to the chicks. The sustaining capacity of the yolk sac had been establishedas it ensures adequate nutrient reserve during the first 3-5 days post-hatch (9). The presence of the residual yolk sac during the first 3 days after hatching is critical to the growth and development of chicks (10) and one of the most important requirements for normal development of the embryo is the adequate supply with nutrients from maternal sources (10).Relative weight of the gut components of broiler differ significantly (p<0.05) across the treatment except oesophagus, proventriculus, duodenum and large intestine.A reduced small intestine in birds may decrease the capacity for breakdown and active absorption of nutrients (11) and birds do not seem to compensate for reduced digestive and absorptive capacity via a longer gut retention time of food, but may develop an increased mucosal surface area via a greater villus area.

Table 2: Gut histological response of broiler fed at different post-hatch feeding days (Starter phase)

Treatments	Control	12Hours	24 Hours	36 Hours	48 Hours	60 Hours	SEM
Villi Height (µm)	910.00	890.00	950.00	880.00	850.00	830.00	20.14
Villi Width (µm)	250.00[ab]	330.00[a]	230.00[b]	220.00[b]	250.00[ab]	260.00[ab]	11.49
Crypt-depth (µm)	390.00[a]	350.00[a]	290.00[b]	260.00[c]	290.00[b]	290.00[b]	11.42
VH:CD	2.33[b]	2.67[b]	3.64[a]	3.48[a]	3.11[a]	3.10[a]	0.12

[a,b,c] : Mean in the same row with different superscripts are significantly (p<0.05) different. 12hrs, 24hrs, 36hrs, 48hrs and 60hrs are No of hours after hatching, SEM = standard error of means.

Table 2 shows the gut histomorphometric parameters of broiler chicks fed at different post-hatch feeding days. Except for villus height, other parameters measured were affected significantly (p<0.005). Broilers chicks fed after 12 hours post-hatched had the highest villus width (330.00 µm) and crypt depth (350.00 µm) compared to other treatments. Thus, when compared with the gut morphometric parameters, birds fed after 12 hours post-hatch had the highest jejunal length and weight.

Plates one to six show the photomicrograph of broiler chicks to different post hatch feeding days

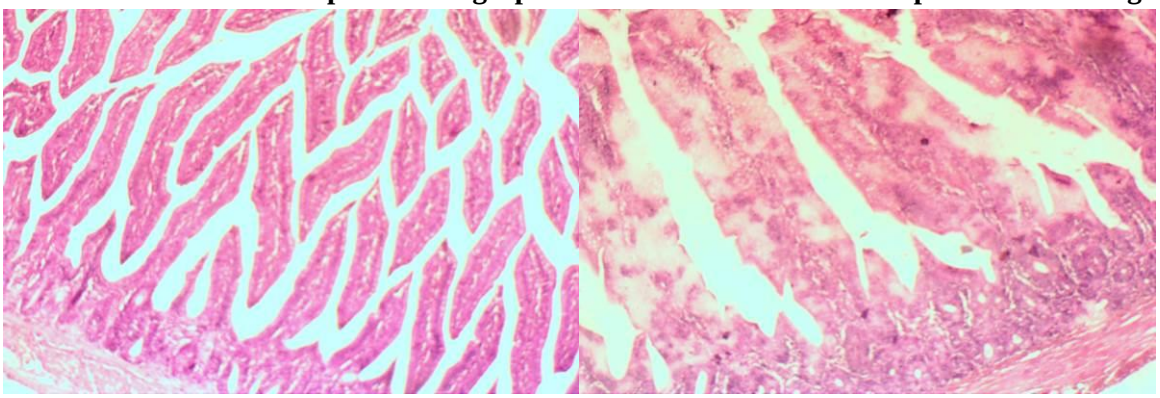

PLATE1: Intestine- no observable lesion

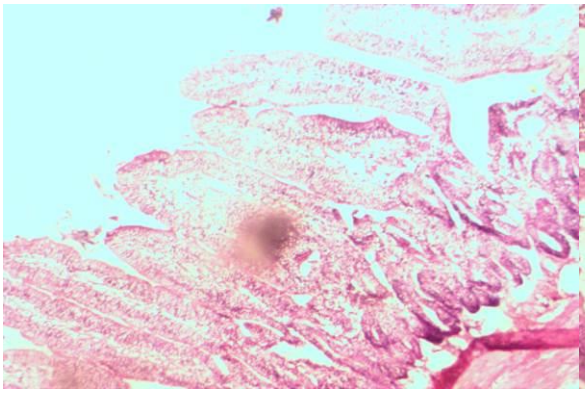

PLATE2:Intestine- no observable lesion

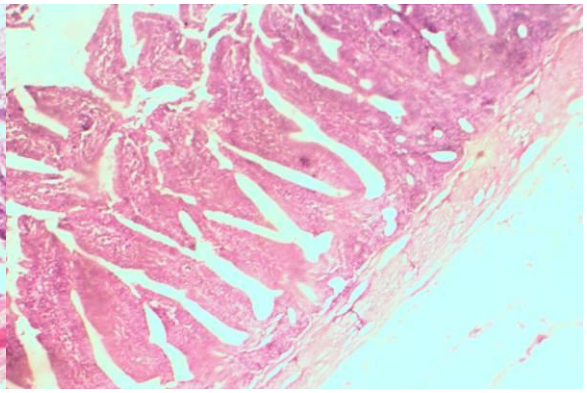

PLATE3: Intestine- no observable lesion

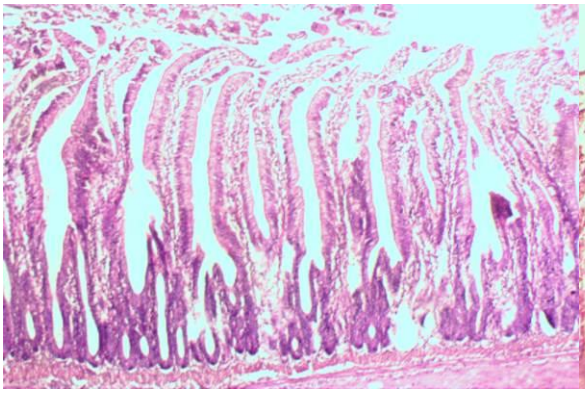

PLATE4:Intestine- no observable lesion

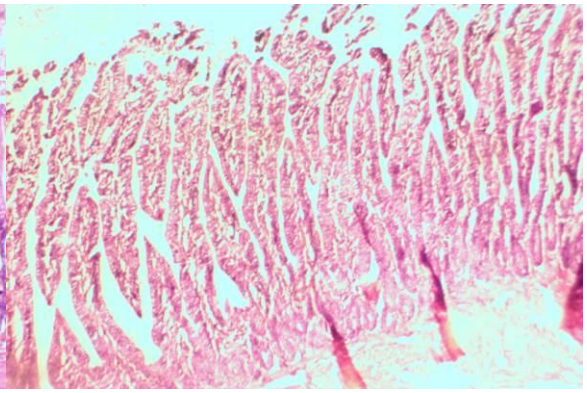

PLATE5: Intestine- no observable lesion

PLATE6: Intestine- no observable lesion

The photomicrograph of the guts of birds fed at different post-hatch feeding days is presented in plates 1-6. There were no histological alterations observed in the gut of all the birds across all the treatments. No clubbing of villi, no observable lesion, no necrosis of villi enterocytes, no villi atrophy and no hepatocellular necrosis. That established the fact that delay feeding had no effect on the mucosal integrity. The sound epithelial architecture supports the development of mucosal-associated lymphoid tissue, which in turn protects the gut against infections and allergy (1, 12).

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Effects of Feed Restriction Prior Mating on The Reproductive Parameters in Rabbit

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Abstract: Eighteen matured (6 Months old) rabbits (comprising 6 males and 12 females) were used to examine the effects of feed restriction prior to mating on the performance, rectal temperature, glucose level and hormonal profile of rabbits. The rabbits were grouped into three experimental treatments representing *ad libitum* feeding, early restriction and late restriction over 60 days experimental period. The animals were allocated randomly to three treatment groups with six animals (2 males and 4 females) per treatment in a complete randomized design. There was a significant increase ($p<0.05$) in the rectal temperature in the early restricted group. Early restricted group also recorded the highest pregnancy rate (75%). Glucose level was significantly higher ($p<0.05$) in the early restricted group before mating. The FSH was significantly lower ($p<0.05$) in late restricted group. It can be concluded that early restriction improved the FSH value and pregnancy rate in rabbit.
Keywords: Feed restriction, glucose, Rabbit, reproductive hormones,

INTRODUCTION

Rabbit production in Nigeria is majorly in the hands of young students and village dwellers who depend mainly on forages as feed for the animals. The animals are bred without concern for their nutrient status before mating. The animals under this management are on feed restriction regime because they are fed mainly with poor quality feedstuff. Feed restriction includes any deviation from the normal husbandry or a limit in the amount of feed fed to animals. It could be quantitative or qualitative. Qualitative feed restriction means feeding the animal with a diet that is nutritionally deficient, while quantitative feed restriction is feeding the animal with a limited amount of diet that is nutritionally balanced

Feed restriction may be required in order to know the reproductive performance of male and female rabbit before mating and the rate of fertility afterwards .However, limiting the feed intake is widespread in animal breeding such as for adjusting the ration to the nutrient requirements or to manage the fattening and the meat quality (Gidenne *et al*, 2009). It has been reported that in order to reduce the excessive fatness of young does, restricted feeding during pregnancy is frequently applied to obtain uniformity in their body weights, to avoid fattening and high mortalities around parturition (Romero *et al*., 2010). Also, performance index was significantly higher for groups of rabbits on feed restriction (Yassein *et al*., 2011). According to Abeer (2008) when rabbits were given a quarter of their daily requirement of feed mixture, they grew to the same size as did those fed normally, within 7 days of re-feeding, producing a saving of 850 g feed mixture per head. Feed restriction could also be exploited in the feeding regimen of rabbits, especially in periods of inadequate supply of concentrates and forages (Yakubu *et al*., 2007) in order to prevent problems associated with reproduction such as high mortality rate around parturition (Romero *et al*., 2010) and metabolic disorders (Boisot *et al.*, 2003).This work therefore focuses on the effect of feed restriction on pregnancy rate, rectal temperature, glucose level, haematological parameters and reproductive hormones in rabbit

MATERIALS AND METHODS

EXPERIMENTAL SITE: The experiment was carried out at the Rabbitry unit, Teaching and Research Farm, Faculty of Agriculture, University of Ilorin, Ilorin, Kwara State, Nigeria (Latitude: 8º 30' 16" N, Longitude: 4º 34" 13" E).

EXPERIMENTAL ANIMALS: A total of eighteen (18) matured (6 Months old) rabbits, six bucks and twelve does of mean weight(1800.00 ± 3.5g) were randomly allocated to three treatments of early feed restriction, late feed restriction and control in a completely randomized design model with 2 bucks and 4 does per treatment. Rabbits were individually accommodated in cages and provided with separate facilities for feeding and watering,

thus, each rabbit was treated as a replicate in a 60 day trial. The Rabbits were provided with a formulated diet of 15% crude protein and 2200kcal/kg Metabolizable energy (Iribeck, 2001). Rabbits were weighed individually and were given daily feed of 5% body weight (Jenkins,1999) for 30 days in the control group. Rabbits in early feed restriction were offered 2.5% daily feed consumption of their body weight from day 1 -15 and 5% daily feed of their body weight from day 16 -30, while rabbits in late restriction feeding were offered 5% daily feed of their body weight from day 1 -15 and 2.5% daily feed of their body weight from day 16 – 30. Water was provided *ad libitum* for all the groups. At the end of the 30th day feeding restriction, blood samples were collected from the ear veins of the rabbits to assess the hormonal level before being mated within treatment. The rabbits were mated the second day post feed restriction by taking the female to the male for 12 h and fed 5% body weight afterward. Blood samples were also collected 2 weeks post mating and palpation test was carried out to confirm pregnancy in the female rabbits. The bucks were only used for mating within treatment.

Table 1: Composition (%) of the diet:

Maize	35.00
Soybean meal	25.00
Corn bran	21.95
Wheat offal	15.00
Bone meal	2.50
Premix	0.25
Salt	0.3.0
Analysis of Feed (Calculated):	
Crude protein	15.10%
Crude fibre	6.37%
Energy	2200.00kcal/kg
Phosphorus	0.58%
Calcium	0.80%

PARAMETERS MEASURED: Body weight: The body weight was measured using a weighing scale on a weekly basis. The body weight and body weight change was measured by subtracting the final weight from the initial weight and was recorded.

Rectal Temperature: The rectal temperature was measured using a thermometer on a weekly basis by inserting the thermometer into the rectum of the rabbit.

Glucose level: The blood glucose level was measured on a weekly basis using a glucometer. This was done by withdrawing blood from the vein in the ear of the rabbit and a drop of blood was placed on the glucometer and the reading recorded.

Blood collection: Blood samples were collected at the end of the 30th day feeding restriction. Blood was collected from the ear veins of the rabbit early in the morning into plain bottles for hormonal analysis at the University of Ilorin Teaching Hospital (UITH). Rayto RT-2100C Microplate Reader was used for the analysis of hormones.

Statistical analysis: The data collected were subjected to Analysis of Variance using the Completely Randomized Deign (CRD) model (Steel and Torrie, 1980). Differences in mean were separated using Duncan Multiple Range Test (Duncan 1955).

RESULTS

The effects of feed restriction on performance and pregnant does were presented in Table 2. The weight gain of does on feed restriction was significantly ($p<0.05$) influenced such that early and late feed restriction had lower weight gain than the unrestricted does (control). Early feed restriction resulted in 75% pregnant does as compared with 25% pregnant does on both unrestricted and late restricted feeding regime. The effects of feed restriction on rectal temperature of does before and after mating were presented in Table 3. Does on early and late feed

restriction had lower ($p<0.05$) rectal temperature before mating than those on unrestricted feeding regime. The influence of feed restriction on rectal temperature was not significantly ($p>0.05$) different after mating. Rabbits on late feed restriction (Table 4) had lower ($p<0.05$) glucose level before mating than those on control and unrestricted feeding regime. The effects of feed restriction on hormonal profile of rabbit before and after mating were presented in Table 5. Does on early feed restriction had increased ($p<0.05$) FSH and LH before mating than late restricted and unrestricted feeding regime.

Table 2: EFFECTS OF FEED RESTRICTION ON PERFORMANCE AND PREGNANT DOES(%)

Parameters	Control	Early restriction	Late restriction	SEM
Initial weight(g)	1805.71	1806.41	1806.30	
Weight gain (g/rabbit/week)	33.3[a]	16.67[b]	16.0[b]	4.63
Final weight(g)	2072.11	1939.77	1974.30	15.54
Percentage number of pregnant does	25	75	25	

Means with different superscripts are significantly different ($p<0.05$), SEM: standard error of mean

Table 3: EFFECTS OF FEED RESTRICTION ON RECTAL TEMPERATURE BEFORE AND AFTER MATING

Treatment	Before mating	After mating
Control	37.68[a]	37.74
Early restriction	37.07[b]	37.94
Late restriction	37.06[b]	37.71
SEM	0.33	0.35

Means with different superscripts are significantly different ($p<0.05$), SEM: standard error of mean

Table 4: EFFECTS OF FEED RESTRICCTION ON GLUCOSE LEVEL OF RABBITS BEFORE AND AFTER MATING

Treatment	Before	After
Control	5.80[a]	6.82
Early	5.93[a]	7.16
Late	5.54[b]	6.30
SEM	0.24	0.87

Means with different superscripts are significantly different ($p<0.05$), SEM: standard error of mean

Table 5: HORMONAL PROFILE OF RABBITS BEFORE AND AFTER MATING

	Before Mating		After Mating	
Treatment	**FSH**	**LH**	**LH**	**FSH**
Control	12.82[b]	10.42[b]	12.47[a]	11.25
Early Restriction	14.63[a]	12.03[a]	11.18[b]	10.80
Late Restriction	13.31[b]	10.41[b]	10.75[b]	10.70
SEM	0.61	0.69	0.44	0.62

a,b means within a row with different superscripts are significantly different ($p<0.05$). FSH: Follicle stimulating hormone, LH: Luteinizing hormone, SEM: Standard error of mean

DISCUSSION

The decreased in weight gain indicated an early symptom of feed restriction period. The weight gain was proportionally reduced according to the time of feed restriction (Tumova *et al.,* 2007) due to decreased availability of nutrient and reduction in the rate of metabolism (Van Hanten and Cardoso, 2010). Reduced weight gain may also be to reduced content of gastrointestinal tract as well as reduction in the mass of skeletal muscle. Tumova *et al.* (2002) also reported that during the restriction period, weight gain in restricted rabbits was about 60-70% lower than in *ad libitum* fed rabbits.

The decreased in rental temperature of rabbits on restricted feeding regime is in a similar pattern to the body weight changes which reveals that feed restriction reduces body temperature. The difference in body temperature between rabbits on restricted feeding and control can in part be related to differences in metabolic rate (Tumova *et al*., 2007)

The blood glucose of rabbit on restricted regime did not fall appreciably below 5mmol and it is high enough to maintain cerebral function. The mechanism that set blood glucose at this level may not be explained however, growth hormone plays a role in setting a steady state during feed restriction (Gidenne *et al*., 2012). This decreased blood glucose before mating in rabbits on restricted feeding regime could be due to increased glucose utilization during muscular movement required for body metabolism (Van Hanten and Cardoso, 2010) and also conservation of energy. Animal will normally fall back to stored energy in the muscle (phosphor-creatinine) when there is reduction in blood glucose

.FSH and LH are not affected in the rabbit on restricted feeding regime. This could be because the restriction period is short and that reproductive hormones are unaffected if there is availability of nutrients for maintenance. The improvement in pregnancy rate of rabbits on early feed restriction regime is a reflection that short term intake limitation may improve occurrence of pregnancy.

It can be concluded that 15 day early restriction of feed before mating could improve pregnancy occurrence in rabbit and it is therefore recommended.

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Thermo-Physiological responses of Broiler Chicken fed Supplemental Vitamin E and C to Change in Diurnal Temperature

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Abstract: Thermo-physiological responses of broiler chicken fed supplemental Vitamin E and C to change in diurnal temperature was evaluated in this study. One hundred and twenty Abor acre broiler chicken were used for the experiment. At day-old, the birds were acclimatized for 7 days, after which the birds were randomly allotted into 4 treatment groups which was replicated three times with 10 birds per replicate in a Completely Randomized Design. Four experimental diets were formulated in which the first treatment (T_1) served as the control with no vitamin, second treatment (T_2) had 100mg of vitamin C per kg of feed, third treatment (T_3) had 200mg of vitamin E per kg of feed, and fourth treatment (T_4) had a combination of both vitamins E and C with 200mg and 100mg respectively per kg of feed. Data were collected on rectal temperature, pulse rate, respiratory rate of the chicken. Result shows that there were significant ($p<0.05$), positive and low correlations between the rectal temperature during the cool hours of the day and the rectal temperature during the hot hour of the day; between the respiratory rate during the cool hours of the day and the hot hours of the day and the pulse rate during cool hours of the day. Result showed that there were significant effects ($p<0.05$) of Vitamins C and E on the rectal temperature during the cool hour of the day, rectal temperature during the hot hour of the day, pulse rate during the hot and cool hours of the day and respiratory rate during the hot hour of the day. It was concluded that vitamin E slightly suppressed thermo-physiological response of the chicken. Also, vitamin C ameliorated the heat stress to a very minimal level during the hot hour of the day in all the observed parameters.

Keywords: Humidity, response, temperature, thermo-physiology, period

INTRODUCTION

Poultry species are particularly sensitive to temperature-associated environmental challenges, especially heat stress. It has been reported that modern poultry genotypes produce more body heat as a result of their increased metabolic activities (Sahin and Kucuk, 2003). One of the major challenges to poultry production in Nigeria and the warm humid tropics is heat stress on broilers. Under high temperature conditions, broiler birds alter their behavior and physiological homeostasis seeking thermoregulation, thereby decreasing body temperature (Panda, 2007). A recent study (Mack *et al.,* 2009) showed that birds subjected to heat stress conditions spend less time feeding, more time drinking and panting, as well as more time with their wings elevated, less time moving or walking, and more time resting. Animals maintain thermoregulation and homeostasis through several means when subjected to high environmental temperatures including increasing radiant, convective and evaporative heat loss by vasodilatation and perspiration (Mustaf *et al.,* 2009).

High temperature coupled with humidity is more stressful that it results in major economic losses to the poultry industry by reducing growth, egg production, hatchability and increasing mortality. Heat stress not only adversely affects production performance but also inhibits immune function (Rhoads *et al.,* 2013). To mitigate the effects of various stress factors antioxidants, play a major role by acting as radical scavengers. Various antioxidants may prevent and/or improve diseased states. These include the intracellular different levels of protection such as prevention, interception antioxidant enzymes and the dietary or oral supplements in the form of vitamin C, vitamin E, zinc and selenium (Knight, 2000). Thus, this study sought to evaluate the thermo-physiological responses of broiler chicken fed supplemental Vitamin E and C to change in diurnal temperature.

MATERIALS AND METHODS

The experiment was carried out at the Student Project Research Unit, Bora Poultry Farm, of Federal College of Animal Health and Production Technology, Moor plantation, Ibadan. Ibadan is located on longitude $03^0$51E, latitude $07^0$23N and altitude 650", in the humid zone of rain forest belt 0703.25 of south western Nigeria. Ecologically it is in the rainforest zone experiencing mean annual rainfall of 1220 mm and mean temperature of 26^0C with two seasons- the dry and wet season. One hundred and twenty Abor acre broiler chicken were used for the experiment. At day-old, the birds were acclimatized for 7 days, after which the birds were randomly allotted into 4 treatment groups which was replicated three times with 10 birds per replicate in a Completely Randomized Design. Four experimental diets were formulated in which the first treatment (T_1) served as the control with no vitamin, second treatment (T_2) had 100mg of vitamin C per kg of feed, third treatment (T_3) had 200mg of vitamin E per kg of feed, and fourth treatment (T_4) had a combination of both vitamins E and C with 200mg and 100mg respectively per kg of feed.

Data were collected on rectal temperature, pulse rate, respiratory rate of the chicken. Rectal temperature was taken using a digital rectal thermometer inserted into the cloaca and left in position for a minute, thereafter the reading was taken. Respiratory rate was recorded as the number of frequency of flank movements per 20 seconds and was calculated as breathes/ minute (Thwaites *et al*. 1990; Popoola *et al*.,2014). Pulse rate was also recorded as beats per seconds by placing the stethoscope on the thigh of the chicken to determine the rhythmic beats of the heart which and was calculated as number beats/ minute (Thwaites *et al*. 1990; Popoola *et al*., 2013a,b; 2014a,b). Temperature and relative humidity in the pen house were monitored across day periods (minimum temperature in the morning and maximum temperature in the afternoon) two to three days using a DeltaTrak thermo-hygrometer as reported by Popoola et al (2013a, b). As far as possible, this instrument was maintained (hung on the wall) inside the pen to provide a record of the temperature and relative humidity experienced by the chicken. These data were collected during the cool hours and hot hours of the day as reported by Popoola *et al* (2014a, b), three times in a week to avoid undue stress to the chicken.
Data subjected to analysis of variance (ANOVA), the relationship between the physiological parameters were tested using correlation analysis of SAS (2004).

RESULTS AND DISCUSSION

Table 1 shows the descriptive statistics of thermo-physiological traits of broiler chicken. The result shows less disparity (coefficient of variation) in means of rectal temperature and respiratory rate of the chicken during the cool hours of the day than those obtained during the hot period of the day. The coefficient of variation (CV) for pulse rate during the cool period of the day was higher than that of the hot period of the day. The smaller the coefficient of variation, the better the accuracy of the test and the smaller the error of the result (Acourene *et al*., 2001, Popoola and Oseni, 2018)

Table 2 shows the correlation analysis of thermo-physiological traits of broiler chicken. Result shows that there were significant ($p<0.05$), positive and low correlations between the rectal temperature during the cool hours of the day and the rectal temperature during the hot hour of the day; between the respiratory rate during the cool hours of the day and the hot hours of the day and the pulse rate during cool hours of the day. The result also shows that there were significant ($p<0.05$), positive and low correlations between rectal temperature during the hot hour of the day and the pulse rate during the cool hours of the day. It also showed that there were significant ($p<0.05$), positive and low correlation between the pulse rate during the cool hours of the day, respiratory rate during the cool hours of the day, pulse rate during the hot hour of the day, and the respiratory rate during the hot hours of the day.

Table 1: Descriptive statistic of thermo-physiological trait of broiler chicken variation

Variable	Mean	Standard deviation	Range	Coefficient of variation
RT am (^{0}C)	40.08	0.85	4.60	2.12
RT pm (^{0}C)	41.23	0.79	4.60	1.91
PR am (beats/min)	67.41	12.22	63.00	18.12
PR pm (beats/min)	80.60	17.03	108.00	21.13
RR am (breathes/min)	60.34	15.84	73.00	26.26
RR pm (breathes/min)	84.38	20.40	114.00	24.18

RT am – Rectal temperature during cool period of the day, RT pm – Rectal temperature during hot period of the day, RR am – Respiratory rate during cool period of the day, RR am – Respiratory rate during cool period of the day, RR pm – Respiratory rate during hot period of the day, PR am – Pulse rate during cool period of the day, PR am – Pulse rate during cool period of the day

Table 2: Correlation of thermo-physiological trait of broiler chicken

Traits	RT am	RT pm	PR am	PR pm	RR am	RR pm
RT am (^{0}C)		0.26	0.23	-0.02	0.15	0.12
RT pm (^{0}C)			0.19	0.08	-0.03	0.16
PRam (beats/min)				-0.01	0.32	0.03
PRpm (beats/min)					-0.06	0.29
RRam (breathes/min)						0.15
RRpm (breathes/min)						

RT am – Rectal temperature during cool period of the day, RT pm – Rectal temperature during hot period of the day, RR am – Respiratory rate during cool period of the day, RR am – Respiratory rate during cool period of the day, RR pm – Respiratory rate during hot period of the day

The result showed that there were significant effects ($p<0.05$) of Vitamins C and E on the rectal temperature during the cool hour of the day, rectal temperature during the hot hour of the day, pulse rate during the hot and cool hours of the day and respiratory rate during the hot hour of the day. However, birds fed with vitamin E had the highest value of rectal temperature during the cool hour of the day, while birds that were not fed Vitamin had the highest value of rectal temperature during the hot hours of the day. Also, birds fed supplementation of vitamin E and C had the highest value of pulse rate during the cool and hot hour of the day. Birds fed vitamin E had the highest value of respiratory rate during the hot hour of the day. However, there was no significant effect ($p>0.05$) of vitamin C and E on respiratory rate during the cool hour of the day. Several researchers have reported beneficial effects of Vitamin C supplements given either in diets and/ in drinking water. Supplements enhanced performance of broiler chickens with experimentally induced hypothyroidis, reduced stress related response (Pardue and Thaxton, 1984) and improved disease resistance of the birds (Amakye-Anim *et al.,* 2000).

CONCLUSION

Based on the findings of this study, it was concluded that vitamin E slightly suppressed thermo-physiological response of the chicken. Also, there was significant and positive correlation between pulse rate and respiratory rate which implied that increase in pulse rate will lead to corresponding increase in respiratory rate. The findings of the study also showed that vitamin C ameliorated the heat stress to a very minimal level during the hot hour of the day in all the taken parameters.

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Influence of *Vernonia amygdalina* flavonoid on performance of cockerels under elevated environmental temperature.

Abstract: Several environmental challenges have been implicated in poultry performance and products. These challenges limit successful poultry production. Different methods have been used to control heat stress such as vitamin C a synthetic source of antioxidant. Use of synthetic drugs generally has retention effect in the muscles of animals consuming it and on human indirectly overtime. Therefore there is need for a readily available source of antioxidant, which does not have adverse effect on the animals and human such as *Vernonia amygdalina.* This research is designed to determine the effects of *Vernonia amygdalina* flavonoid (VAF) on Performance of cockerel under elevated environmental temperature.

A total of 140 cockerels were randomly distributed into 5 treatment groups, replicated 4 times with 7 birds per replicate and given 0mls, 0.4g of Vit. C, 30mls, 60mls and 90mls of the flavonoid extract in 1 litre of clean water, designated as T1, T2, T3, T4 and T5 respectively. The birds were randomly assigned in a completely randomized design (CRD). Data were collected on, initial live weight, final and the body weight on every other day for the three weeks of the experiment, final weight, feed and water intake.

The result of the Phyto chemical screening of *Vernonia amygdalina* leaves showed that *Vernonia amygdalina* contained essential compounds, like flavonoid, essential as antioxidant. The performance showed improved general performance observed in birds given 30mls VAF.

Keywords; Vernonia amygdalina, flavonoids, performance, heat stress, antioxidants

INTRODUCTION

Poultry farming is one of the most profitable businesses in the world which is equally lucrative and legitimate (Yalcin *et al.,* 2001). Poultry represents one of the major sources of animal protein in both developed and developing countries like Nigeria. This is because it can be reared on a commercial scale, small scale and backyard basis, which make it accessible and affordable by low income earners especially in developing countries to meet the protein requirement of the human population. As a contingent plan, the search for more economical source of animal proteins makes cockerel production attractive (Lin *et al*., 2010). However, heat stress is a major limiting factor of high productivity, especially in tropical environments At a temperature exceeding 27^{o}C, birds begin to feel uncomfortable and start panting whereas and at above 30^{o}C proper heat release becomes highly difficult especially when high temperatures are associated with high air humidity. This is because birds are homeothermic in nature and their thermoneutral zone lies between 18 and 36°C. Since time immemorial, man has been in search of remedies for pain, fever and inflammation which are the commonest of human diseases. Analgesic as well as inflammatory and antipyretic drugs are frequently used as be remedy (Pardue and Thaxton, 1982).

Heat stress is a physiological condition when the core body temperature of a given species exceeds its range specified for normal activity, which results from a total heat load (internal production and environment) exceeding the capacity for heat dissipation and this prompts physiological and behavioral responses to reduce the strain. Heat stress has several serious economical adverse effect on the general performance and of livestock, such as reduced feed intake, weight gain e.t.c (Abu -Dieyeh, 2006). Heat stress can enhance the formation of reactive oxygen species (ROS), which can cause oxidative injury due to lipid peroxidation and oxidative damage to proteins and DNA. The activities of superoxide dismutase (SOD), catalase (CAT) and the levels of malondialdehybe (MDA) were increased in the liver of cockerel chickens exposed to high temperatures. It has been stated that compounds sourced from plants are cheaper, safer and often readily available compared to synthetic drugs used as antioxidants (Soladoye *et al*., 2012), such as vitamin C, which could be retained in the tissue of animals when used over time. Some recent studies have also revealed that supplementation of natural source of antioxidant is a positive means of minimizing the adverse effects of heat stress in farm animals. This could be due to their mopping up action on the free radicals produced by heat stress. Sahin *et al.* (2008) also

investigated in another study on the effect of antioxidant properties of tomato powder to enhance the oxidative potential of quail muscles reared under elevated summer temperature. Propolis which is a strong antioxidant has also been documented to enhance the production and quality of egg in poultry reared under high environmental temperature (Soven, 2008). Among many other natural antioxidants, flavoniods are getting noticeable as a result of their multifunctional biological activities (Middleton *et al., 2000*). Kambohe*t at.,* (2013) conducted a research using genistein (a soy flavoniod) and hesperidin (a citrus flavoniod) at dosage of 5mg/kg to 10mg/kg and 20mg/kg which are 2 (two) naturally occurring plant compounds belonging to phytochemical sub group flavoniods. The results showed that genistein and hesperidin improved the weekly performance of broiler at the finisher period and oxidative biomarkers were also positively influenced. *Vernonia amygdalina* (V. amygdalina), is a member of the Asteraceae family that grows in tropical Africa. The aqueous extract of the leaves is used traditionally as treatment for anemia, nausea, diabetes, loss of appetite, dysentery, and other gastrointestinal tract problems in Nigeria. A number of researchers have isolated and characterized some chemical compounds with potential biological activities from the leaves of *Vernonia amygdalina* which include flavonoid like luteolin, luteolin 7-0-glucosides and luteolin- 7-0- glucuronide. (Igile *et. al., 1994*). Phytochemical analysis of *V. amygdalina* revealed high levels of flavonoids, saponin, tannins, and alkaloids. Also, Iwalokun *et. al.,* (2006) reported the antioxidant effect of aqueous extract of *Vernonia amygdalina* leaves against acetamoninophen-induced hepatotoxicity and oxidative stress in mice. Therefore the objective of this study is to evaluate and determine the effect of *Vernonia amygdalina* flavoniod (mixture of luteolin, luteolin-7-0 glucoside and luteolin-7-0 glucoronide) on the growth performance of cockerel reared under elevated environmental temperature.

MATERIALS AND METHOD

Experimental site: The experiment was conducted during the dry season at the Kwara State University Teaching and Research farm, Malete, Kwara State, a guinea savannah ecological zone of Nigeria with average daytime temperature of 23-36^{o}C and relative humidity of 60-80%, with latitude 8.7082^{o} N and longitude 4.4723^{o} E

Animal Feeding and Management: 140 Rhode Island white cockerels of 3 weeks were purchased from a reputable farm in Ilorin for the experiment. The weight of the birds ranged 0.5-0.6kg. The birds were acclimatized for 14days in a battery caging system for physiological adjustment to the environment. During this period, the cockerel were administered with medications such as glucose, vitamin C, molasses, Starter mash was fed to the birds in relation to their body weight gain per day with *ad libitum*. Clean water supply from the beginning till the end of the experiment which lasted for 3 weeks

Collection and Processing of Plant Material: The *Vernonia amygdalina* leaves was collected fresh from Osere area, Ilorin. Kwara State. The leaves that were collected were rinsed with distilled water and then air dried at room temperature (23^{o}C) for 10days. The dried leaves were then blended into a powdery form with an electronic blender and kept in an air tight container. The blended portion weighed 900g.

Chemical Analysis: The proximate analysis of *Vernonia amygdalina* sample was determined chemically according to the official methods of analysis described by Association of Official Analytical Chemist (AOAC, 18th Edition, 2005). The *Vernonia amygdalina* leaves extract as also subjected to phytochemical screening. Qualitative test were carried out on the powered sample of *Vernonia amygdalina* using standard procedures as described by Sofowora (1993), Trease and Evans (1989) and Harborne (1973). Flavonoid component was extracted, filtrate was concentrated using rotary evaporator. Crystallization of sample was carried out using gas chromatography from Agilent USA hypherated to a mass spectrophotometer (5975C) (GCMSD), Ms Solution software was used to control the system acquire the data; Identification of the compounds was carried out by comparing the mass spectra obtained with those of the standard mass spectra from NIST library (NISTII). Freeze drying/ lyophilizing of the sample for storage till when re-constituted to its original form for experimental purpose. Material used was Topt-10B Lyophilizer from TOPTION

Administration of the Extract and Experimental Design: Birds on treatment 1 received ordinary clean water, 0.4g of vitamin C was added to 1000mls of water for birds in Treatment 2. Treatments 3, 4 and 5 received 30, 60 and 90 mls of re-constituted flavonoid component of *Vernonia amygdalina* leaf extract respectively in1000mls of water. The extract was administered every other day. The140 birds were randomly allotted into

five treatments with four replicate consisting of seven birds per replicate using completely randomized design (CRD).

The poultry pen was covered with taponing to reduce minimally the wind effect and enhance averagely stable temperature. Also, the sides of the cages were also covered with big sacs. Continuous artificial source of heat was supplied for 6 hours from morning till afternoon at the same time throughout the experimental period to attain a temperature 40±2 ^{o}C . The temperature and humidity of the pen were monitored using digital hygrometer and thermometer throughout the experimental period. Humidity was also maintained between 60-72%.

Measurement of performance parameters

Body weight and body gain (gram/bird): At the 2nd week and 3rd week of the experiment, all the birds of each treatment weighed as group using a 50 kg-balance. The total weight is divided by the number of weighed birds. The average body weight gain was calculated by subtracting the average weight at the beginning of the experiment (4-week old broilers) from the average weight at the end of the experiment (8-week old).

Feed intake (gram/bird): Feed intake is calculated for each treatment. At the end of the experiment, the residual amount of feed was weighed and subtracted from the known weight of feed at the beginning of experiment. The product figure is divided by the total number of birds. Feed conversion ratio and Mortality rate (%) were also determined.

.**Statistical Analysis:** All data collected was analyzed using one way analysis of variance (ANOVA) and analysis was determined using SPSS software package, the mean were separated using Duncan Multiple Range Test (Duncan 1955) at 5% significant level.

RESULTS AND DISCUSSION

Table 1: Proximate composition of *Vernonia amygdalina* leaves

PARAMETERS	VALUES (%)
Crude protein	23.68
Crude fiber	7.33
Moisture	6.68
Ether extract	0.37
Ash	8.90
NFE	53.04
Caloric value	1295.19KJ/mole

NFE- Nitrogen Free Extract

Table1 shows the result of proximate analysis of *Vernonia amydalina* leaves. This result shows that *Vernonia amygdalina* contain certain amount of crude protein which is (23.68%), crude fibre of (7.32%), moisture of (6.68%), crude fat of (0.37%), ash of (8.90%), carbohydrate of (53.03%) and caloric value of (1295.19KJ/mole). (Udochukwu*et al*., 2015) reported much higher crude protein (35.7%) in *Vernonia amygdalina* leaves. The crude fibre (7.90%), crude fat (0.48%), ash (8.98%) and moisture (6.80%) the content he reported by were also slightly higher than the values obtained in this study. The values obtained in this study are however higher than the value reported by Igile *et al.,* (1995). However, the result might vary due to geographical location, stage of plant, soil types and weather condition of the place the plant source were been derived .

TABLE 2: Phytochemical screening of *Vernonia amygdalina* Leaves

Phytoconstituents	Qualitative Abundance
Saponin	+++
Flavoniod	++
Tannin	+++
Alkaloid	++
Phenol	+++
Steroid	++
Glycoside	++
Anthraquinone	++

Present at low levels (+), present at moderate levels (++), Present at high level (+++)

Table 2 shows the result of the Phyto chemical screening of *Vernonia amygdalina* leaves. It was observed that *Vernonia amygdalina* contained essential compounds, saponin (+++) which is highly present that is higher level of saponin, flavonoid (++) which is present at moderate level it is not to high and it is not too low, tannin (+++) also present in higher level, alkaloid (++), phenol (+++), steroid (++), glycoside (++), anthraquinone (++). The presence of these compounds implies that *Vernonia amygdalina* leaves could be utilized as an unconventional source of antioxidant to alleviate heat stress effect on the performance characteristics of cockerels and also a nutritional valuable and healthy ingredient for poultry. Antioxidant activity of the compounds has also been reported (Udochukwu *et al.,* 2015). Their antioxidant activity was higher than the conventional antioxidant such as ascorbic acid, which is also present in large amount in Vernonia leaves (Igile *et al.,* 1995). An examination of the phyto chemicals of Vernonia species affords the opportunity to examine a range of fairly unique compounds (Getahun, 1976).

TABLE 3: Growth perfomance of cockerels given flavonoid of VALE under heat stress

PARAMETERS	T_1 (Control)	T_2 (0.4g of Vit.C)	T_3 (30mls)	T_4 (60mls)	T_5 (90mls)	SEM
Water intake (mls)	417.64^{ab}	483.09^{a}	486.72^{a}	470.36^{ab}	431.86^{b}	16.14
Initial Body wt (g)	105.00	112.50	112.50	112.50	112.50	5.39
Final Body wt (g)	357.50^{ab}	347.50^{b}	372.50^{a}	355.00^{ab}	342.50^{b}	19.92
EviscératedBodywt (g)	118.48^{a}	113.20^{ab}	103.38^{ab}	89.93^{b}	100.25^{ab}	0.35
Mortality (g)	2.50^{a}	1.00^{b}	1.25^{ab}	1.75^{ab}	1.00^{b}	0.35
Weight Gain (g)	$252^{a}.00$	234.37^{ab}	260.81^{a}	243.78^{b}	230.65^{ab}	37.59
Feed intake (g)	91.05	81.97	84.05	78.06	84.05	4.46
FeedConversion Ratio	0.52	0.41	0.36	0.41	0.45	0.05

Table 3 shows growth performance of cockerels given flavonoid of VALE under heat stress. All the performance parameters evaluated were not significantly influenced by the experimental material except the water intake, final body weight, weight gain, eviscerated body and mortality. The result of this research is in collaboration with the findings of (Durunal *et al.* 2011) who reported an improvement in the growth performance of birds feed with *Vernonia amygalina* leaf. This enhanced growth performance is observable in highest final body (372.57g)

and lowest FCR (0.35). Lower FCR signifies the ability of birds to convert feed consumed to meat. This is in agreement with the report of Olobatoke and Oloniruha (2009) that inclusion of bitter leaf powder in cockerel feed significantly improved FCR. This could be that VALE enhanced the gastrol intestinal enzymes causing improvement in digestion and assimilation of nutrient (Adaramoye *et al.,* 2009). The water intake recorded in this study ranged from 427.64mls to 486.72mls. The lowest water intake was observed in birds under the control group which was not significantly different from that of treatment 5.

The eviscerated weight of birds in treatment 1,2 and 4 are not significantly different compared to that of birds in the control while eviscerated weight of birds in treatment 3 (89.93g) were significantly decreased compared to the birds in the control group (118.48g) inclusion of bioflavonoid of VALE did not positively influence the eviscerated body weight. The reason for this is unknown at the time of this response. The result of this finding did not support the claim of Odomedela *et al.* (2013) who reported that the inclusion of VAL in broiler diets lead to improvement in dressed weight and carcass quality. The highest mortality value is observed in birds under the control group (2.50%) while the lowest in observed in birds in T1and T4 (1.00%) the high mortality recorded in the control group could be as a result of oxidative stress which increased reactive oxygen species production and increased lipid decreasing the survival of stressed cells and subsequent mortality of such birds.

CONCLUSION AND APPLICATION

Flavonoid sourced from VALE can be used to improve the performance of heat stressed cockerels. Further research can be carried out to determine its use with other synthetic antioxidants.

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Effect of *Kigelia africana* Based Diets on Semen Characteristics 0f Rabbits

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Abstract: An experiment was conducted to investigate the antioxidant potentials as well as the effect of feeding graded levels of *Kigelia africana* fruit and leaf meals on semen characteristic of rabbit. The free radical scavenging activity of both of both fruit and leaf on the reduction of 1, 1-diphenyl-1-picrylhydrazyl (DPPH), and total antioxidant potential (TAP) were both compared with a standard, ascorbic acid. The antioxidant potentials (DPPH and TAP) of both fruit and leaf were significantly ($p<0.05$) higher than that of the standard. The inclusion of fruit meal significantly ($p>0.05$) increased the percentage active motile, live sperm and sperm concentration. In conclusion, Kigelia africana fruit is richer compared with the leaf. The findings from this work revealed that *Kigelia africana* fruit and leaf meals can be used as natural antioxidant to boost reproduction in rabbit.

Key words: Antioxidant, *Kigelia africana*, Sperm, Rabbit

INTRODUCTION

Kigelia africana tree which is commonly called Sausage tree or Cucumber tree due to its long sausage-like fruit belongs to the family *Bignoniaceae*. Its fruits weighs between 4 - 10 kg and hangs from a long and fibrous stalk, it can be found in open woodland (Owolabi *et al*., 2007; Owolabi and Omogbai, 2007). In folklore, the fruit of *Kigelia africana* represents a symbol of fertility (Burkill, 1985), the fruits and flowers are usually mixed with alcohol or water by traditional healers for treatment of fertility related problems among women and men of child bearing age (Ogbeche *et al*., 2002). All the functional properties attributed to *Kigelia africana* plant have been associated with the presence of numerous phytochemicals such as flavonoids, naphthoquinones, tannins, steroids, saponins and so on (Conn, 1995 and Khan, 1999). The combined effects of these phytochemical compounds in this plant makes it function as an antioxidant, anti-inflammatory, antiseptic, antibacterial and antifungal. Plants that have been identified to possess these properties can maintain and also improve the reproductive as well as general health status of the animals. This study was however carried out to investigate the antioxidant potentials and effect of feeding graded level of *Kigelia africana* fruit and leaf in rabbit production.

MATERIALS AND METHODS

Source and Preparation of *Kigelia africana* Meals: The *Kigelia africana* fruit and leaves were collected from Ilorin. The fruits and the leaves of the plant were air-dried and milled to powdered form. The milled samples were taken to the laboratory for analysis. The analyses were conducted at the Central Research Laboratory, Tanke, Ilorin. The samples were replicated in three places for antioxidant activities following the methods described by Larrauri *et al*., (1999) and (Sanchuz-Moreno *et al*., 1998). A total of 36 matured bucks were randomly allotted to nine dietary treatments consisting levels of fruit and leaf meals of *Kigelia africana* plant independently fed at 0%, 5%, 10%, 15% and 20% inclusion. Rabbits were housed individually and had access to feed and water *ad libitum*. Semen was collected with the help of an improvised artificial vagina (which was maintained at 45°C) and a teaser doe as described by Ewuola *et al*., (2014). The ejaculate from each buck was analysed immediately after collection for semen volume, semen colour, pH, sperm concentration, mass motility, mass activity, and sperm morphology.

STATISTICAL ANALYSIS: All data obtained from antioxidant tests were subjected to a *t*-test using SAS, 2012, and data obtained for semen characteristics were subjected to statistical analysis using the analysis of variance (ANOVA) procedure following a Factorial Design (SAS, 1999) and the levels of significance was determined using the Duncan's Multiple Range Test.

RESULTS AND DISCUSSION:

The results of the DPPH (1, 1-diphenyl-1-picrylhydrazyl) antioxidant activity and total antioxidant potentials (TAP) of *Kigelia africana* fruit and leaf are presented in Table 1. There was a significant difference ($P<0.05$) in the values obtained for DPPH antioxidant test in the fruit and leaf, with fruit reporting a significantly ($p<0.05$) higher mean values at all DPPH concentrations except at 50 where there was no difference between fruit and leaf. However, the mean DPPH antioxidant values of fruit and leaf were higher when compared with the standard vitamin (ascorbic acid). More so, the fruit presented a higher TAP compared with that of the leaf. It was revealed from the present study that the fruit of *Kigelia africana* can be regarded as a potential anti-oxidant based on the results of total anti-oxidant potential and DPPH anti-oxidant test in which fruit showed a better result compared with the leaf. However, both fruit and leaf had better antioxidant properties than the conventional source (ascorbic acid). This anti-oxidant potential of KA can be attributed to the numerous phytochemicals present in it. Some phytochemicals have been reported to be more effective than Vitamin C and E (Dai and Mumper, 2010). They inhibit oxidation through a variety of mechanisms and their protective effects in biological systems are ascribed to their capacity to transfer free radical electrons (Middleton *et al*. 2000) as well as scavenge or prevent the production of free radicals and reactive oxygen species, which are the major cause of oxidative stress related diseases. The percentage of active motile sperms increased with increasing levels of the treatments, however, there was no significant difference ($p>0.05$) in the results obtained for fruit and leaf at all the inclusion levels in sperm concentration except at 15% and 20% inclusions. At 15%, it was significantly higher in fruit groups compared with those on the leaf. Meanwhile, it was significantly higher in leaf group at 20% inclusion. Comparing fruit and leaf impacts on live sperm percentage however, no significant difference was observed between them. There was an increasing percentage live sperm as the level of treatments increased for both fruit and leaf, with the control presenting the least live sperm percentage. This result is similar to that obtained by Yousef *et al*. (2003) who fed rabbit bucks with water supplemented with vitamin E (as antioxidant) and reported a significant improvement in semen volume and sperm concentration. The higher sperm motility observed with dietary inclusion of KA fruit and leaf in this study is in line with the observations of Eskenazi *et al*. (2005) who reported that a high intake of antioxidant was associated with better sperm motility in man.

CONCLUSION:

Based on the result obtained from this study, it can be concluded that *Kigelia africana* fruit and leaf meal can be used as a potential natural sources of antioxidant agents in rabbit feed in order to boot their reproductive performance.

Application: *Kigelia africana* fruit meals can be used in rabbit diet up to 15% inclusion to boost the semen quality. However, the leaf meals can be used up to 20% inclusion without any negative effects.

Table 1. Composition of Experimental Diet Supplemented with *Kigelia africana* Fruit and Leaf Meals

Ingredients	Control	5% fruit	10% fruit	15% Fruit	20% Fruit	5% Leaf	10% leaf	15% leaf	20% leaf
Maize	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
SybMeal	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
WheatOffa	12.00	14.00	10.00	10.00	5.00	14.00	12.00	9.00	11.00
Maizeoffal	7.00	5.00	5.00	7.00	11.00	10.00	5.00	10.00	5.00
Ricehusk	27.00	22.00	21.00	14.00	10.00	21.00	19.00	12.00	10.00
Fish Meal	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
KAFM	0.00	5.00	10.00	15.00	20.00	5.00	10.00	15.00	20.00
Salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
BoneMeal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Lysine	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Premix	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

%CP	15.94	16.06	16.36	16.61	16.98	15.80	15.62	15.59	16.23
%CF	11.62	11.71	11.88	11.80	11.50	10.08	10.12	10.28	10.32
ME (Kcal/kg)	2,417.10	2,366.83	2,286.66	2,247.39	2,212.82	2,349.67	2,308.83	2,200.50	2,200.16

Table 2: Anti-oxidant Activities of *Kigelia africana* Fruit and Leaf Meals

DPPH conc	KAF	KAL	Vit C	(P<0.05)
10	131.05±1.82 [a]	99.08±3.35[b]	73.497	0.001
20	135.45±2.47 [a]	108.68±1.44[b]	79.018	0.001
30	135.18±1.75 [a]	118.23±1.56[b]	83.067	0.002
40	136.80±2.26 [a]	123.45±2.25[b]	87.485	0.014
50	134.75±3.38	128.39±0.22	89.571	0.134
TAP	2320.1±32.35[a]	2020.7±44.93[b]	-	0.001

*KAF= *Kigelia africana* fruit, KAL= *Kigelia africana* leaf, TAP= total anti-oxidant potential, DPPH=1, 1-diphenyl-1-picrylhydrazyl, Vit= Vitamin a, b, c – means with different superscript are significant along the row

Table 14.0: Semen Analysis of Rabbit Bucks Fed *Kigelia africana* Fruit and Leaf Meal

Treatment Types	Volume (ml)	Colour	pH	Motility (%)	Active motile (%)	Concentration (×10⁶)	Live/Dead (%)
Fruit	1.83	Creamy white	7.70	72.75[a]	70.25	146.50	82.10[b]
Leaf	1.75	Creamy	7.74	70.70[b]	68.75	146.25	84.25[a]
SEM	0.03	-	0.01	0.50	0.56	1.65	0.73
Treatment Levels (%)							
0	0.68[b]	Creamy white	7.60[c]	61.25[d]	63.75[c]	88.75[c]	72.50[d]
5	2.01[a]	Creamy white	7.70[b]	65.63[c]	65.63[c]	127.50[b]	77.50[c]
10	2.00[a]	White	7.80[a]	73.13[b]	70.00[b]	131.88[b]	86.50[b]
15	2.11[a]	Creamy white	7.60[c]	78.63[a]	71.88[b]	192.50[a]	91.88[a]
20	2.13[a]	White	7.60[c]	80.00[a]	76.25[a]	191.25[a]	87.50[b]
SEM	0.17	-	0.05	2.77	3.53	10.43	4.58
Treatment* Levels	NS	-	NS	NS	S	S	S

a, b, c – means with different superscript are significant along the row, SEM=Standard Error of Mean

Table 3: Interaction between Treatment Levels and Types of meal on sperm characteristics of Rabbit Bucks Fed *Kigelia africana*

		Treatment					
Parameter	Treatment Types	0%	5%	10%	15%	20%	SEM
Active motile	Fruit	63.75[d]	65.00[cd]	72.50[abc]	73.75[ab]	74.25[a]	1.61
	Leaf	63.75[d]	66.25[bcd]	67.50[bcd]	70.00[abcd]	73.25[a]	1.61
Sperm conc	Fruit	88.75[d]	132.50[c]	136.25[c]	207.50[a]	167.50[b]	5.22
	Leaf	88.75[d]	122.50[c]	127.50[c]	177.50[b]	215.00[a]	5.22
Live sperm	Fruit	72.50[e]	76.25[de]	85.50[abc]	92.50[a]	83.75[a]	1.57

Leaf	72.50^{e}	78.75^{cde}	87.50^{ab}	91.25^{ab}	91.25^{ab}	1.57

a, b, c – means with different superscript are significant along the row, SEM=Standard Error of Mean

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Survival and Biophysical Changes of Three Common Species of Land Snails in Edo and Delta States During A 12-Week Aestivation

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Abstract: The experiment was conducted to determine the changes in the biophysics during starvation in three common species of land snails identified in Edo and Delta States. A total of 252 matured healthy snails comprising of three species (*Archachatina marginata*, *Archachatina papyracae* and *Achatina fulica*) were used. A completely randomized design was used in a 3 x 4 factorial arrangement. At the end of two weeks acclimation period, feed and water were withdrawn for 4, 8 and 12 weeks. Result shows that *A. marginata* has significantly ($P<0.05$) highest initial liveweight. *A. papyracae* had the least weight but was not significantly ($P>0.05$) different from the weight of *A. fulica* used in the study. During the 12 weeks of starvation, *A. papyracae* recorded the highest mortality rate of 24.58 %. *A. marginata* and *A. fulica* respectively recorded mortality rate of 9.05 and 6.52 %. *A. marginata* reflected two stages of major weight decline; 2nd and 9th weeks. *A. papyracae* and *A. fulica* however declined conspicuously only at the 1st week. The weight of the muscular foot which constitutes the edible portion of the three species decreased between 0W, 4W and 8W. There were no significant differences in weight in each of the three species. 12W aestivation eventually resulted in further and significant weight loss. The aestivation lengths did not affect the shell weight in the three species, except *A. marginata* with significant decline at the 12W. This study indicates that *A. marginata* and *A. fulica* are bigger in size and more tolerant to extended starvation than *A. papyracae*.

Key Words: Biophysical, aestivation, *Archachatina marginata*, *Archachatina papyracae*, *Achatina fulica*

INTRODUCTION

Land snails usually exhibit cycles of activity and dormancy (aestivation or hibernation). The transition of these two states is accompanied by a range of behavioural, morphological and physiological responses to ensure their survival under adverse environmental conditions. The humid rainforest climatic condition of Edo and Delta States, Nigeria provides favourable factors for the proliferation of different species of snails. When conditions becomes unfavourable; naturally or otherwise – resulting in starvation, they aestivate. Besides, snails are perceived to be hardy. It is therefore a common practice to leave snails unfed (starved) for days. This is also seen when food is limited and vegetations are scarce particularly during the long dry season in the tropics. During this period, snails aestivate as a means of coping with the unfavourable conditions.

The study was therefore carried out to examine the biophysical changes as well as the tolerance and survivability of three species of land snails common in both Edo and Delta States, Nigeria, during aestivation.

MATERIALS AND METHOD

Experimental Site: The research work was carried out at the University of Benin Teaching and Research Farm, Benin City, Edo State, Nigeria. The farm is located within the tropical rainforest vegetation zone of southern Nigeria lying between longitude 5ºE and 6º 42'E and latitude 5º 45 and 7º 34'N of the equator (FAAN, 2016). Edo is bounded by Kogi. Anambra, Delta and Ondo States on the North, East, South and West respectively. The climate of Edo is humid

Materials: From a preliminary survey in markets in Edo and Delta States, three common species of land snails were identified. These include; *Archachatina marginata*, *Archachatina papyracae* and *Achatina fulica*. A total number of 252 healthy snails comprising of the three species were purchased from Edo and Delta State. Well ventilated plastic basket, weighing scale, vernier caliper were used. Feed and water were made available two weeks prior the experiment (during the period of acclimation)

Experimental Design and Procedure: The experiment was laid out in a completely randomized design (CRD), in a 3 (species) x 4 (starvation length) factorial arrangement. Seven snails constituted each of the replicates

The experiment was conducted between the months of December, 2015 to March, 2016. Well ventilated plastic baskets, (40 cm x 25 cm x 20 cm with cover) were prepared and filled with humus soil to a depth of 5 cm and

moistened with water. Snails were weighed and allotted based on sizes. This was done using an electronic weighing scale and randomly allocated to the treatment groups.
Optimum hygiene was ensured by removing excreta and left-over feed on a daily basis and the soil moistened as required. Feed (layers mash, fresh pawpaw leaves, plantain leaves, cocoyam leaves, pawpaw fruit and water melon) were provided during the acclimation period, watering of the soil was stopped two days to the end of acclimation period.
At the end of the two weeks acclimation period, the live weight of the snails (fed weight) were taken; feed and water were also withdrawn to induce starvation. Snails on 0W were immediately dissected, haemolymph collected, and the foot (mass) also obtained. Similar data were collected from snails in treatment group 4W, 8A and 12A after 4, 8 and 12 weeks of starvation respectively.
Data Collection: The data collected on the biophysical parameters of snails were weight gained measured weekly with a sensitive weight scale, shell thickness, shell weight, and mass. Mortality rate was also recorded.
Statistical Analysis: All data obtained were subjected to two way analysis of variance and the means were separated using Duncan multiple mean comparison. The analysis was carried out using Genstat (2006), 12th edition statistical package.

RESULTS AND DISCUSSION

A. marginata, *A. papyracae* and *A. fulica* were the common species of snails observed to be commonly consumed in Edo and Delta States. In this study, epiphragm formation was observed while the snails were subjected to starvation. According to Arad and Avivi (1998), the secretion of a calcareous epiphragm is one of several water preserving mechanisms in land snails (Arad and Avivi, 1998) and accounts for up to 20 % of their resistance to evaporative water loss during dormancy (Egonmwan, 2012).
Figure 1 shows the mortality rate of the three species of land snails in Edo and Delta States over the 12 weeks starvation length. *A. papyracae* recorded the highest mortality rate of 24.58 %. *A. marginata* and *A. fulica* respectively recorded mortality rate of 9.05 and 6.52 %.

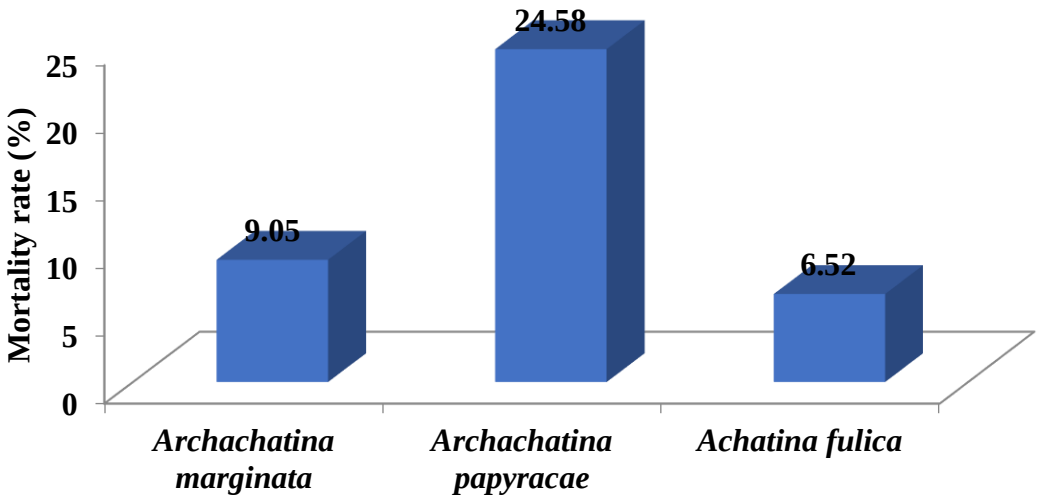

Figure 1: Mortality rate of three (3) common species of land snails in Edo and Delta States during starvation

The biophysical responses of three (3) species of snails (*Archachatina marginata*, *Archachatina papyracea* and *Achatina fulica*) in Edo and Delta States during 12 weeks starvation are shown in Tables 1. The initial and abrupt decline in liveweight (first week in *A. papyracae* and *A. fulica* and up to the 2nd week in *A. marginata*) due to starvation (Figure 2) could be attributed to dehydration.

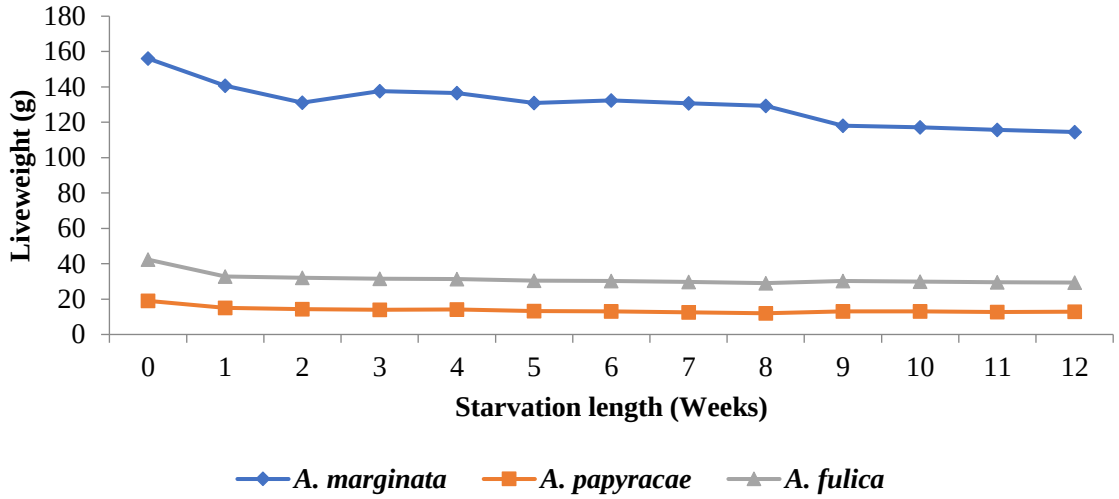

Figure 2: Trend in liveweight of three species of snails in Edo and Delta States during starvation treatment

Cumulatively, Emerson and Duer (1967) reported weight reduction of 62 % in *Littorina planoxis*. About 50 % loss in weight was also reported by Russel-Hunter and Eversole (1976) after 132 days of starvation in the fresh water pulmonate snail, *Helis onatrivolvis*. Lukong and Onwubiko (2004) reported a live weight decline of 44.60 % in *Achatina achatina* aestivated for 4 months. Omoyakhi (2007) and Abdusamad *et al*. (2010) reported a live weight decline of 52.40 % and 35.60 % respectively in *A. marginata* after six weeks of aestivation.

A. marginata showed significant (P<0.05) differences with aestivation lengths but *A. papyracae* and *A. fulica* reflected no significant change in Liveweight at 0, 4, 8 and 12 weeks starvation lengths.

Table 1: Changes in the biophysical parameters in three (3) common species of land snails in Edo – Delta State during starvation

SPECIES	Starvation length	Biophysical variables			
		Liveweight (g)	Muscular foot (g)	Shell weight (g)	Shell thickness (mm)
A. marginata	**0W**	156.07_{A}	96.80_{A}	45.00_{A}	1.17_{AB}
	4W	136.53_{B}	52.50_{B}	43.03_{A}	0.90_{AB}
	8W	129.27_{B}	51.00_{B}	43.77_{A}	1.42_{A}
	12W	114.50_{C}	37.33_{C}	30.73_{B}	1.23_{A}
A. papyracae	**0W**	19.00_{EF}	14.30_{E}	4.23_{D}	0.85_{AB}
	4W	14.06_{F}	6.70_{EF}	5.93_{CD}	0.62_{B}
	8W	11.99_{F}	4.70_{F}	3.73_{D}	1.21_{A}
	12W	12.88_{F}	5.33_{F}	4.33_{D}	1.04_{AB}
A. fulica	**0W**	42.33_{D}	27.03_{D}	9.00_{CD}	1.19_{AB}
	4W	31.34_{DE}	10.53_{EF}	7.83_{CD}	0.97_{AB}
	8W	29.04_{DE}	12.20_{EF}	13.43_{C}	1.08_{AB}
	12W	29.27_{DE}	11.83_{EF}	14.10_{C}	1.41_{A}
±SEM		4.50	2.54	2.59	0.17

$_{ABC}$ Means with different subscripts within the same row differ significantly (P<0.05)

At 12W, *A. marginata* eventually resulted in further and significant weight loss, presumably due to dehydration between 0W and 4W and consumption of endogenous food reserve thereafter. In *A. papyracae* and *A. fulica*, after the initial decline between 0W and 4W, the weights at subsequent starvation lengths, no significant weight loss was observed suggesting better resistance of these species than *A. marginata*. The weight of the muscular

foot which constituted the edible portion of the three species decreased between 0W and 4W. Between 4W and 8W, there were no significant differences in weight.

The respective weight of shell in *A. marginata*, *A. papyracae* and *A. fulica* represented 28.83 %, 22.26 % and 21.26 % at pre starvation which tend to correlate directly with body weight of the respective species and shell thickness. The starvation lengths did not affect the shell weight in the three species, except *A. marginata* with significant decline at the 12W. The thickness showed similar trend indicative of the larger the body weight, the thicker the shell. The significant decline in shell weight at the 12th week starvation length in *A. marginata* may be connected with calcium and potassium mobilization from the shell for metabolic processes and epiphragm formation at prolonged starvation length as it was observed that epiphragm formation was occasionally been replaced; similar but no significant decline was observed with *A. marginata* aestivated for 12 weeks (Omoyakhi *et al*., 2015). The result showed 26.73 and 26.52 % for *A. marginata* aestivated for 6 and 12 weeks lengths of aestivation. Adu *et al*. (2002) in a study of performance and carcass analysis of *A. marginata* also reported a range of 24.94 to 25.48 % and Omoyakhi (2007) similarly reported a range of 27.56 and 30.56 %. No conclusion?

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Gross anatomy and histopathological parameters of some internal organs of broilers fed cassava grit-based diets

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Abstract: Histopathology studies are useful to evaluate the pollution potential of various toxicants, which do not cause animal mortality over a given period, but are capable of producing considerable original damage. This study was conducted to investigate effect of feeding cassava grit on some internal organs of broilers. Five diets were formulated to replace maize at 0, 25, 50, 75 and 100% constituting diets 1 – 5. The feeds were fed to broilers for seven weeks. At the end of seventh week, two birds per replicate were selected for gross anatomy and histopathological analysis. Organs prepared for histological analysis were liver, kidney, intestine, lung and spleen. Result of gross anatomy showed that all the organs examined were normal. The multi focal intestinal haemorrhages was discovered in the kidney of broilers fed 0% cassava based diet, however, this histological change reduced with increasing cassava grit in the diets. Kidney was not adversely affected by dietary treatments. Histopathological parameters of liver, lung and spleen of broilers fed cassava based diets were better than values recorded by birds fed the control diet. Inclusion of cassava in the diet of broilers did not adversely affect the gross anatomy and tissue histopathology of the internal organs considered.
Keywords: broilers, cassava, gross anatomy, histological change, hyperplasia

INTRODUCTION

All tissues of cassava contain cyanogenic glycosides, and an acyanogenic cassava cultivar has never been found (1). Cyanide is an extremely destructive chemical which can kill both target and non-target organism when expelled in the environment (2). The toxicity of cyanide is a consequence of its high potency as it inhibits all aerobic form of live (3). Acute doses of cyanide are usually fatal, due to the marked susceptibility of the nerve cells of the respiratory centre to hypoxia (4). Kumar and Pant (5) have stated that histopathology studies are useful to evaluate the pollution potential of various toxicants, which do not cause animal mortality over a given period, but are capable of producing considerable original damage. Kidney serves as a major route of excretion of metabolites of xenobioties and is more likely to undergo histopathological alterations under toxic stress (6), also cyanide exposure has effect on liver (7). This study investigated the effect of dietary intake of cyanide through cassava on histopathology of broiler chicken.

MATERIALS AND METHODS

Cassava grit was used to replace maize in the diets of broilers at 0, 25, 50, 75 and 100% constituting diets 1 – 5. The feeds were fed to broilers for seven weeks. At the end of seventh week, two birds per replicate were selected for gross anatomy and histopathological analysis. The birds were fasted for 12 hours and mechanically eutinized by strangulation and gross anatomical examination was carried out on the internal organs. The following organs were taken for histological analysis; liver, kidney, intestine, lung and spleen. The tissues were subjected to the following histological procedure; collection, fixation, embedding, sectioning, and staining as described by Andreas (8).

Histopathology examination was carried out according to method described by Humason (9) the tissues were dissected, samples isolated immediately and fixed in Bovin's fluid for 24 to 48 hours. The tissues were processed in a series of graded alcohol and embedded in paraffin which was filtered thrice. The organs in paraffin were sectioned into 5Nm thick ribbons by using semi-automated microtonne (Leica, 2255) and sections were stained with primary haematoxylin and counter stained eosin (H&E) for light microscopic examination according to Lille (10). The sections were observed under 200x and 400x magnification, respectively. The microscopic view

was photographed by using an Olympus phase contrast microscope (Olympus Bx51, Tokyo, Japan) with attached photography machinery (progress 3, Jenoptic- Germany). The photographed images were further observed for differences and the findings were recorded.

RESULTS

Post-mortem examination of broilers fed experimental diets revealed that there was no lesion, necrosis and abnormal size increment on the organs considered. Liver, kidney, spleen, proventiculum, intestine gizzard, lung, and crop of broilers fed cassava based diets did not show any abnormal change visible grossly. Histopathological changes in organ of broilers fed graded level of cassava based diets is presented in Table 1. There were some gross pathological changes in some of the organs. Multi focal intestinal haemorrhages was discovered in the kidney of broilers fed 0% cassava based diet, however, this histological change reduced with increasing cassava grit in the diets. Except mild villons altrophy, epithelial degeneration and cellular infiltration observed in the intestine of birds fed diet 2 (25% cassava grit), no gross pathology changes and histological abnormality was observed in this organ of birds fed other experimental diets

Histopathological result of the liver showed that broilers fed 0% cassava based diet had marked bile ductular hyperplasis, periportal inflammation, however, perivascular cellular aggregation was observed in those fed treatment 2. Diffuse coagulative necrosis of the hepotocytis, periportal and perivascular necrosis infilteration was recorded for birds fed 50% cassava based diet. Histological examination of liver of those fed 75% and 100% cassava grit was moderate.

The spleen of broilers fed 50, 75 and 100% cassava grit showed no histological changes, however, those of birds fed 100% maize and 25% cassava grit had lymphoid hyperplasia. Histopathological result of the kidney of birds fed experimental diets revealed that broilers fed diets 4 and 5 had hyperplasia, while treatment 1had mononuclear infiltration and capillary congestion and those fed 50% showed bronchial epithelia, vascular congestion, peribronchial, mononuclear infiltration, bronchial epithelial hyperplasia. However, 25% cassava grit based diet recorded no histological changes.

The result obtained from this study revealed that cassava did not cause any gross anatomy and histopathological changes in organs of broilers fed cassava based diets. Gross anatomy of cassava grit fed broilers was as normal as those on maize based diets. In fact, histological parameters of cassava based diets were better than those fed the control diet. The toxicity of cyanide is based on the inactivation of cytochrome oxidase, a terminal enzyme in the cellular respiration chain. Thus, acute cyanide poisoning affects the cerebral structures with the highest oxygen requirement, such as the basal ganglia, the cerebral cortex, and the sensorimotor cortex (11). As a result, the anoxic encephalopathy shows hemorrhagic necrosis, mainly in the striatum, and pseudolaminar necrosis of the cortex (3).

Therefore better result from histological examination proved that cassava grit used for the feeding was properly processed as heat helps in elimination of cyanide (12)

CONCLUSION

Processing cassava into grit effectively reduced cyanide in cassava and thus feeding cassava diet based diets to broilers did not cause anatomical disorder and also had no effect on histopathatology of the internal organs of the fed birds

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Table 4.3: Histological parameters of broilers fed graded level of cassava

Treatment	Treatment 1 100% Maize	Treatment 2 25% Cassava Grit	Treatment 3 50% Cassava Grit	Treatment 4 75% Cassava Grit	Treatment 5 100% Cassava Grit
Kidney	Multifocal intestinal haemorrhage, tubular epithelial, coagulative necrosis. No gross pathology changes	Renal Tubular Epithelial (RTE) necrosis. No gross pathology changes	Extensive nephrosis, coagulative necrosis, lymphoid aggregation, no interstitium. No gross pathology changes	Moderate duffuse RTE necrosis. No gross pathology changes	No histopathological changes, no gross pathology changes
Intestine	No gross pathological changes	Mild villons altrophy, epithelial degeneration, cellular infilteration. No gross pathology changes	No histological changes, no gross pathology changes	No histopathological changes, no gross pathology changes	No histopathological changes; no gross pathology changes
Liver	Marked bile ductular hyperplasis, periportal inflammation. No gross pathology changes	Perivascular cellular aggregation. No gross pathology changes	Diffuse coagulative necrosis of the hepotocytis, periportal and perivascular necrosis, infilteration, No gross pathology change	Hepatus cell necrosis (W. H. Pykrotie nuclei). No gross pathology changes	Moderately diffuse coagulation necrosis. No gross pathology changes

Spleen	Lymphoid hyperplasia. No gross pathological changes	Lymphoid hyperplasia. No gross pathology changes	No histological changes, no gross pathological changes	No hisptopathological changes, no gross pathology changes	No histopathological changes; No gross pathological changes
Lungs	Mononuclear infilteration, capillary congestion. No gross pathological changes	No histopathological changes, no gross pathology changes	Branchial epithelia, vascular congestion, peribronchial mononuclear infilteration, bronchrial epithelial hyperplososa. No gross pathology changes	Hyperplasis, peribronchola oedema, cellular infilteration, goblet cell hyperplasia. No gross pathology changes	Hyperplasis, no gross pathological changes

Haematological Profile of Donkeys (*Equusa sinus*) as Affected by Age in Northwestern Nigeria

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Abstract: Haematological evaluations are carried out for a variety of reasons such as screening procedure to determine the general health and nutritional status of animals. Therefore, the aim of this study was to determine how some haematological parameters of donkeysin northwestern Nigeria vary with age. Blood samples for haematological profile were collected randomly from 125 donkeys across three states (Jigawa = 39, Katsina = 41 and Zamfara = 45).There were a total of 66 males and 59 females, and they were divided into three groups based on their determined ages; Young (≤3 years; N = 33), Adult (3 - 10 years; N = 53) and Old (> 10 years; N = 39).Results obtained indicate that there were significant differences ($P < 0.05$) between young, adult and old donkeys in the values obtained forpacked cell volume (PCV), hemoglobin, white blood cells (WBC), neutrophils, lymphocytes, eosinophils and basophils. While there were no significant differences ($P > 0.05$) between young, adult and old donkeys in red blood cells (RBC), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) andtotal plasma protein. This study has shown that there are considerable variations in haematological values due to age, and these should be noted during haematological examinations of donkeys in northwestern Nigeria.

Keywords: Donkeys, Haematological Parameters, Northwestern Nigeria

DESCRIPTION OF PROBLEM

In Nigeria, like anywhere else, donkey (*Equusasinus*) has been used as a work animal mainly for transportation; conveying farm produce to the market or pulling of carts and other farm tillage equipment (7). Donkeys are known to survive with little management. Their body conditions may fluctuate during the year as feed supply fluctuates resulting in poor body condition, weight loss and delay in resumption of ovarian cycles after parturition (12). Haematological evaluations are carried out for a variety of reasons such as screening procedure to determine the general health and nutritional status of the animal, as an adjunct to an infection and to ascertain the progress of disease conditions (5) and distinguish between normal and stress conditions (10). Haematological values provide baseline information for comparison in conditions of nutrient deficiency, physiology and health status of farm animals (9) and help in providing information on the relationship between blood characteristics and the environment (11,8). However, unlike other livestock species, there is very scanty of information on the baseline haematological parameters of the donkey in Nigeria. Therefore, a study to determine the haematologicalprofile of donkeysis necessary, and it will be the basis for providing interventions that will improve the productivity of the donkeys.

MATERIALS AND METHODS

Study area and experimental animals: A total of 125 donkeys owned by subsistence farmers were sampled using simple random sampling method from Jigawa, Katsina and Zamfara States. They consisted of thirty-nine (39) from three Local Government Areas in Jigawa (Roni, Kiyawa and Maigatari), forty-one (41) from the three Local Governments areas in Katsina (Kurfi, Daura and Dandume) and forty-three (45) from the three local government areas in Zamfara (Tsafe, KauranNamoda and Bakura). There was a total of 66 males and 59 females, and they were divided into three groups based on their determined ages; Young (≤3 years; N = 33), Adult (3 - 10 years; N = 53) and Old (> 10 years; N = 39) (Table 1). The ages of the animals were determined using dentition according to the procedures described by (2).

Blood sample collection and analysis: Blood samples (8ml) were drawn aseptically from the jugular vein using a 10 ml heparinisedvacutainer tube (BD Vacutiner Systems, Plymouth, UK). Blood samples were placed into

vacuum tubes containing 10% anti coagulant and were used for haematological analysis. Immediately after collection blood samples wereshake gently about ten times (10x) and placed over ice in an ice packed "polio vaccine" box (1). Haematological analysis were performed using automates cell counter (Sysmex- KX-21).

Data Analysis: The Data obtained were analyzed using the GEN-STAT software (6).

RESULTS

Table 1 shows the variation of haematological parameters with ages of the donkeys. The young donkeys had significantly higher values of white blood cells (WBC), monocytes, eosinophils and basophils, while adult donkeys had significantly higher packed cell volume (PCV), haemoglobin (Hb) concentration and lymphocytes, whereas, old donkeys had significantly higher neutrophils values.

Table 1: Effect of age on haematological parameters of donkey

Parameters	Young	Adult	Old	S.E.M	LOS
PCV (%)	31.88^{b}	34.27^{a}	34.80^{a}	0.56	*
Hb (g/dl)	10.36^{b}	11.34^{a}	11.19^{a}	0.20	*
WBC ($x10^{9}$/µl)	8.73^{a}	6.96^{b}	5.70^{c}	0.38	*
RBC ($x10^{6}$/µl)	5.51	5.88	5.94	0.76	NS
MCV (*f*L)	59.35	57.85	58.61	1.25	NS
MCH (pg)	19.24	19.57	18.94	0.80	NS
MCHC (g/dl)	32.55	33.19	32.42	1.22	NS
TP (g/dl)	6.48	6.98	6.60	0.65	NS
NEUT (%)	41.45^{b}	38.40^{c}	45.56^{a}	0.56	*
LYMP (%)	55.69^{b}	60.60^{a}	50.96^{c}	1.27	**
MONO (%)	1.30^{a}	0.33^{c}	0.72^{b}	0.28	**
EOS (%)	0.68^{a}	0.57^{b}	0.52^{b}	0.03	*
BASO (%)	0.33^{a}	0.03^{b}	0.00^{b}	0.10	*

S.E.M: Standard error of mean, LOS: Level of Significance, PCV: Packed Cell Volume, Hb: Hemoglobin concentration, WBC: White blood cells, RBC: Red blood cells, MCV: Mean corpuscular volume, MCH: Mean corpuscular hemoglobin, MCHC: Mean corpuscular hemoglobin concentration, TP: Total plasma protein, NEUT: Neutrophils, LYMP: Lymphocytes, MONO: Monocytes, EOS: Eosinophils, BASO: Basophils.
Means within rows with different superscript are significantly different.
*= P<0.05; **= P<0.01

DISCUSSION

The trend of haematological parameters with respect to age shows that adult and old donkeys have higher PCV, Hb and red blood cells (RBC)than young donkeys and this agreed with the finding of Etana*et al.* (3). The lowerlevel of erythrocytes in the young donkeys could be associated with iron deficiency in the young donkeys (15). Total WBCvalue was higher in young donkeys than adult and old donkeys. This agrees with the findings of French and Patrick (1995) and Etana *et al.,* (2011). The higher WBClevel in the young donkeys could be attributed to the increased bone marrow production in young animals (13). Total WBCcounts showed a significant decrease with age, while lymphocytes number did not seem to beinfluenced. Similar results were reported by (15, 14). Age is the main factor that causes steady decline in WBCvalues (15,3).

CONCLUSION AND APPLICATION

This study has indicated that there are considerable variations in haematological values due to age, and these should be noted during haematological examinations of donkeys in northwestern Nigeria.

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Proximate Composition of *Kigelia africana* Fruit and Leaf Meals

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Abstract: An experiment was conducted to investigate the chemical composition of *Kigelia africana* fruit and leaf meals. The proximate, vitamins and minerals compositions of the fruit were compared to that of the leaf. There was no significant ($p>0.05$) difference between fruit and leaf for proximate parameters except in the ash content which was higher in the fruit than leaf. Similarly, the glucose content was significantly ($p<0.05$) higher in the fruit than leaf. The vitamins, except vitamin E were significantly ($p<0.05$) higher in the fruit. Ca and P were significantly ($p<0.05$) higher in the fruit while Zn and Fe contents were similar in both. In conclusion, *Kigelia africana* fruit is richer compared with the leaf. However, based on the nutritional composition of this plant parts, they can both be included in rabbit and ruminant diet to boost productivity and also solve the environmental problem associated with the fruit in areas where the tree is plenty.
Key words: *Kigelia africana*, fruit, leaf, chemical composition

INTRODUCTION

Determination of chemical composition of a feed is very essential in animal production as it allows a legitimate comparison of feedstuff for a specific nutrient and how much of a particular feed material should be used in formulation of feed for a particular class of animal. The proximate analysis of food gives an insight to the percentages of nutrients present in a feed sample. However, due to the inadequate information provided by proximate as a measure of chemical compositions of food/feedstuffs, more laboratory analysis becomes essential in order to achieve a more detailed chemical compositions that enables formulation of a balanced diet for livestock. The chemical composition of feedstuffs can be influenced by many factors such as plant species, soil, climatic conditions, and stage of harvest of the plant. *Kigelia africana* tree which is commonly called Sausage tree or Cucumber tree due to its long sausage-like fruit belongs to the family *Bignoniaceae*. It grows commonly in tropical west, east and central African regions. Its fruits weighs between 4 - 10 kg and hangs from a long and fibrous stalk, it can be found in open woodland (Owolabi *et al*., 2007; Owolabi and Omogbai, 2007). This study was carried out to investigate the chemical compositions of *Kigelia africana* fruit and leaf in order to validate their application in animal production.

MATERIALS AND METHODS

Source and Preparation of *Kigelia africana* Meals: The *Kigelia africana* fruit and leaves were collected from Ilorin metropolis. The fruits and the leaves of the plant were air-dried and milled in to fine particles. The milled samples were taken to the laboratory for analysis. The analyses were conducted at the Central Research Laboratory, Tanke, Ilorin. The samples were replicated in three places; proximate analysis was done using the analytical methods of AOAC (2005). The phytochemical screening of the samples was determined using the method described by Makkar (2000). Various vitamins (vitamins C, A, E and B) and minerals were determined as described by A.O.A.C (2005).

Statistical Analysis*:* All data obtained were subjected to a *t*-test using SAS (1999).

RESULTS AND DISCUSSION

The results of proximate analysis conducted on *Kigelia africana* fruits and leaf meals are presented in Table 1. There was no significant difference among the means of all the parameters (crude protein, crude fibre, ether extract, and dry matter) investigated on the fruit and leaf except in the ash and glucose contents which was significantly ($p<0.05$) higher in the fruit. The crude protein results obtained from this study is similar to the values reported by Anon (1934) on fruit and leaf of same plant. However, Eliton *et al*. (2011) reported a higher percentage of crude protein, but similar value of dry matter content in the dried seeds of the plant. The variation in the results could be due to several factors such as soil, plant parts, and climate, as these can affect the

nutritional composition of a plant. The crude protein and the crude fibre contents of *Kigelia africana* fruit and leaf are comparably higher than that of *Mangifera indica*, *Theobroma cacao*, *Sorghum bicocor*, and *Harungana madagascariensis* (Gbadamosi *et al*., 2012). This makes it a better option as feed supplement in rabbit and ruminant feed since they have ability to convert fibrous feed materials into meat.

The results of selected minerals (calcium, phosphorus, zinc and iron) present in the fruit and leaf of *Kigelia africana* are presented in Table 2. The mean values of Calcium, Phosphorus and Zinc were significantly ($p<0.05$) higher in the fruit (197.88, 5.2, and 19.08, respectively) than the in leaf (, respectively). There was no significant difference in values obtained for Iron (Fe) in both fruit and leaf. Minerals are important in the diet of growing animals, Calcium and Zinc has been described as being vital in maintaining the immune system and optimal functionality of male reproductive health. In this study, Phosphorus, calcium, zinc and iron are more available in the fruit than in the leaf however; Eliton *et al*. (2011) reported higher values for phosphorus and calcium in the seed. This suggests that the minerals are more available in the seed than the entire fruit. Considering the importance of these minerals in animal health, growth and reproductive performance *Kigelia africana* fruit and leaf can be used in animal feed for ruminat animals and rabbit.

The results of the vitamins in the fruit and leaf of *Kigelia africana* are presented in Table 3. There was a significant difference ($p<0.05$) among the evaluated vitamins. The Vitamin C content of the fruit was significantly higher ($p<0.05$) than that of the leaf. Similarly, the folic acid (B9) content of the fruit was higher than that present in the leaf. The mean values of Vitamin A and E present in the leaf are however significantly ($p<0.05$) higher compared with that present in the fruit. Both fruit and the leaf of KA have reasonable contents of vitamins A, B9, C and E. Vitamin A helps in maintaining healthy vision, skin, and mucous membrane as well as promoting bone and tooth growth making their inclusion in animal diet a necessity to achieve a maximum productivity. Vitamin C and E are known for their anti-oxidant properties (Argarwal *et al*., 2004), helps in boosting the immune system, the effects of which can be seen in the improved general health and reproductive performance of the animals, Mangiagalli *et al*. (2003). It has been established that anti-oxidant promotes male fertility by reducing oxidative stress, scavenging free radicals and promoting general health (Dada *et al*., 2010). The vitamin E contents of both the fruit and the leaf obtained from this work is higher than what was obtained from the seed of same plant by (Elinton *et al*., 2011).

CONCLUSION

The results showed that *Kigelia africana* fruit and leaf has reasonable contents of crude protein, crude fibre, essential vitamins and minerals which are all vital for growth and reproductive performance of animals. The presence of phytochemicals especially flavonoid makes it good source of antioxidant.

Table 1**:** Proximate Composition of *Kigelia africana* Fruit and Leaf Meals

Parameters	**KAF**	**KAL**	**(P<0.05)**
Dry Matter (%)	90.55±1.16	91.38±0.94	0.388
Ash (%)	18.90 ± 2.05^{a}	7.40 ± 2.75^{b}	0.004
Ether Extract (%)	3.58±1.22	3.66±1.99	0.96
Crude Protein (%)	7.73±2.79	9.12±0.98	0.49
Crude Fibre (%)	27.38±2.10	22.02±3.36	0.11
Glucose(mg/g)	17.83 ± 0.36^{a}	$3.51.8\pm0.00^{b}$	0.0001

*KAF= *Kigelia africana* fruit, KAL= *Kigelia africana* leaf, a, b, c – means with different superscript are significant along the row

Table 2: Quantitative Analysis of Selected Vitamins in *Kigelia africana* Fruit and Leaf Meals

Parameters	**KAF**	**KAL**	**(P<0.05)**
vitamin C (mg/100g)	32.72 ± 2.49^{a}	20.83 ± 0.29^{b}	0.001
A (µg/100g)	2.36 ± 0.01^{b}	4.38 ± 0.023^{a}	0.0002
E (µg/100g)	2.10 ± 0.21^{b}	4.45 ± 0.22^{a}	0.025
B9 (µg/100g)	121.39 ± 0.21^{a}	120.17 ± 0.22^{b}	0.020

*KAF= *Kigelia africana* fruit, KAL= *Kigelia africana* leaf, a, b, c – means with different superscript are significant along the row

Table 3: Quantitative Analysis of Selected Minerals in *Kigelia africana* Fruit and Leaf Meals

Parameters	**KAF**	**KAL**	**(P<0.05)**
Calcium (ppm)	214.15±2.24[a]	16.27±6.85[b]	0.0001
Phosphorus (ppm)	7.33±0.28[a]	2.13±0.06[b]	0.001
Zinc (ppm)	21.59±9.29[a]	2.51±0.44[b]	0.011
Iron (ppm)	4.02±0.55	2.44±0.59	0.12

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Effect of Honey and Vitamin C on The Performance Ofroiler Finisher Birds

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Abstract: This study was designed to investigate the effect of honey and vitamin C on the performance and physiological response of broiler finishers. Sixty (60) unsexed broiler birds of Abbor-acre strain were used for this experiment. The birds were randomly allotted to four (4) treatment groups of 15 birds, each replicated thrice of 5 broilers per replicate. Data collected were subjected to analysis of variance (ANOVA), using the completely randomized design (CRD). The measurements taken were daily rectal temperature, body weights, daily feed intake and blood parameters. The results showed that the weight gain and feed intake were significantly (P>0.05) influenced by the treatment. Broilers on T_4 and T_3 had the highest values of 3095.33g and 2235.67g body weight against the control, which was 1048g. The result on the haematological profile indicated that there were significant (P>0.05) differences on all the parameters measured. Broilers on 20ml of honey and 5.0g of vitamin C had the highest PCV, WBC and Haemoglobin (Hb) of 38%, 4.23 x 10^{-3}/ml and 12.63 Hbg/dl against T_2 and T_1 which were 33%, 4.11 x 10^{-3}/ml and 10.99 Hbg/dl respectively. Results on WBC count showed significant (P>0.05) effect with respect to lymphocyte and Neutrophils. Broilers in T_3 recorded the highest lymphocyte and neutrophil values of 46.70% and 65.30% as against T_1 values which were 32.70% and 47.30% respectively. There were no significant (P<0.05) effects in all serum biochemistry parameters analyzed. The result from this study showed that honey and vitamin combined enhanced the performance of finished broiler chickens.

Keywords: Honey; Vitamin C; Physiology; Rectal and Temperature

INTRODUCTION

For the rapidly increasing human population in Nigeria, broiler production plays a major role in food security. This can be attributed to their short production cycle, high feed efficiency and growth rate. However, compared to other domestic animals, broiler chickens are more susceptible to changing environmental conditions mostly during growing-finishing phase (1). This is because they have rapid metabolism, high body temperature and no sweat gland. Yahav (2) reported that success in breeding for high growth rate in broilers has resulted into inferior development of their cardio-vascular and respiratory systems which predispose them to heat-stress. These physiological characteristics, in combination with confined housing make it difficult for broilers to regulate their heat balance. High environmental factors affect the production performance of broilers by reducing their feed intake, lowering body weight, and increasing mortality (3). During the period of heat-stress, broilers make major thermo-regulatory adaptations in order to prevent death from heat exhaustion by diverting energy needed for growth, immunity, feathering and reproduction (4) to thermo-regulation. The result is that the full genetic potential of the broiler is often not achieved. An increase in ambient temperature beyond the thermo-neutral zone of birds causes birds to start panting as a physiological mechanism for controlling body temperature. Increased respiratory rate (5) and rectal temperature (6) has been observed as major physiological indicators of heat-stress. Various researches have been conducted on the management techniques that can be adopted in order to reduce the effect of heat-stress in poultry, some of which are: use of ventilators, fans and foggers (7) in the poultry, feed and feeding manipulations (1), vitamin supplementation (4). Modern-day agriculture is gradually embracing organic agriculture which involves the use of natural materials rather than synthetic material. Honey is a natural source of vitamin C, a natural antioxidant which has been used by man for several purposes especially as an anti-bacterial and anti-diarrhea. Honey has since been used as both food and medicine. The anti-oxidant capacity of honey is important in many disease conditions and is due to a wide range of compounds including phenolics, peptides, organic acids, enzymes and maillard reaction products (8).

MATERIALS AND METHODS

This research was carried out at the Poultry Unit of Ebonyi State University Teaching and Research Farm, Abakaliki. A total of 60-day-old unsexed Abbor-acre strain of broiler chicks was used for the experiment. The birds were randomly allotted to four (4) treatments in a completely randomized design (CRD). Each treatment was replicated three (3) times to give five (5) birds per replicate. Data collected was subjected to analysis of variance (ANOVA) using the completely randomized design (CRD) model and treatment means were separated, using fisher's least significance difference (F-LSD)

RESULTS AND DISCUSSION

Effect of Dietary Honey and /or Vitamin Con Rectal Temperature of Broiler Finisher: The addition of honey in the drinking water of birds had no significant ($P<0.05$) effect on rectal temperature (RT) of the birds (Table 1). Although, there was gradual numerical decrease in RT values across the treatments, it was not statistically different. However, this report is in contrast with the reports of (9) and (10) which stated that ascorbic acid (vitamin C) reduced skin and rectal temperature of broiler chickens either in feed or in water. Furthermore, the birds in T_4 recorded a mean lower RT compared to those in T_3, T_2 and T_1 respectively. This shows that the administration of honey and vitamin C combined helped reduce the cloacal temperature of birds than sole honey or vitamin C supplementation. This result also agrees with the findings of (11), who reported a mean lower RT with the administration of honey in the drinking water of the laying birds.

Effect ofDietary Honey and /or Vitamin Con growth performance of broiler chickens: Table 2 shows the effect of treatment on the growth performance of broiler chickens during finisher phase (5–8 weeks). The result shows that there were significant ($P>0.05$) differences in initial body weight gain, final body weight gain, total body weight gain, average weekly weight gain, total feed intake and feed conversion ratio, but not on average daily weight gain. The results recorded in this study agrees with the findings of (12) and (13) who reported increased body weight gain, feed conversion ratio, livability and improved immune response in broiler chickens supplemented with honey and ascorbic acid (vitamin C).

Effect of Dietary Honey and /or Vitamin Con Haematological Parameters of Broiler Chickens: The effect of honey and vitamin C on the haematology of broiler chickens during finisher phase (Table 3), showed that the treatment had a significant ($P>0.05$) effect on PCV, RBC, MCV, MCHC, haemoglobin, neutrophils and lymphocyte respectively. Birds offered ordinary water and 20ml honey had a significantly higher PCV, followed by those offered 5.0g of vitamin C. Birds offered 2.5g of vitamin had lower PCV values. It has been reported that broilers subjected to heat stress had reduced PCV (6). It can then be explained that the effect of ambient temperature in broilers was a reduction in PCV, which was corrected by offering either 20ml of honey or 5g of vitamin C to the birds.

However, it should be noted that the PCV values of all the experimental birds were within the normal range for chickens (24.9-45.2%) as reported by (12). Addition of honey 20ml of honey or 5g of vitamin C significantly ($P>0.05$) affected the haemoglobin, MCV, MCHC, Neutrophil and hymphocyte. This result agrees with the report of (12) who stated that the number of erythrocytes in chickens is influenced by physiological conditions. (14) also reported that cell morphology is affected by heat-stress as red blood cells in broilers become longer and thinner compared to unstressed ones.

Table 1: Rectal temperature values of broiler finisher fed honey and vitamin C

Week	T_1	T_2	T_3	T_4	SEM
6	42.7	41.6	41.2	40.2	0.17
8	42.9	41.4	40.8	39.8	0.12
Average	42.8	41.5	41.0	40.0	0.15

Table 2: Effect of Dietary Honey and /or Vitamin Con growth performance of broiler chickens

Parameters (g/birds)	T_1	T_2	T_3	T_4	SEM
Initial body weight gain	1600^{bc}	1586.67^{c}	1781^{ab}	1860^{a}	5.32
Final body weight gain	2648^{c}	3206.67^{abc}	4016.67^{ab}	4955.33^{a}	8.12
Total body weight gain	1048^{c}	1620^{abc}	2235.67^{ab}	3095.33^{a}	7.16
Average daily weight gain	66.89	65.73	66.83	69.93	1.62
Average weekly weight gain	466.91^{ab}	409^{c}	433.96^{bc}	485.37^{a}	3.58
Total feed intake	3733.67^{a}	4362^{ab}	4709^{abc}	5448.67^{c}	8.57
Daily feed intake	140.35^{c}	165.78^{bc}	174.16^{ab}	204.60^{a}	1.96
Feed conversion ratio	2.18^{c}	3.08^{bc}	3.32^{b}	3.27^{a}	0.16

Table 3: Effect of Dietary Honey and /or Vitamin Con the haematology of broiler chickens during finisher phase

Parameters (g/bird)	T_1	T_2	T_3	T_4	SEM
PCV (%)	33^{c}	34^{bc}	35.7^{ab}	38^{a}	1.61
RBC x 10^{-6}/ml	4.58^{a}	4.52^{b}	4.52^{bc}	4.65^{c}	0.36
WBC x 10^{-3}/ml	4.11	4.13	4.15	4.23	0.32
MCV (Fl)	69.77^{c}	73.52^{bc}	74.25^{b}	77.90^{a}	1.48
MCH (pg)	24.61	25.54	25.80	27.07	0.74
MCHC (%)	24.00^{c}	27.45^{c}	27.66^{bc}	27.67^{a}	0.63
Haemoglobin (Hbg/dl)	10.99^{c}	11.30	11.87^{ab}	12.63^{a}	0.47
Neutrophils (%)	65.30^{c}	47.30^{bc}	51.30^{a}	65.00^{ab}	1.65
Lymphocyte (%)	32.70^{a}	41.30^{abc}	46.70^{a}	36.70^{ab}	1.82
Monocyte (%)	1.83	1.93	2.03	2.23	0.13
Basophils (%)	0.73	0.70	0.47	0.67	0.01
Eosonophils (%)	1.70	1.30	1.30	1.30	0.08

PCV Packed Cell Volume, RBC Red Blood Cell, WBC White Blood Cell,
MCV Mean Corpuscular Hemoglobin, MCHC Mean Corpuscular Hemoglobin Concentration.

CONCLUSION

1. The addition of honey and vitamin C in the water of broiler finisher birds significantly increased the lymphocyte and neutrophil counts.
2. This helped to boost the immunity of the birds, thereby increasing their ability to fight off diseases.
3. The antioxidant effect of honey and vitamin C combined proved effective at improving the overall performance of heat-stressed broiler chickens, especially in terms of weight gain, feed intake and improved immune response

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Influence of Aidan (*Tetrapleura tetraptera*) Pod Meal on Haematological and Serum Chemistry Indices of Pubertal Boars

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Abstract: A 10-week-long study was conducted to evaluate the influence of Aidan pod pulp meal (APM) on haematology and serum chemistry of eighteen 18-week old peri-pubertal Large White x Duroc cross-bred boars. The boars were systematically divided into three equal treatment groups. APM, added at 0.0% (control), 2.5% and 5.0%, respectively, to a basal boar diet constituted the treatments. Each treatment was replicated thrice in a completely randomized design. Erythrocyte counts and packed cell volumes were higher($P<0.05$) in boars fed 5% APM than in those fed control. There was higher($P<0.05$) haemoglobin concentration in boars fed 5% APM than in their peers placed on 2.5% and 0% APM. Leucocyte counts were higher ($P<0.05$) in boars fed APM than those fed control diet; while platelets were more abundant ($P<0.05$) in boars fed control than in APM-treated counterparts. Boars fed 5% APM had more ($P<0.05$) serum glucose than their peers. Total protein and albumin increased ($P<0.05$) with increase in APM across the treatments. Aspartate aminotransferase (AST) and creatinine were reduced($P<0.05$) with increase in APM across the treatments; while alanine aminotransferase (ALT) was reduced ($P<0.05$) at 5% APM. The lowest ($P<0.05$) serum urea was obtained at 5% APM. It was concluded that APM improved the haematology and serum chemistry of the boars, except for depressed platelets and elevated ALT.

Keywords: Aidan, haematological indices, serum chemistry, pubertal, boars

INTRODUCTION

The disposition of an animal to its feed or a given feed additive can be evaluated to a great extent through the changes that occur in the haematological and blood chemistry parameters of the animal. In a bid to enhance growth and produce high quality pork without pharmaceutical anti-biotic growth promoters (AGPs), the pace of researches on additives of plant origin is on the increase. This is informed by the limitations to the use of AGPs (1), which have led to a ban on their application in animal production. Several plant-derived additives are being explored for their potential effectiveness in modulating certain biological activities in the systems of animals. Pulp from the pod of aidan tree has been credited with an array of bioactivities, some of which are yet to be sufficiently substantiated through scientific searches. Cardio-vascular, anti-inflammatory, hypoglycaemic, hypolipidaemic, hypotensive, anti-fertility, anti-microbial, anti-parasitic properties, among others have been attributed to extracts of this pod (2). The explanations for these may not be far-fetched as the pod has been reported to contain phytochemicals such as scopoletin (a coumarin) (3), polyphenols (tannins, flavonoids), saponins, phytates, triterpenoids, phenols (caffeic and cinnamic acids), triterpene glycoside (aridanin) (4,5,6). A pod meal of aidan added at 2.5% and 5%, respectively, significantly depressed haematological indices in weanling piglets (7). This study was aimed at evaluating the effect of Aidan (*Tetrapleuratetraptera*) pod pulp meal on the haematology and blood chemistry of pubertal boars; and formed part of preliminary steps to explore the pod for its potential usefulness in boars.

MATERIALS AND METHODS

Experimental site, Animals, Management and Design: The research was carried out at the Piggery Unit, Livestock Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike, Abia State. Umudike lies on co-ordinates $05^0$29'Nand 07^0 33'E, and an altitude of about 122m above sea level. The average

annual rainfall ranges from 1700 to 2100 mm. Minimum and maximum temperature are in the ranges18-23^0 C and 26-36^0 C, respectively; while relative humidity is 57-91% (8).

Eighteen (18) peri-pubertal boars of Large White x Duroc cross-breeds, aged 18 weeks and raised at the Livestock Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike, Abia State, were used for the study. The boars were raised in pens with concrete floor, fed twice daily andsupplied with water *ad libitum*. The boars were randomly divided into three (3) equal treatment groups each replicated thrice in a completely randomized design.

Preparation of Aidan pod pulp meal: Dry pods of Aidan plant purchased from the New Market, Aba, Abia State, had the two softs, pulpy 'wings' peeled with a sharp kitchen knife. The peels were further cut into smaller pieces and air-dried. Subsequently, they were milled and packed in air-tight bags. The meal was added in a basal diet formulated for the boars at 0% (control), 2.5% and 5%, respectively, as presented in table 1.

Table 1: Ingredients composition of experimental boar diets

Ingredient (%)	Diet 1	Diet 2	Diet 3
Maize	30.10	30.10	30.10
Groundnut cake	5.50	5.50	5.50
Palm kernel meal	20.00	20.00	20.00
Wheat offal	41.80	41.80	41.80
Bone meal	0.25	0.25	0.25
Oyster shell	1.50	1.50	1.50
Vit. /Min. premix**	0.20	0.20	0.20
Methionine	0.05	0.05	0.05
Lysine	0.15	0.15	0.15
Salt	0.45	0.45	0.45
Total	**100**	**100**	**100**
APM*	0.00	2.50	5.00
Calculated CP (%)	16.03	16.03	16.03
Calculated Energy (Kcal/kg)	2817.65	2817.65	2817.65

* Aidan pod pulp meal ******To provide per kg of diet: vitamin A (10 000 IU), vitamin D (20 000 IU),vitamin E (5 IU), vitamin K (2.5 mg), choline (350 mg), folic acid (1 mg),manganese (56 mg), iodine (1 mg), iron (20 mg), copper (10 mg), zinc(50 mg), cobalt (1.25 mg).

DATA COLLECTION AND ANALYSES

At the end of the experiment two boars were selected from each treatment and slaughtered. Blood samples were collected into two sets of bottles for haematology and serum chemistry studies. Samples for haematologywere collected in bottles treated with ethylene diamine tetra-acetic acid (EDTA) to forestall clotting while those for serum studies were collected in EDTA-free bottles. The haematological indices studied were: packed cell volume (PCV), by the micro-haematocrit method (9); haemoglobin (Hb) concentration, by the cyanmethaemoglobin method, using a haemocytometer (10), erythrocyte (RBC) and leucocyte (WBC) counts (use of Neubauerhaemocytometer) according to (11). Erythrocyte indices: mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were computed according to (12).

Serum chemistry indices: glucose, total protein, albumin, aspartate aminotransferase (AST), alanine aminotransferase (ALT), urea and creatinine were determined with Randox kits following the procedures described by the manufacturer.

All data were subjected to analysis of variance according to(13)with SPSS version 22. Significantly different ($P<0.05$) means were separated using Duncan's Multiple Range Test as provided in the software.

RESULTS AND DISCUSSIONS

Table 2: Effect of Aidan pod pulp meal on the haematological indices of pubertal boars

Parameter	0.0% APM	2.50% APM	5.0% APM	SEM
Red Blood Cell ($x10^6/\mu L$)	7.42^b	4.46^{ab}	8.05^a	0.16
Packed Cell Volume (%)	42.17^b	44.43^{ab}	45.27^a	0.54
Haemoglobin (g/L)	11.57^b	11.80^b	12.47^a	0.22
White Blood Cells ($x10^3/\mu L$)	14.70^b	15.76^a	16.02^a	0.25
Platelets ($x10^3/\mu L$)	215.00^a	206.00^b	206.00^b	2.86
MVC (fL)	56.88	57.48	56.30	1.02
MCH (*p*g)	15.58	15.22	15.50	0.17
MCHC (%)	27.43	26.56	27.54	2.74

[a,b]Means on the same row with different superscripts are significantly (P<0.05) different, SEM = standard error of the mean, APM = Aidan pod pulp meal

Table 2 shows the effect of Aidan pod pulp meal on haematological indices of the experimental boars. Erythrocyte counts and packed cell volumes were higher (P<0.05) in boars fed 5% APM than in those fed control. There was higher (P<0.05) haemoglobin concentration in boars fed 5% APM than in their peers placed on 2.5% and 0% APM. Leucocyte counts were higher (P<0.05) in boars fed APM than those fed control diet; while platelets were more abundant (P<0.05) in boars fed control than in their APM-treated counterparts. The values obtained in this study fell within the reference values documented by (14) for erythrocytes (5-8 x $10^6/\mu L$), packed cell volume (32-50 %), haemoglobin (10-16 g/dl), leucocyte count (11-22 x 10^3 /μL) and mean corpuscular volume (50-68 fL). Mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration was however, slightly lower than the reference values of 17-21 g/dl and 30-34g/dl, respectively, reported by (14). Erythrocyte count, packed cell volume, haemoglobin concentration and leucocyte count obtained in this work compare with the values reported for 25-week old Large White boars by (15). Lowered platelet count could mean a compromised clotting factor.

Table 3: Effect of Aidan pod pulp meal on the serum chemistry indices of pubertal boars

Parameter	0.0% APM	2.50% APM	5.0% APM	SEM
Glucose (mg/dl)	64.33^b	65.00^b	69.33^a	0.88
Total protein (mg/dl)	6.42^c	6.80^b	7.15^a	0.12
Albumin (mg/dl)	2.72^c	3.28^b	3.75^a	0.15
Globulin (mg/dl)	3.70^a	3.52^{ab}	3.40^b	0.06
AST(u/l)	53.00^a	48.00^b	35.00^c	2.74
ALT(u/l)	32.00^a	30.00^a	25.00^b	1.12
Urea(mg/dl)	20.67^b	23.92^a	18.44^c	0.83
Creatinine(mg/dl)	1.56^a	1.38^b	0.88^c	0.10

[a,b,c]Means on the same row with different superscripts are significantly (P<0.05) different, SEM = standard error of the mean, APM = Aidan pod pulp meal

Table 3 shows the influence of Aidan pod pulp meal (APM) on some serum chemistry parameters of the boars. Boars fed 5% APM had significantly (P<0.05) higher serum glucose than other treatments. Total protein and albumin increased (P<0.05) with increase in APM across the treatments. Aspartate aminotransferase (AST) and creatinine were significantly (P<0.05) reduced with increase in APM across the treatments; while alanine aminotransferase (ALT) was reduced (P<0.05) at 5% APM. The lowest (P<0.05) serum urea was obtained at 5% APM. All the indices fell within the normal ranges submitted for pigs by (16); except total protein, which is rather lower and ALT, which on the other hand is higher than the reference ranges. Protein quantity and quality are implicated in a case of low serum total protein and albumin (17). High levels of ALT are attributed to necrosis of the hepatocytes, myocardial and skeletal muscle cells (18).

CONCLUSIONS AND APPLICATION

1. Aidan pod pulp meal (APM) improved the haematological indices except the platelets
2. Aidan pod pulp meal did not adversely affect the hepatic, renal and skeletal muscle cell functions, except for the elevated ALT.
3. There should be application of caution in the use of Aidan pod pulp meal by pig farmers due to its effect on the platelet count and ALT, pending further researches on the pod.

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Effects of Graded Levels of Black Plum (*Vitex doniana*) Leave Meal on Hormone and Cholesterol Levels of West African Dwarf Bucks

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Abstract: Fifteen (15) West African Dwarf bucks with average initial weights of 10kg were used in an experiment to investigate the effect of varying levels of *Vitex doniana* leaf meal on the haematology and serum biochemistry of West African Dwarf buck. The animals were randomly signed to five treatments in a completely randomized design and the experiment lasted for twenty-eight (28) days. At the end of the feeding trial, blood samples were collected from the jugular veins of the animal for the determination of haematological and serum biochemical characteristics using standard laboratory methods. Phytochemical results shows Vitex doniana has a high phenol, flavonoid and saponin; it significantly increase total cholesterol and low density lipoprotein with a reduction in high density lipoprotein with 20g/kg feed while triglyceride and high density lipoprotein were high with 10g/kg feed. It significantly reduced lueinizing hormone while causing an increase in follicle stimulating hormone, testosterone and prolactin with 15g/kg. The administration of 15g inclusion level of *Vitex doniana* leaf meal increases the reproductive performance while administration of 10g inclusion level help to lower the cholesterol level in WAD bucks with no conspicuous adverse effects and their health status was not compromised.
Keywords: Feed, bucks, leaf meal, blood.

INTRODUCTION

Utilization of leaves from browse trees such as African Black Plum (*Vitex doniana)* especially during the dry season period, could serve as a viable option to address the lingering feed scarcity to livestock in Nigeria (Frances *et al.*, 2013). *Vitex doniana* tree is a good source of food and fodder for livestock in different parts of Nigeria (Makun *et al.,* 2013). Despite information on general feeding management of goats in Nigeria, there is little information on the utilization of *Vitex doniana* dry leaves in the feeding management of West African Dwarf bucks. Therefore, knowledge of the utilization of graded level of *Vitex doniana* in combination with other feed resources, to improve the general performance of West African Dwarf bucks is needed in efforts to address unrelenting feed shortages in Nigeria. As a result of these arising nutritional issues, *Vitex doniana* dry leaves were used in this study to investigate the possibility of including graded levels of the leaves to improve the productivity of goats using local resources available and at least costs.

The aim of the present work was to exploit the potential of *Vitex doniana* (black plum) leaves, which presently are of little economic value for goat feeding under intensive system of production. The work aims at assessing the nutritive value of *Vitex doniana* leaves through a feeding trial with goats.

MATERIALS AND METHODS

Site and Period of the Study: Feeding trials and laboratory analyses were conducted in the Livestock unit of the University Farm and the Animal Production Laboratory respectively at the Department of Animal Production, University of Ilorin located on Latitude 08º 29`N; Longitude 004º 35`E; Elevation 308 m, having a mean annual rainfall of 98.75 mm that is spread largely over the months of May to October.

Collection and Processing of *Vitex doniana* Leaves

Fresh leaves were collected from *Vitex doniana* (Black plum) trees on the University of Ilorin farm during the dry season months of November and December. Leaf samples were identified at the Faculty of Life Science, University of Ilorin Herbarium and a sample deposited with assigned voucher number. The leaves were subsequently air-dried for 10 days and kept inside jute bags in a well ventilated open shed that was protected from rain and direct rays of sunlight. The leaves were later processed by grinding in a hammer mill to pass

through 2 –mm sieve and kept in jute bags for subsequent feed formulation. Samples of the leaves were analyzed for gross energy, dry matter and chemical components (Table 1).

Feed Formulation and Processing: The leaves were mixed with crushed maize, soy bean meal, bone meal and sodium chloride in the different inclusion levels of 0, 5, 10, 15 and 20g/kg of leaves to feed as indicated on Table 1. The resultant feeds were processed into crumbles to reduce dustiness, facilitate handling and encourage intake by animals. Each feed was wetted with about 2% (V/W) clean drinking water and sun-dried on concrete slab for 5 – 6 hours.

Experimental Design and Animal Management: A 28 – day growth and nutrient digestibility trial was conducted with fifteen weanling male West African Dwarf goats of average initial live weight of 10.50 ± 0.34. Goats were divided into five dietary treatment groups of three bucks each in a completely randomized design. Animals in treatment A (control) were given formulated diet with no *Vitex doniana* leaf meal while the other four treatment (B, C, D and E) had *Vitex doniana* leaf meal in varying inclusion level of 5, 10, 15 and 20g/kg of feed respectively. The animals were fed 300g/day of the formulated feed throughout the experimental period. *Panicum maximum* were also provided in abundance for the bucks.

On the 28th day, blood was collected by jugular vein puncture with hypodermic needles and syringe from three animals per treatment into two (2) clean test tubes, one with an anticoagulant, Ethylene Diamine tetra Acetate (EDTA) for haematological analysis and the other without EDTA for serum biochemical analysis. All haematological parameters were determined by conventional laboratory methods of Baker and Silverton (1982). Serum biochemical indices were assayed using standard laboratory methods (Ochei and Kolhatkar, 2007). All data were analyzed using the analysis of variance (ANOVA) procedure following a completely randomized model (Steel and Torrie, 1980) and the levels of significance were determined using the Duncan's Multiple Range Test.

Table 1: Composition of basal experimental diet

Ingredients	% Inclusion
Maize	30.00
Groundnut cake	14.00
Wheat offal	33.00
Rice bran	10.00
Palm kernel cake	10.00
Table Salt	1.00
Premix	0.25
Limestone	1.00
Bone meal	0.75
Total	100.00

Parameter (%)	**A**	**B**	**C**	**D**	**E**	**V**
Dry matter	84.62	91.46	90.88	90.98	91.51	**92.75**
Moisture content	15.38	8.54	9.12	9.02	8.49	**7.25**
Crude fat	3.94	4.98	2.91	4.39	5.42	**6.44**
Crude protein	16.19	16.59	19.69	16.79	15.31	**8.53**

Crude fibre	6.05	13.40	8.35	9.03	9.14	**7.15**
Ash content	8.69	10.23	8.33	9.50	8.56	**8.26**

Table 2: Proximate composition of experimental diets and *Vitex doniana* leaf meal

Where A is the control (basal diet without *Vitex doniana* leaf meal), B (basal +5g *V. doniana*), C (basal +10g *V. doniana*), D (basal +15g *V. doniana*), E (basal + 20g *V. doniana*), V (*Vitex doniana* leaf meal).

RESULTS AND DISCUSSION

The effects of graded levels of *Vitex doniana* leaf meal on blood cholesterol level of West African dwarf bucks shows that Total cholesterol was highest in Treatment E (20g inclusion level), followed by Treatment C (10g inclusion level), Treatment A (0g inclusion level) and Treatment D (15g inclusion level) are the same while Treatment B (5g inclusion level) had the lowest. This may be due to the fact that the body also compensates for any absorption of additional cholesterol by reducing cholesterol synthesis as reported by Lecerf and de Lorgeril (2011). For these reasons, seven to ten hours after ingestion of cholesterol, blood levels will show little if any effect on total body cholesterol content or concentrations of cholesterol in the blood. However, during the first seven hours after ingestion of cholesterol, the levels significantly increase (Okukpe *et al.*, 2015).

The observed increased in total cholesterol, triglycerides and low-density lipoprotein could be attributed to its health and medicinal effects of three groups of active phytochemicals (tannins, saponins, alkaloids). Saponin (in excess) causes hypocholestrolaemia because it binds cholesterol making it unavailable for absorption (Soetan and Oyewole, 2009).

The results of hormone profile of WAD bucks fed with graded level of *Vitex doniana* shown in Table 5 there were significant differences in luteinizing hormone and these ranges from 0.10 ± 0.03 in Treatment D and Treatment E to 0.40 ± 0.03 in Treatment A. LH has been reported to stimulate testosterone output in a variety of in-vitro systems including perfused testes, incubations of testicular slices, minces or homogenates, incubations of entire decapsulated testes and in suspensions of purified Leydig cells (Catt and Dufau, 1976).

Follicle stimulating hormone increases gradually but pick up at Treatment D (15g inclusion level) which had the highest value of 4.75 ± 0.39, followed by Treatment E (4.00 ± 0.39). Treatment A had the lowest value of 0.50 ± 0.39. This support the work of El Safoury and Bartke (1974) that increase in serum estradiol levels cause a decrease in FSH production by inhibiting GnRH production in the hypothalamus. The decrease in serum FSH level causes the smaller follicles in the current cohort to undergo atresia as they lack sufficient sensitivity to FSH to survive (Thorner *et al*., 1977).

There was significant different in the Testosterone of West African Dwarf bucks. Treatment D had the highest value (7.10 ± 0.34) while Treatment C had the lowest value (0.30 ± 0.34). Testosterone is essential for health and well-being as well as the prevention of osteoporosis. (Tuck and Francis, 2009).

There were no significant differences in prolactin, this shows that *Vitex doniana* has no deleterious effect on the reproductive performance of West African Dwarf bucks at Treatment D (15g inclusion level). Prolactin has been reported to enhance spermatogenesis by augmenting the effect of endogenous or exogenous LH on testicular steroidogenesis rather than potentiating the effect of androgens on the seminiferous epithelium (Bartke *et al.*, 1978).

Table 3: Phytochemical composition of *Vitex doniana* leave meal

PHYTOCHEMICALS	**QUALITATIVE**	**QUANTITATIVE (Mg/100g)**
ALKALOIDS	+	2.61
SAPONINS	++	6.48
TANNINS	+	1.45
FLAVONOIDS	++	20.82
TERPONIDS	+	0.21
PHENOLS	+++	96.14

STEROIDS	+	2.02
ANTHRAQUINONES	+	0.04

KEY: + PRESENT; ++ MODERATELY PRESENT; +++ HIGHLY PRESENT

Table 4: Effects of graded levels of *Vitex doniana* leave meal on blood cholesterol of West African dwarf bucks

Parameters	**A**	**B**	**C**	**D**	**E**	**±SEM**
Total cholesterol (mmol/L)	0.65^{ab}	0.45^{b}	0.70^{ab}	0.65^{ab}	1.20^{a}	0.14
Triglyceride (mmol/L)	0.10^{b}	0.15^{b}	0.45^{a}	0.10^{b}	0.15^{b}	0.02
Low-density lipoprotein (mmol/L)	0.30^{b}	0.30^{b}	0.45^{ab}	0.40^{b}	0.70^{a}	0.06
High-density lipoprotein (mmol/L)	0.25^{b}	0.04^{d}	0.30^{a}	0.10^{c}	0.10^{c}	0.02

a, b, c, d – means along the rows with different superscripts differ significantly ($p<0.05$); A (basal diet without *Vitex doniana* leaf meal), B (basal +5g *V. doniana*), C (basal +10g *V. doniana*), D (basal +15g *V. doniana*), E (basal + 20g *V. doniana*).

Table 5: Effects of graded levels of *Vitex doniana* leave meal on blood hormone profile of West African dwarf bucks

Parameters	**A**	**B**	**C**	**D**	**E**	**±SEM**
Luteinizing hormone (MIU/ml)	0.40^{a}	0.25^{b}	0.15^{bc}	0.10^{c}	0.10^{c}	0.03
Follicle-stimulating hormone (MIU/ml)	0.50^{b}	1.50^{b}	3.25^{a}	4.75^{a}	4.00^{a}	0.39
Testosterone (ng/dl)	5.5^{b}	2.2^{c}	0.3^{d}	7.1^{a}	0.4^{d}	0.34
Prolactin (µg/L)	0.5^{b}	0.25^{b}	0.5^{b}	0.9^{a}	0.6^{ab}	0.19

a, b, c, d – means along the rows with different superscripts differ significantly ($p<0.05$); A (basal diet without *Vitex doniana* leaf meal), B (basal +5g *V. doniana*), C (basal +10g *V. doniana*), D (basal +15g *V. doniana*), E (basal + 20g *V. doniana*).

CONCLUSION AND RECOMMENDATION

In conclusion, the use of *Vitex doniana* at varying inclusion level could control cholesterol and increases reproductive performance in West African Dwarf Bucks and it is economically cheap for easy adoption for smallholder farmers. The study indicate that 10g inclusion level of *Vitex doniana* control cholesterol in WAD bucks and 15g inclusion level of *Vitex doniana* increases the reproductive performance of WAD bucks, this confirms the report of various authors that *Vitex doniana* improve male sexual performance, enhance sexual behavior and slightly increase hormone levels. It is recommended that 15g of *Vitex doniana* leaf meal should be

included in formulated ruminant diet for improved reproductive performance while it could be reduced to 10g inclusion in meat animals to reduce cholesterol deposit. Further studies should be done on the mechanism for effecting the changes on the animal and the residual effect on the animal product.

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Animal Physiology, Reproduction and Health

Influence of Aqueous Leaf Extract of *Moringa oleifera* lam. on Liver and Kidney histo – architecture and Liver Indices enzymes of growing rabbit bucks

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Abstract: The influence of aqueous leaf extract of *Moringa oleifera* Lam. on the liver and kidney histo-architecture, as well as liver indices enzymes (ALP, ALT, and AST) of 36 rabbit bucks were investigated in a completely randomized design experiment and another 15 bucks were used to establish the lethal dose fifty of the leaf extract in this study. The *Moringa oleifera* leaf was harvested, processed into aqueous extract and stored in a refrigerator at 2^0C for further use and the assigned treatment levels of the prepared leaf extract were then drawn and administered orally via syringe to each of the bucks in their respective treatment groups for 5 days within 56^{th}-84^{th} days period of the buck's age. Liver and kidney were harvested for histological study; while blood samples were collected for liver enzyme test. The result revealed the value of LD_{50} to be 9.0 ml/kg body weight of the rabbit bucks. Significant ($p > 0.05$) reduction in the values of liver indices enzymes in comparison with the values of their respective control group were observed. The photomicrographs of liver and kidney of bucks receiving the different treatment levels of the test extract revealed normal histo- architecture. Hence, the test extract at the dose levels employed in this investigation did not present any marked negative influence on the assessed parameters and could be recommended for use in production of rabbit bucks.

Keywords: Moringa oleifera Lam.; aqueous leaf extract; histo- architecture; lethal dose 50, liver; kidney rabbit bucks

DESCRIPTION OF THE PROBLEM

Leaf extracts exhibit the greatest antioxidant activity, and *Moringa oleifera* Lam. leaf is claimed to be very nutritive (1) having specific plant pigments with demonstrated potent antioxidant properties arising from the presence of some important phytochemical compounds (2). Most herbal practitioners believe that plant medicines are non-toxic and free from undesirable side effects. To ascertain this, (3) opined liver enzyme indices study; as well as liver and kidney histological assessment are good indicators of side effects since any alteration in their structural appearance portrays adverse effects and hence this study.

METHODOLOGY

The experiment was conducted at the University of Uyo Teaching and Research Farm, Use Offot, Uyo Local Government Area of Akwa Ibom State, Nigeria, with a total of 51 mixed breeds (Chinchilla and New Zealand) domesticated rabbit bucks of 5 - 6 weeks old. At the commencement of the experiment, the bucks were weighed individually and randomly assigned into 4 treatment (T) groups (T1, T2, T3 and T4) in a Completely Randomized Design (CRD) and 0 ml, 2.5 ml, 5.0 and 7.5 ml of the test extract per kg body weight of the bucks administered respectively. Oral administration of the leaf extract was done via syringe to each of the bucks in their respective treatment groups for 5 days within the 56^{th} – 84^{th} day of the bucks' age. Each treatment had three replicates with three bucks. Fresh feed and drinking water were provided with normal daily routine management practices in all treatment groups. The processed *Moringa oleifera* Lam. leaf extract was stored in a refrigerator at 2°C for further administration to the bucks. Fixed – dose procedure (FDP) (4) was employed to establish the lethal dose $_{50}$ of the test leaf extract using 15 bucks from the 51 bucks acquired at 5 bucks per trial at 5 ml, 8.5 ml and 10 ml.

The liver enzyme indices [Alkaline phosphate (ALP), Alanine aminotransferase (ALT), and Aspartate aminotransferase (AST)] were determine from blood samples collected from the bucks; whereas the histological study of the harvested liver and kidney was conducted by processing them routinely for paraffin embedding and section to 5µ thickness for staining with haematoxylyn and eosin (H&E). Data analysis was done with General Linear Model (GLM) procedure of SAS System (5); and Duncan's New Multiple Range Test (6) was used to separate the significant means.

RESULTS AND DISCUSSION

The result of lethal dose investigation showed no mortality at 5ml, dull and inactive bucks at 8.5ml and death of two bucks at10ml. (7) described any chemical substance with LD_{50} estimate greater than 2-5g (equivalent to 2-5 ml/kg) oral route as having a low toxicity and safe. These results is in accordance with (8) who maintained that *Moringa oleifera* leaf extracts are non-lethal at 2000 mg/kg.

The result of the liver function test and liver histology (Plates A-D) shows negative influence on the bucks. Significant ($p > 0.05$) decrease in the values of these enzymes (ALP, ALT, and AST) which were within the ambient of the standard recommended value (9) were observed in comparison to the values of their respective control group. This result found support from (10) who reported that *Moringa oleifera* Lam. leaf prevents liver against damage. The photomicrographs for histological sections of the liver for the various treatment groups revealed normal cellular architecture when compared to the control group. This result was at variance with (8) who reported alterations induced by *Moringa oleifera* Lam. leaf meal; but found support from (11) and (12) who both reported that aqueous leaf extract of *Moringa oleifera* Lam. protect liver damage from high fatty diet. Similarly, the photomicrographs for histological sections of kidney (Plates E- H) also revealed normal cellular profile and was supported by (13).

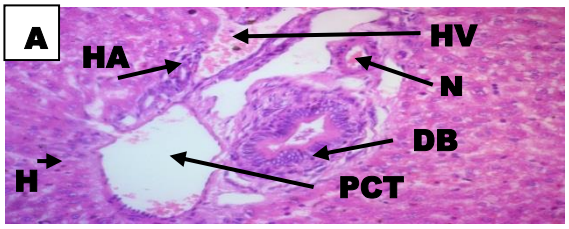
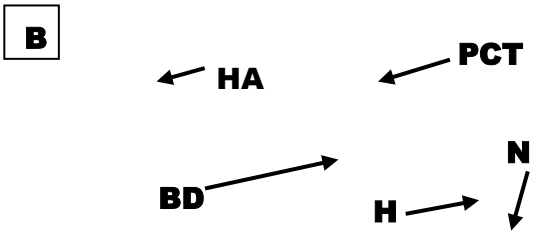


Plate A. Photomicrograph of liver section of rabbit buck at magnification x400 not treated with *Moringa oleifera* Lam. leaf extract stained with H & E technique showing normal architecture



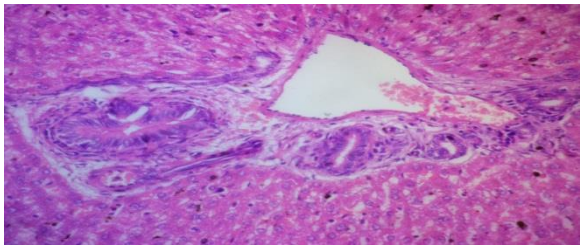
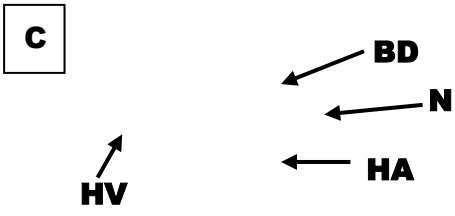


Plate B. Photomicrograph of liver section of rabbit buck at magnification x400 treated with 2.5 ml *Moringa oleifera* Lam. leaf extract stained with H & E technique showing normal architecture



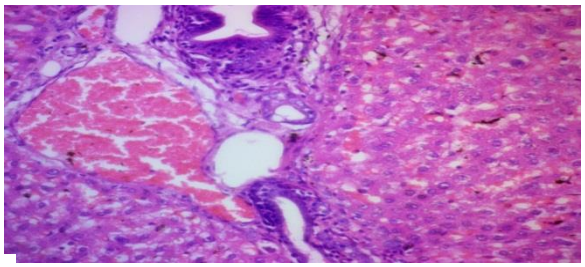
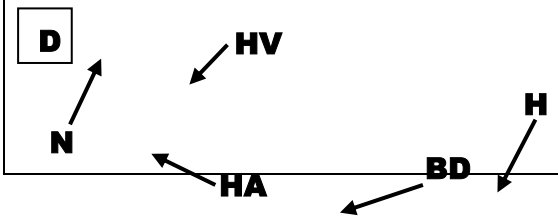


Plate C. Photomicrograph of liver section of rabbit buck at magnification x400 treated with 5.0 ml*Moringa oleifera* Lam. leaf extract stained with H & E technique showing normal architecture



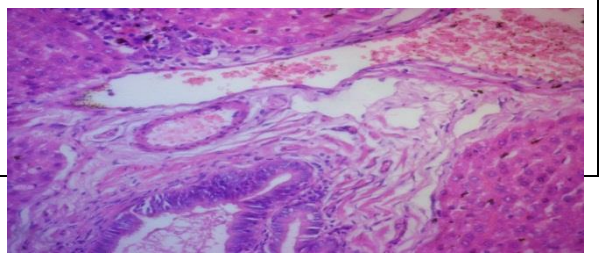


Plate D. Photomicrograph of liver section of rabbit buck at magnification x400 treated with 7.5 ml *Moringa oleifera* Lam. leaf extract stained with H & E technique showing normal architecture.

Keys: Portal Triad (**PT**), Bile Duct (**BD**), Hepatic Artery (**HA**), Hepatic Vein (**HV**), Hepatocytes (**H**), Nucleus (**N**), Haematoxylin And Eosin (**H&E**).

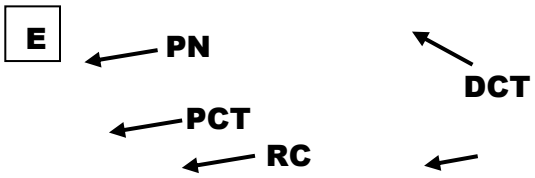


Plate E. Photomicrograph of Kidney section of rabbit buck at magnification x400 not treated with *Moringa oleifera* Lam. leaf extract stained with H & E technique showing normal architecture

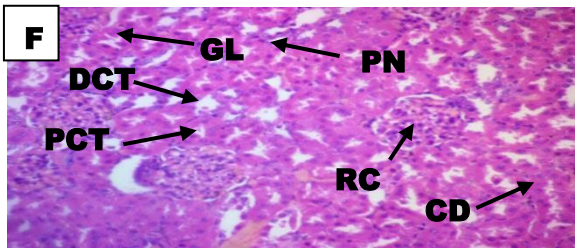


Plate F. Photomicrograph of Kidney section of rabbit buck at magnification x400 not treated with 2.5 ml *Moringa oleifera* Lam. leaf extract stained with H & E technique showing normal architecture.

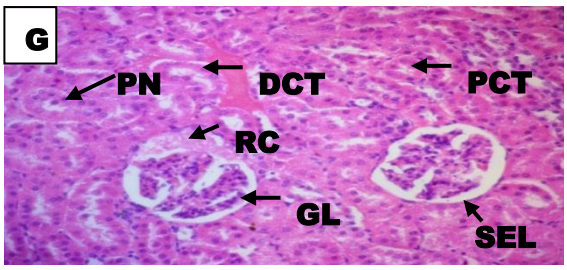


Plate G. Photomicrograph of Kidney section of rabbit buck at magnification x400 treated with 5.0 ml *Moringa oleifera* Lam. leaf extract stained with H & E technique showing normal architecture

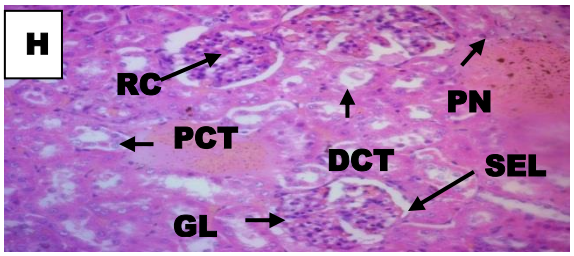
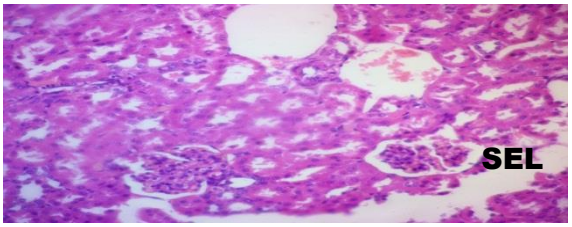


Plate H. Photomicrograph of Kidney section of rabbit buck at magnification x400 treated with 7.5 ml *Moringa oleifera* Lam. leaf extract stained with H & E technique showing normal architecture

Keys: Renal Corpuscle **(RC),** Proximal Convoluted Tubules **(PCT),** Distal Convoluted Tubules **(DCT),** Collecting Ducts **(CD),** Squamous Epithelial Lining **(SEL),** Glomerulus (**GL**) Pyknotic Nucleus (PN**),** Haematoxylin and Eosin (**H&E**).



CONCLUSION AND RECOMMENDATION

(1) There was significant ($p > 0.05$) reduction in the values of the liver enzyme indices (ALP, ALT, and AST) in comparison with the values of their respective control group.
(2) Normal cellular architecture of the liver and kidney were observed in this present experiment which shows a negative influence on these organs even with the administration of the test extract up to 7.5ml/kg.
(3) This may also proof that the plants' aqueous leaves extract is relatively safe for use nutritionally and medicinally and may be used in production of rabbit bucks.

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Haematology and Blood Biochemistry of West African Dwarf Bucks Fed Graded Levels of Black Plum (*Vitex doniana*) Leave Meal

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Abstract: Fifteen (15) West African Dwarf bucks with average initial weights of 10kg were used in an experiment to investigate the effect of varying levels of *Vitex doniana* leaf meal on the haematology and serum biochemistry of West African Dwarf buck. The animals were randomly signed to five treatments in a completely randomized design and the experiment lasted for twenty-eight (28) days. At the end of the feeding trial, blood samples were collected from the jugular veins of the animal for the determination of haematological and serum biochemical characteristics using standard laboratory methods. The effects of graded levels of *Vitex doniana* leaf meal on haematology of West African dwarf reveals that red blood cell (RBC) significantly ($p<0.05$) increase with concurrent increase in *Vitex doniana* leaf meal whereas the haemoglobin (Hb) and packed cell volume (PCV) reduced with the addition of the leaf meal. Other parameters were not significantly ($p>0.05$) different from the control, although it varies with increase in the leaf meal addition. The serum biochemistry of West African dwarf bucks showed that total protein (TP), albumin (ALB), urea and glucose significantly increase with increase in *Vitex doniana* leaf meal. Alkaline phosphatase (ALP), Alanine aminotransferase (ALT) and Aspartate aminotransferase (AST) was significantly ($p<0.05$) influenced by the increase in *Vitex doniana* leaf meal inclusion. The ALT and AST were not significantly ($p<0.05$) different ($p<0.05$) from the control in treatment D. All the haematological and serum biochemical characteristics of the bucks were within the normal/ standard blood ranges for apparently healthy bucks. The study therefore concludes that farmers can supplement goat feed with up to 20% *Vitex doniana* leaf meal in formulated diets meant for goats, without fear of compromising haematopoietic processes and chemistry

Keywords: Feed, bucks, leaf meal, blood.

INTRODUCTION

Production of ruminant animals in developing African countries is often characterized with low level of efficiency. The apparent inefficiency of ruminant production was attributed to unfavourable climate, disease prevalence and feed shortage especially during dry seasons. The first two factors tend to encourage adoption of intensive ruminant farming system which can further aggravate the problem of inadequate feed supply. The cost of feed accounts for about 60% of total intensive production cost compared to 40% value under extensive production system (Atteh, 2002). A large reduction in feed cost is achievable by the use of unconventional feed resources such as fodder or shed tree leaves to bring about improvement in ruminant production efficiency in the resource poor developing countries like Nigeria.

The aim of the present work was to exploit the potential of *Vitex doniana* (black plum) leaves, which presently are of little economic value for goat feeding under intensive system of production. The work aims at assessing the nutritive value of *Vitex doniana* leaves through a feeding trial with goats.

Materials and Methods

Site and Period of the Study: Feeding trials and laboratory analyses were conducted in the Livestock unit of the University Farm and the Animal Production Laboratory respectively at the Department of Animal Production, University of Ilorin located on Latitude 08^{o} 29`N; Longitude 004$^{o}$ 35`E; Elevation 308 m, having a mean annual rainfall of 98.75 mm that is spread largely over the months of May to October.

Collection and Processing of *Vitex doniana* Leaves

Fresh leaves were collected from *Vitex doniana* (Black plum) trees on the University of Ilorin farm during the dry season months of November and December. Leaf samples were identified at the Faculty of Life Science,

University of Ilorin Herbarium and a sample deposited with assigned voucher number. The leaves were subsequently air-dried for 10 days and kept inside jute bags in a well ventilated open shed that was protected from rain and direct rays of sunlight. The leaves were later processed by grinding in a hammer mill to pass through 2 –mm sieve and kept in jute bags for subsequent feed formulation. Samples of the leaves were analyzed for gross energy, dry matter and chemical components (Table 1).

Feed Formulation and Processing: The leaves were mixed with crushed maize, soy bean meal, bone meal and sodium chloride in the different inclusion levels of 0, 5, 10, 15 and 20g/kg of leaves to feed as indicated on Table 1. The resultant feeds were processed into crumbles to reduce dustiness, facilitate handling and encourage intake by animals. Each feed was wetted with about 2% (V/W) clean drinking water and sun-dried on concrete slab for 5 – 6 hours.

Experimental Design and Animal Management: A 28 – day growth and nutrient digestibility trial was conducted with fifteen weanling male West African Dwarf goats of average initial live weight of 10.50 ± 0.34. Goats were divided into five dietary treatment groups of three bucks each in a completely randomized design. Animals in treatment A (control) were given formulated diet with no *Vitex doniana* leaf meal while the other four treatment (B, C, D and E) had *Vitex doniana* leaf meal in varying inclusion level of 5, 10, 15 and 20g/kg of feed respectively. The animals were fed 300g/day of the formulated feed throughout the experimental period. *Panicum maximum* were also provided in abundance for the bucks.

On the 28th day, blood was collected by jugular vein puncture with hypodermic needles and syringe from three animals per treatment into two (2) clean test tubes, one with an anticoagulant, Ethylene Diamine tetra Acetate (EDTA) for haematological analysis and the other without EDTA for serum biochemical analysis. All haematological parameters were determined by conventional laboratory methods of Baker and Silverton (1982). Serum biochemical indices were assayed using standard laboratory methods (Ochei and Kolhatkar, 2007). All data were analyzed using the analysis of variance (ANOVA) procedure following a completely randomized model (Steel and Torrie, 1980) and the levels of significance were determined using the Duncan's Multiple Range Test.

Table 1: Composition of basal experimental diet

Ingredients	% Inclusion
Maize	30
Groundnut cake	14
Wheat offal	33
Rice bran	10
Palm kernel cake	10
Table Salt	1
Premix	0.25
Limestone	1
Bone meal	0.75
Total	100

Table 2: Proximate composition of experimental diets and *Vitex doniana* leaf meal

Where A is the control (basal diet without *Vitex doniana* leaf meal), B (basal +5g *V. doniana*), C (basal +10g *V. doniana*), D (basal +15g *V. doniana*), E (basal + 20g *V. doniana*), V (*Vitex doniana* leaf meal)

Parameter (%)	**A**	**B**	**C**	**D**	**E**	**V**
Dry matter	84.62	91.46	90.88	90.98	91.51	**92.75**
Moisture content	15.38	8.54	9.12	9.02	8.49	**7.25**
Crude fat	3.94	4.98	2.91	4.39	5.42	**6.44**
Crude protein	16.19	16.59	19.69	16.79	15.31	**8.53**
Crude fibre	6.05	13.40	8.35	9.03	9.14	**7.15**
Ash content	8.69	10.23	8.33	9.50	8.56	**8.26**

RESULTS AND DISCUSSION

The effects of graded levels of *Vitex doniana* leaf meal on haematology of West African dwarf reveals that red blood cell (RBC) significantly increase with concurrent increase in *Vitex doniana* leaf meal whereas the haemoglobin (Hb) and packed cell volume (PCV) reduced with the addition of the leaf meal (Table 3). Other parameters were not significantly different from the control, although it varies with increase in the leaf meal addition. Table 4 shows the effects of graded levels of *Vitex doniana* leaf meal on serum biochemistry of West African dwarf bucks. The result showed that total protein (TP), albumin (ALB), urea and glucose significantly increase with increase in *Vitex doniana* leaf meal. Alkaline phosphatase (ALP), Alanine aminotransferase (ALT) and Aspartate aminotransferase (AST) was significantly influenced by the increase in *Vitex doniana* leaf meal inclusion. The ALT and AST were not significantly different ($p<0.05$) from the control in treatment D.

Table 3: Effects of graded levels of *Vitex doniana* leaf meal on haematology of West African dwarf bucks

Parameters	**A**	**B**	**C**	**D**	**E**	**±SEM**
Red blood cells$\times10^{12}$/L	12.68^{d}	12.88^{c}	13.18^{b}	13.22^{b}	13.89^{a}	0.03
Haemoglobin (g/dl)	9.86^{b}	10.70^{a}	10.63^{a}	9.22^{c}	9.36^{c}	0.26
Packed cell Volume (%)	26.00^{b}	28.33^{a}	29.00^{a}	24.00^{c}	24.33^{c}	1.32
White blood cells$\times10^{9}$/L	13.33^{a}	13.00^{ab}	13.00^{ab}	12.56^{b}	12.78^{ab}	1.81
Neutrophils (%)	21.67^{ab}	20.00^{b}	23.33^{a}	23.33^{a}	23.33^{a}	1.84
Lymphocyte (%)	83.70^{ab}	90.03^{a}	78.45^{b}	77.04^{b}	74.07^{b}	1.23
Monocytes (%)	2.33^{b}	3.00^{a}	1.33^{c}	1.33^{c}	1.33^{c}	0.37
Eosinophil(%)	0.00^{b}	1.00^{a}	0.00^{b}	0.00^{b}	0.00^{b}	0.87

a, b, c, d – means along the rows with different superscripts differ significantly ($p<0.05$); A (basal diet without *Vitex doniana* leaf meal), B (basal +5g *V. doniana*), C (basal +10g *V. doniana*), D (basal +15g *V. doniana*), E (basal + 20g *V. doniana*).

Table 4: Effects of graded levels of *Vitex doniana* leaf meal on serum biochemistry of West African dwarf bucks

Parameters	**A**	**B**	**C**	**D**	**E**	**±SEM**
Total protein (g/L)	10.00^{b}	11.67^{a}	9.65^{ab}	9.15^{b}	11.33^{a}	1.19
Albumin (g/L)	3.67^{c}	3.77^{b}	3.67^{c}	3.00^{d}	4.44^{a}	0.35

Urea (mmol/L)	2.00[d]	2.53[c]	3.10[b]	2.07[d]	5.73[a]	0.26
Creatinine (µmol/L)	0.24[d]	0.39[a]	0.24[d]	0.27[c]	0.31[b]	1.04
Glucose (mmol/L)	0.57[b]	0.87[a]	0.33[c]	0.30[c]	0.83[a]	0.05
ALP (IU/L)	86.00[c]	68.67[d]	98.00[b]	108.33[a]	108.33[a]	2.83
ALT (IU/L)	27.67[a]	26.00[b]	21.67[c]	28.00[a]	17.67[d]	1.19
AST (IU/L)	90.33[b]	83.33[b]	88.00[b]	92.00[b]	142.33[a]	0.91

a, b, c, d – means along the rows with different superscripts differ significantly ($p<0.05$); A (basal diet without *Vitex doniana* leaf meal), B (basal +5g *V. doniana*), C (basal +10g *V. doniana*), D (basal +15g *V. doniana*), E (basal + 20g *V. doniana*), ALT- Alanine aminotransferase, ALP- Alkaline phosphatase and AST- Aspartate aminotransferase.

Red blood cell (RBC) of $13.89\pm0.03\times10^{12}$/L obtained for buck receiving *Vitex doniana* leaf meal at level of 20g in treatment E was significantly ($P>0.05$) higher than all other treatment. RBC values of $12.88\pm0.03\times10^{12}$/L in treatment A and $13.89\pm0.03\times10^{12}$/L in treatment E were in contrast with the report of Kocatepe (2012) in Saanen goats but was within the range reported by Daramola *et al.* (2005) in West African Dwarf goat. It could be said that RBC value changes with breed. It therefore shows that *Vitex doniana* has no negative effect on the health status of the animal. Haemoglobin concentration (g/dl) were significantly higher ($P>0.05$) in treatment B and C while A was slightly different from treatment C and D. The haemoglobin concentration was within the normal range reported by Daramola *et al.* (2005). Increase in haemoglobin implies that the animals were able to transport oxygen to tissues for oxidation of ingested food so as to release energy for the other body functions (Olorunnisomo *et al*., 2012). The PCV value fell within the normal range reported by Tambuwal *et al.* (2002) for Red Sokoto goat; *Vitex doniana* leaf meal has positive effect on treatment two and three but this decrease at four and five. The WBC counts were in contrast with the report of Kocatepe (2012) on Saanen goat. This different could be as a result of breed, environmental factor and age of the animal. Neutrophil, the most abundant of white blood cell type increases from treatment B to C but constant till treatment E which means *Vitex doniana* has no significant effect again with 20g of the leaf meal. Lymphocytes are the largest type of white blood cell and it is a-granulocyte. It is significant ($P>0.05$) at treatment B while it was constant at treatment C, D and E. Eosinophil was only significant in treatment B. Eosinophils are responsible for fighting infections of parasitic worms. These cells release toxins that kill the worms and are also involved in the inflammatory response when there is an allergic reaction. This fell within normal range reported by (Daramola *et al.*, 2005; Zamiri and Heidari, 2006).
Total protein value is significantly high ($P>0.05$) compared with the control, *Vitex doniana* leaf seems to improve the total protein which serves as buffer in the maintenance of Acid-base balance and a carrier of essential blood constituents such as hormone, vitamins and certain minerals. Plasma protein helps to transport calcium, phosphorus and other substances in the blood by attachment to the albumin (Dacie and Lewis, 2001; Okukpe *et al.*, 2015). Albumin which is most abundant serum total protein, in this study, it is high in treatment five but no significant different between other treatments and control. This implies that *Vitex doniana* leaf meal at 20g improve Albumin level. Urea and creatinine are waste products of protein metabolism and waste generated from creatine respectively. High value of urea is toxic to the body likewise the high value of creatinine shows a renal dysfunction. Though, urea is high in treatment E followed by treatment C, while the others including control are indifferent, but these values still fell within the normal range reported by Daramola *et al.*, (2005). Hence, the leaf meal has no deleterious effect on bucks. Glucose level was significantly different at treatment B compared with control but decreases at treatment C, but gradually increases at treatment E. When glucose is lower than the normal range, it is an indication of hypoglycaemia while higher levels are indication of hyperglycaemia (Okukpe *et al*., 2015). Alkaline phosphatase (ALP) increases with increase in level of the leaf meal inclusion. Alanine aminotransferase in this study fell within normal range reported by Kocatepe (2012) on Saanen goat, also

Aspartate aminotransferase increases with increase in level of leaf meal inclusion but still within the normal range (Ochei and Kolhatkar, 2007).

CONCLUSION AND RECOMMENDATION

In conclusion, *Vitex doniana* leaf meal has a valuable non-conventional feedstuff potential; Livestock farmers can use it as a feed supplement in the diet of West African dwarf bucks with up to 20g/kg concentrate feed, without fear of compromising haematopoietic processes and blood chemistry. Further investigation is suggested to determine the possibility of 100% *Vitex doniana* leaf meal in West African dwarf goat diets and its effect on blood chemistry as well as other physiological processes.

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Physiology

Breed and Gender effect on Blood profile of Muturu and Bunaji cattle in Benue and Ogun State, Nigeria

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Abstract: Blood is an important tool in the evaluation of metabolic, productive, reproductive, health and adaptability status of animals. This research was conducted to study the blood profile of Bunaji and Muturu cattle in Benue and Ogun States. A total of 480 cattle comprising 240 of each breed and 120 of either gender at each location were studied. The experiment was set in a 2×2×2 factorial format in a completely randomized design (CRD) with location, breed and gender as factors. Samples were collected five times at each location. Blood parameters analyzed were Packed Cell Volume (PCV), Haemoglobin (Hb), Red Blood Cell Count (RBC), Lymphocytes, Granulocytes and Monocytes. The result showed that Muturu cattle presented significantly ($p<0.05$) higher mean PCV, Hb, WBC, percent Lymphocyte and Monocytes. It was also observed that Muturu cattle at Benue State showed higher ($p<0.05$) mean PCV, RBC and percent granulocyte while the Bunaji presented higher ($p<0.05$) mean MCHC, with the bulls presenting significantly ($p<0.05$) higher mean MCHC (39.45g/dl) than the cows (36.38g/dl). Similarly, higher ($p<0.05$) mean MCHC were observed in Muturu bulls (31.02g/dl) in Benue State compared to the cows (28.90g/dl) is same location. These variations in mean MCHC were not observed among breed and gender of cattle in Ogun State. Mean lymphocytes and granulocytes also varied significantly ($p<0.05$) with Bunaji gender at Ogun State. The study concluded that location and breed affected haematological parameters of cattle breed investigated.

Keywords: Breed, Gender, Blood, Muturu, Bunaji

INTRODUCTION

Haematological values during different physiological situations could be used for the diagnosis of various pathological and metabolic disorders, which can adversely affect the productive and reproductive performance of cattle, leading to heavy economic losses (Sattar and Mirza, 2009). In addition, habitat quality and adaptability to environmental conditions can be assessed by haematologic parameters (Pavlik*et al.*, 2010). The Bunaji breed makes up higher percentage of cattle and they are found in the drier north and sub-humid zones of Nigeria while the Muturu are the main indigenous breed (ILCA, 1979). A detailed appraisal of the nutrition and health status of beef cattle in extensive management condition is a prerequisite for effective production of quality beef. In addition, variations in environmental factors and/or nutrition are known to influence diseases prevalence and productivity of the animal (Mordak and Nicpoń, 2006). The study of blood parameters is more economical compared to the traditional measures of effect such as reduction of mortality. It serves also as an excellent medium for the measurement of potential biomarkers, because its collection is relatively non-invasive and it encompasses an enormous range of physiological process in the body at any given time (Adenkola*et al.*, 2009). Apart from veterinary uses of blood picture, it enables one to see weak points on the farm and it is a useful tool to improve the health, welfare and productivity of the animal (Pavlik*et al.*, 2010). Currently in Nigeria, the available information on the haematology and serum chemistry of indigenous cattle with reference to seasonal influence is inadequate or tending to being obsolete. This study was designed to evaluate the effects of location, breedand gender on blood profile of Muturu and Bunaji breeds of cattle.

MATERIALS AND METHODS

The experiment was carried out in Ogun and Benue States of Nigeria. Farmers' animals were used for the experiment. A total of four hundred and eighty (480) animals were used for the experiment. Two hundred forty (240) mature cattle comprising of Muturu and Bunaji were sampled. This is made up of one hundred and twenty (120) of either gender in Benue and Ogun States. The experiment is a symmetrical factorial (2×2×2) arrangement in a complete randomized design (CRD). The factors include two breeds of cattle (Muturu and Bunaji), two locations (Benue and Ogun States) and two genders (Bulls and Cows). Fivemililitres of blood sample was collected from the jugular vein of each animal by veinupuncture over ethylene-diamine-tetra-acetic acid (EDTA) in a haematological bottle for laboratory analysis of cellular components of the blood. Haematological analysis was carried out using Mindray® BC-2800Vet auto haematology analyzer. The parameter measured included values for red blood cell (RBC) count, white blood cell (WBC) count, haemoglobin (Hb), packed cell volume (PCV), mean cell haemoglobin concentration (MCHC) and leucocyte differential cell counts. Data collected were subjected to analysis of variance (ANOVA) using GENSTAT® (2011) version 4 statistical packages. Where significant differences occurred, the mean was subjected to Duncan Multiple Range Test (DMRT) using SAS® (2009) version 9.2 statistical packages.

RESULTS AND DISCUSSIONS

The result showed that location significantly ($p<0.05$) influenced mean percent PCV, RBC, WBC, percent lymphocytes, granulocytes and monocytes. Etim*et al*. (2014) documented cow reference ranges of PCV (24 – 48%), Hb (8 -15g/dl), WBC ($4 – 12\times10^{3)}$, MCHC (30 -36g/dl) and RBC ($5.0 – 10.0\times10^{6}/mm^{3}$). Generally, blood parameters can be influenced by age, gender, breed, climate, geographical location, day length, nutritional and physiological status of the animal (Addass*et al*., 2012); stress, exercise, transport and disease condition (Etim*et al*., 2014). It could be inferred from value of mean percent PCV that serum total protein was higher in the cattle at Benue than Ogun State. Opara*et al.* (2010) had noted that PCV is proportional to the level of total protein. The WBC value observed in cattle at Benue State in this study could be compared to the value reported (Mahima*et al.* 2013). However, the higher ($p<0.05$) value of WBC of cattle at Ogun State may be a response to immune challenges. The number of circulating WBC corpuscles is contingent on the demand and their development along different lineages is governed by external stimuli including cytokines, matrix proteins (Ravandi and Hoffman, 2005). Breed differences ($P<0.05$) were also noticed in the mean percent PCV, RBC, Hb and WBC. The muturu breed was observed to have higher ($p<0.05$) value for PCV, RBC, Hb and WBC but lower MCHC. Addass*et al*. (2012) reported variation in haematological parameters in breeds of cattle at Adamawa state in Nigeria. Njidda*et al.*, (2013) pointed out PCV and Hb correlated with nutritional status of animals. The result of this study may then imply that the muturu are healthier; better adapted and nourished as compared to the bunaji. Other disparities in the parameters due to gender observed in this experiment were numerical. The findings of this work agreed with Mapiye*et al.* (2010) that gender does not have effect on PCV of cattle. The gender differences in the MCHC may be attributed to genetic and physiologic distinction between the genders of cattle (Njidda*et al*., 2013)

Table 1: Effect of location, breed and gender interaction on haematological profile of cattle in Benue and Ogun state

Parameters	Treatment Combination								SEM
	Benue				Ogun				
	Bunaji		Muturu		Bunaji		Muturu		
	Bulls	Cows	Bulls	Cows	Bulls	Cows	Bulls	Cows	
PCV (%)	28.29^{d}	29.89^{d}	37.02^{a}	37.90^{a}	32.75^{c}	32.72^{c}	34.99^{b}	34.35^{bc}	0.63
RBC ($\times 10^{6}$/µl)	7.82^{a}	7.88^{a}	8.25^{a}	8.10^{a}	4.24^{c}	4.46^{c}	5.80^{b}	5.26^{b}	0.23
Hb (g/dl)	10.66^{ab}	10.40^{bc}	10.75^{ab}	10.76^{a}	10.21^{c}	10.21^{c}	10.78^{a}	10.81^{a}	0.13
WBC ($\times10^{3}$/µ/l)	6.52^{c}	6.76^{c}	11.14^{b}	11.36^{b}	11.45^{b}	10.96^{b}	16.30^{a}	16.18^{a}	0.46

MCHC (g/dl)	39.45^{a}	36.38^{b}	31.02^{c}	28.90^{d}	31.55^{c}	31.38^{c}	31.15^{c}	31.70^{c}	0.84
Lymphocytes (%)	31.60^{d}	30.58^{d}	31.15^{d}	31.55^{d}	44.40^{b}	38.35^{c}	55.50^{a}	52.87^{a}	1.56
Granulocytes (%)	55.80^{ab}	55.95^{ab}	60.36^{a}	56.69^{ab}	44.01^{c}	51.57^{b}	33.28^{d}	33.23^{d}	1.69
Monocytes (%)	4.77^{cd}	3.78^{d}	5.53^{cd}	6.27^{c}	11.59^{ab}	10.42^{b}	11.22^{b}	12.48^{a}	0.43

Key: PCV= Packed cell volume; RBC= Red blood cell; Hb = haemoglobin; WBC=White blood cell; MCHC= Mean corpuscular haemoglobin count. SEM= standard error of means. Means in the same row with different superscript(s) differ significantly ($p<0.05$).

CONCLUSION

The result of this study showed that haematological parameters of Bunaji and Muturu cattle measured were influenced by location and breed. Muturu breed were better adapted and nourished than the Bunaji breed of cattle.

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Index of Reproduction and Production Performance of Doe Among Small Holder Goats Herd in Bali, Taraba, Nigeria

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Abstract: The parity and litter size of doe from randomly 30 selected herds in five wards of Bali-Town were surveyed to determine the relationship between the herd size, parity and litter size of small holder goat's herds. The study revealed that the average parity and litter size of small holder goats' herd was 1.23 and 1.2, respectively with mean herd size of 1.5 goats. Majority of the breeding were among the size of 5 to 10 goats (63.3%), 11 to 20 goats (26.7%) followed by 31 and above (6.7%) and least, 21-30 goats (3.3%). Most of the breeding does were within the 1st and 2nd parity (83%) and (13.3%) a number within the 4th parity (3.3%). Although the farmers started culling the does after 2nd parity with the majority of does were culled after 4th parity. Relating to the distribution of the parity and litter size showed that single bearing does could remain in the herds up to 4th parity, but with the number of decreasing with increasing in parity. Twinning does exist up to parity 4. However, this litter size was attained at much latter parity by the does. The result presented seem to indicate that parity is an important factor in the evaluation of litter size in goats and multiple births could be achieved with good breeding plant and better management practices.

INTRODUCTION

Kidding frequency and litter size are important components of an efficient kid production system litter size or number of kids in the litter as defined by Alexander *et al*, (1999) is a total number of born kids per kidding per goal. The number of young produced per female per year measuring reproductive potentials i.e. reproductive rate. This is a major importance in goat production and determined by age at first estruses, oestrus duration, oestrus cycles length, number of services per conception rate, age of first kidding litter size, interval between kidding, weaning age and number weaned. Awemu*et al.* (1999) stated that the ability to kid is a major factor that determines productivity in different goals production systems. There is no seasonal reproduction in tropical breeds as it is common among their temperate counterpart (Wilson 1989) due to change in photo period (Mellado*et al.*, 1991) kids year-round and therefore may have more kids per given periods than exotic counterpart in addition, tropical breeds have good fitness traits (Olayiwole and Adu, 1989) are able to adopt and reproduce under harsh environments condition (Kiwuwa, 1992).

It has also been postulated (Webb *et a*l., 2004) that the average litter size of indigenous goats of South Africa is approximately. 1.7. These goats appear to be one of the efficient tropical breeds. Their average litter size is similar to goats in south Western Nigeria (1.65) and India larger than African dwarf goats (1.3-1.5) and smaller than goats in temperate areas (1.85-1.9).

Kidding frequency and litter size are important components of an efficient kid production system. Litter size or number of kids in the litter (Alexander *et al;* 1999). The litter size at birth is an important trait for selection of goats to produce next generation and increase of meat and milk production.

Similarly, studies have shown that relationship between litter size and parity in does among small holder goats (Akpa*et al*.,2011) ranged from 1-4 with mean of 1.7. However, some scientists (Sodiq*et a*l., 2003), Moaeen- ud-Din *et al*., 2008; (Inkulav*et a*l., 2009), reported to have 2.06 kids 2.09 kids and 1.96 kids respectively. An increase of this average can be expected from first to fifth parity and reduction in the sixth parity. It was also observed (that, the increase in litter size with advance parity may be associated with the physiological maturity of the doe (Akpa*et al*., 2011). Furthermore, it was also observed that most frequent litter size was singles, with next highest frequency being twins (Akpa*et al*., 2011)

MATERIALS AND METHODS

Bali is situated at the latitude 7° 12 **N** 12⁰00' N of equator and longitude 1⁰00 `E- of the meridian (TSD, 2000). It lies within the guinea savannah zone (semi-arid zone) of the West Africa which is characterized by short duration of rainfall. The climate condition is characterised by hot and dry season almost throughout the year and the rainfall varies from 750mm- 1100mm. ambient temperature is usually higher in March and April which ranges from 35°E 45°C whole relative humidity ranges from 85-94% (TSD, 2007).

The data for the study was obtained from randomly selected goats herders, with initials visit to identify herders and their goats. This was followed by the next visit to administer questionnaire and verbal interview to four (4) ward (Mission, Tiv ward, NEPA and Kwararrafa ward). This was followed by the next visit to retrieve the questionnaires after two weeks of administering of questionnaires.

All data obtained was used to generate the information on the relationship between herd size, parity, breeds and litter size of goats, from the small holder goats' herds. The data obtained was analysed using deceptive statistics and frequency distribution.

RESULTS

Table 1: Deceptive statistics for parity herd size litter size and breeds of goals

Characteristics	Number	Mean ISE	CV (%)	Min	Max
Herd size	30	1.5+0.571	56.11	1	4
Litter size	30	1.23.+0.114	50.76	1	3
Parity	30	1.23+0.114	50.76	1	4
Breeds	30	1.36+0.090	35.86	1	2

Table 1: above shows the deceptive statistics for parity, herd and litter size and breeds of goats predominantly found in the study area. The mean litter size N, parity with a mean of herd size of 1.50 goats.

Table 2: Bio data of the respondents

Factors	frequency	percentage
Gender		
Male	20	66.7
Female	10	33.3
Age		
10-20	0	0.0
21-30	5	16.7
31-40	15	50.0
41-50	10	33.3
Herd Size		
1-5	19	63.3
6-10	8	26.7
11-15	1	3.3
16-20	2	6.7
Occupation		
Livestock farmer	8	26.7
Civil Servant	2	6.7
Crop/Livestock farmer	2	6.7
Trader/Crop farmer	18	60.0
Period involved in livestock keeping		
> 5yrs	9	30.0
6-10yrs	18	60.0
11-15yrs	3	10.0
< 15yrs	0	0.0

Table 2, above depicts the bio data of small holder goats' herders. The result showed the majority of the breeding does were found within the herd size of 1-5 goats (63-3%), followed by 6-10 goats (26.7%). The types of individuals that were found in goats herds keeping traders/ crop farmers (60%) followed by livestock farmers (26.7%). All the categories mentioned above had between 6-10years (60%) of experience and 3 (10%) of the respondent had up to 15 yrs experience in goat herd farming

Table 3: frequency Distribution for herd management practices, methods of feeding types of supplementary feeds adopt by goat farmers

Factor	frequency	Percentage
Management		
Intensive	1	3.3
Extensive	17	63.3
Semi- intensive	10	33.3
Methods of Feeding		
Grazed pasture only	27	90.0
Zero or stall feeding	1	3.3
Supplementary feeding		26.7
Types of supplementary feed		
Maize bran/Kitchen waste	16	53.3
Browsers/cowpea husk	4	13.3
Rice bran/cowpea husk	10	s33.3

Table 3, above shows, the distribution according to management practice adopted by the herders methods of feeding and types of supplementary feeds given to the animals. The result reveals most (63.3) of the herders practices extensive system of management while few (3.3%) practices intensive system of management similarly on other hand type of supplementary feeds which the farmers feed their animals with are mostly (53.3%) maize bran/ kitchen waste followed by rice bran/cowpea husk (33.3%)

Table 4: Distribution of goat's farmers for socioeconomic and association maximum production

Factors	Frequency	percentage
Types of Associations		
Livestock farmers Association	9	30.00
Fadama users Association	18	60.00
Other Associations	3	10.00
Reason for keeping livestock		
Income generation	21	70.00
House hold consumption	4	13.33
Ceremonies	5	16.67
Market outlet for the goats		
Open livestock market	22	73.30
House hold level	2	6.67
Directly to butches	6	20.00

Table 4, above shows consider the frequency distribution of goat's farmers for socio-economic and association for maximum production. The findings reveal that the small holder farmers belong mostly (60 by) to Fadama users associations, followed by livestock farmers association (30%)

Similarly, the small holder goat herds, responded to some of semi of socioeconomic associated with rearing of goat even at household level. About 70% of the herders do rear their goat for income generation. This was

followed by ceremonies such as naming ceremony Religion festivities Marriage vows goat at house for food. Also, when inquired on the market out-let of product (goats) most (73.3%) take their animal to any nearby livestock market to sale them. Sometimes butcher (20%) approaches the farmers directly for slaughter and only very few (6.67%) transact at household level mostly for festivities.

Tables 5: frequency distribution on various challenges associated with goat production in Bali

Factor	Frequency	Percentage
Common disease		
Pest des petit Rinderpest	6	20.0
Contagious Plurepneumonia	9	30.0
Brucellosis	4	13.3
Tuberculosis	11	36.0
Others	0	0.0
Other challenges		
Housing	12	40.0
Marketing	3	10.0
Feeds	51	6.7
Environmental factors	15	33.3

Table 5, shows the frequency distribution on various challenges associated with goat production in the study area. The result reveals that other than disease problems there are challenge associated with good production whole ranges from housing (10%) for the animals' environmental factors (33.3%) feeds (16.7%) and marketing (10.02) problems. The most occurring diseases of goats in the study area are those of tuberculosis (36%) and CCPP (30%). This was followed by PPR (20%) while the case of brucellosis was recorded less (13.32)

DISCUSSION

The litter size and parity of doe in this study ranged from 1-3 and 1-4 respectively with the equal mean of 1.23, which comparable to the litter size ranged 1-3 earlier reported by Amoah and Gelaye (1990). The litter size of many kids obtained in this study (1.23) was lower than what was obtained in the earlier work of Akpa *et al* (2011), who reported the mean of 1.7 kids per doe. Similarly, the parity which ranged 1-4 and Mean 1.23 kids in this was also low when compared with the work of Akpa *et al* (2011). The difference observed could be due to validation in climatic and environmental conditions in the study area. It could also be due to socio economic characterisations of farmers in the study area (Bali), who mostly depends on the Trans humans for sources of meat of small ruminant. Hence only very few people in the community keep goats on intensive system of management. It was observed that only two (West African Dwarf and Ecotype of goats) breeds of goat are predominantly kept at an average of 1.36 per household.

Reproductive index when properly observed and managed its give rise to production of small ruminant in any given community. The present study has observed in accordance with the descriptive statistics of reproductive index of doe revealedthat, it has a good relationship with each other except for means of hard size (1.5 ± 591) with a 56% CV. This finding was also observed by Alexander *et al*, (1999), who reported that letter size or number of kids born per goats is an important component of goats' hard system among the rural and pre-urban settlers of guinea savannah of Nigeria. In a similar tune, the relationship between parity litter size and breeds type of goats was found to be positive. This was also in conformity with early work carried out by Webb, *et al*., 2004, who postulated that the average letter size of indigenous breeds of goats of South Africa is approximately 109, which is higher than what was obtained in the present study write average 1.23 for both litter size and parity respectively.

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Semen Quality of FUNAAB – Alpha Cocks in a Sudano-Sahelian Region of Nigeria

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Abstract: An experiment was conducted to determine the semen quality of FUNAAB – alpha cocks in a sudano-sahelian region of Nigeria. Sixteen 32 weeks old FUNAAB – alpha cocks reared in individual cages were used for the 34-week study. Data on cock body weight, semen volume, colour, pH, sperm motility, mass activity, live sperm, abnormal sperm and sperm concentration were recorded weekly for each bird. Also, semen plasma sodium, potassium, chloride and total protein were determined. Results of the study showed that body weights of cocks ranged from 2000 – 5600g with a mean of 3213g. Semen volume averaged 0.67 ± 0.04ml while percentage normal sperm was 97.63 ± 0.65. Ranges for plasma Potassium and Chloride were 2.80 -6.90mmol/l and 63.90 – 126.40mmol/l respectively. There was no significant relationship between bodyweight with semen volume and other semen characteristics except with plasma sodium level (r = 0.39). Significant positive correlations were noted between normal sperm cells and pH, mass activity and percentage life cells. Sperm concentration per ejaculate was highly ($P<0.01$) correlated with semen volume (r = 0.89), percent life (r = 0.62) and percent normal (r = 0.55). It was concluded FUNAAB – alpha cocks reared in the sudano-sahelian zone of Nigeria maintain good semen quality and thus can be used for breeding programs in the region.

Key words: FUNAAB – alpha, semen volume, sperm concentration, motility

DESCRIPTION OF PROBLEM

There are two principal methods that are used in large scale poultry production to enhance economic worth namely; genetic selection/crossbreeding and multiplication (i.e. production of progeny). Genetic selection is used to improve the nuclear or parental stocks, whereas effective reproduction in a multigenerational multiplication scheme is essential to increase the number of offspring produced with desired genetic traits (1). Reproduction is the most important requirement of poultry breeding while sperm fertilizing ability is the basis of successful reproduction (2). Therefore, to achieve success in any poultry breeding program cocks of good fertility must be selected.

The importance of semen evaluation in poultry either for selecting breeding males or for monitoring reproductive performance is well recognized (3, 4). Semen quality is often defined by determining volume, colour, concentration, motility, viability and morphology of spermatozoa (5). There are several factors that influence semen quality including species, breed/strain, and individuals within strains, age, diet, body weight, environment, collection techniques and frequency (6, 7).

In Nigeria efforts have been geared towards the development of indigenous chicken breeds with improved meat and egg production. These efforts have led to the development of the Shika brown layers by National Animal Production Institute (NAPRI) (8). Similarly, the Federal University of Agriculture Abeokuta (FUNAAB) has developed the FUNAAB – alpha (9). Although, there is information on the semen quality of the FUNAAB – alpha reared in the southern parts of Nigeria, none has been reported from the Sudano-Sahelian region of the country. This study therefore aims to study semen characteristics of the FUNAAB – alpha in a Sudano-sahelian area of Nigeria.

MATERIALS AND METHODS

The experiment was conducted at a private farm about six kilometres from the Animal farm of the Abubakar Tafawa Balewa University Bauchi, Bauchi state, Nigeria. Bauchi State is located between latitudes 9° 3′ and 12° 3′ north, longitudes 8°50’ and 11° east of the equator, at an elevation of 537 meters above sea level. The climate is characterized by two well defined seasons: The rainy season (May to October) and the dry season (November to April) (10). The vegetation is Sahel/Sudan in the north and guinea savannah in the central and western zones (11).

Sixteen matured (32 weeks of age) FUNAAB – alpha cocks were used for the study. The birds were reared in individual cages for the 34-week experimental period. Semen samples were collected weekly by abdominal massage technique (6) into 2ml Eppendorf tubes® (Eppendorf India) from which volume and colour were obtained**.** A total of 465semen samples were collected. A drop of semen was evenly placed on a pH paper (range

6 – 10), after the colour of the impregnated zone became uniform (< 30 seconds) it was compared with the calibrated strip to determine the pH.

Mass activity (gross motility) was determined according to the method described by (12) while individual sperm motility was as described by (3). Percentages of live and normal spermatozoa were evaluated using the eosin/nigrosin staining procedure (13). Semen concentration was determined with the improved Neubauer haemocytometer (Superior®, Marienfeld, Germany) using the direct cell count method (13). While the concentration of sperm per volume was determined using the method of (12).

Semen samples were collected in labelled plain sample bottles and centrifuged at 3000 rpm for 10 minutes to obtain the seminal plasma which was frozen until required for chemical analysis. Total semen plasma protein was determined using the Lowry method (14). Chloride content of ejaculates was determined by Volhard method (15). The method uses a back titration with potassium thiocyanate to determine the concentration of chloride ions in the plasma. Sodium and potassium contents of ejaculates were analysed by flame photometry as described by (16).

Data were summarized as mean plus or minus the standard error of mean and Pearson's coefficients correlations between parameters were computed using SPSS 20.0 (17).

RESULTS AND DISCUSSION

The descriptive statistics for semen characteristics of FUNAAB –alpha cocks in a sudano-sahelian region of Nigeria are shown in Table 1. Body weight of cocks ranged from 2000 – 5600g with a mean of 3213g. Semen volume averaged 0.67 ± 0.04ml while percentage normal sperm was 97.63 ± 0.65. Semen volumes observed in this study are similar to those reported by (18) and (19) for normal feathered Nigerian indigenous cocks. It was observed by (20) that the most obvious evaluation of semen quality is colour and in this study, semen colour for the FUNAAB – alpha in the region was basically creamy. It was noted by (18) that the further away from creamy white colour the semen of the chicken is, the more likely is the presence of contaminations which in turn may have a deleterious effect on its quality. The semen pH observed in the study are similar to those reported by (18) for Nigeria indigenous cocks. It was noted by (21) that chicken sperm can tolerate a pH range of 6.0 to 8.0. According to (18), the relationship between semen volume, sperm motility, sperm concentration, pH and colour are very important since they, to a large extent determine the fertility potential of the semen. The results of correlation analysis among semen quality traits of FUNAAB – alpha cocks are shown on Table 2. There was a moderately significant ($P<0.05$) but negative relationship between total motility and semen pH. Percentage life sperm was also negatively correlated ($r = -0.68$) with semen pH. Significant positive correlation was noted between normal sperm cells and pH, mass activity and percentage life cells. There was a negative but non-significant correlation between semen volume and sperm concentration which means selecting cocks for higher semen volume may result in lower sperm concentration. However, sperm concentration per ejaculate was highly ($P<0.01$) correlated with semen volume ($r = 0.89$), percent life ($r = 0.62$) and percent normal ($r = 0.55$). Total protein was moderately but negatively correlated to semen pH. There was no significant relationship between bodyweight with semen volume and other semen characteristics except with sodium level where a significant ($P<0.05$) but weak correlation ($r = 0.39$) was recorded. This concurs with the observation of (22) who reported no relationship between semen output and body weight of Nigerian local cocks in the semi-arid region of the country.

Table 1: Semen characteristics of FUNAAB – alpha cocks in a sudano-sahelian region

		Range	
Parameter	**Mean ± SEM**	**Minimum**	**Maximum**
Body weight (g)	3213 ± 274.98	2000	5600
Volume (ml)	0.67 ± 0.04	0.41	1.16
Colour	Creamy	-	-
pH	7.13 ± 0.02	7.00	7.32
Mass activity	3.59 ± 0.03	3.30	3.78
Total motility (%)	82.01 ± 0.51	77.01	86.11
Live sperm (%)	89.69 ± 0.89	78.14	95.29
Normal sperm (%)	97.63 ± 0.65	96.41	98.42
Sperm concentration ($x10^9$/ml)	2.02 ± 0.37	1.58	2.78
Sperm concentration/ejaculate ($x10^9$/ml)	1.35 ± 0.45	0.65	2.18
Sodium (mmol/L)	508.75 ± 278.35	150.00	1425.00

Potassium (mmol/L)	3.99 ± 1.32	2.80	6.90
Chloride (mmol/L)	99.83 ± 19.74	63.90	126.40
Total protein (g/L)	13.25 ± 6.99	2.00	32.00

Table 2: correlation among semen traits of FUNAAB–alpha cocks under a sudano-sahelian environment

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1 Volume	1												
2 pH	0.16	1											
3 Mass activity	0.09	-0.27	1										
4 Total motilities	0.12	-0.42*	0.69**	1									
5 Percent Life	0.55**	0.21	0.56**	0.11	1								
6 Percent Normal	0.26	-0.68**	0.73**	0.65**	0.36*	1							
7Spermconcentration	-0.26	-0.25	0.35	-0.17	0.14	0.48**	1						
8Spermconcentration / ejaculate	0.89**	-0.02	0.33	0.14	0.62**	0.55**	0.19	1					
9 Sodium	-0.04	0.27	0.07	0.24	0.04	-0.14	-0.31	-0.17	1				
10 Potassium	0.09	-0.06	0.01	0.01	-0.16	0.24	0.39*	0.28	-0.38*	1			
11 Chloride	-0.26	-0.21	-0.07	0.19	-0.22	-0.09	-0.33	-0.39*	-0.24	0.13	1		
12 Total protein	-0.01	-0.49**	-0.09	0.05	-0.18	0.24	0.07	0.04	-0.11	-0.17	0.02	1	
13 Bodyweight	-0.02	-0.07	-0.05	0.15	-0.17	0.04	-0.09	-0.05	0.36*	-0.32	-0.17	-0.02	1

CONCLUSION AND APPLICATION

It was concluded FUNAAB – alpha cocks reared in the sudano-sahelian zone of Nigeria maintain good semen quality and thus can be used for breeding programs in the region.

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The Effect of Dietary Salt on Fertility, Hatchability and Hatchling Performance of Artificially Inseminated Commercial Layers' Eggs

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Abstract: Studies on the reproductive performance of two breeds of commercial layers fed varied levels of dietary salt were carried out at in a twelve-week experiment. Dietary salt was used at 0.25%, 0.50%, 0.75%, and 1.00% corresponding to four dietary treatments: T1, T2, T3 and T4 respectively. One hundred and sixty (160) matured hens comprising 80 each of Isa Brown (IB) and Harco Black (HB) breeds were artificially inseminated with the cocks' semen samples from twenty-four cocks of Barred Plymouth Rock (BPR) and Isa White (IW) breeds. Reproductive parameters like, fertility, hatchability and post-hatch performance of the chicks were assessed. Results revealed significant effects of dietary salt on egg fertility, hatchability and percentage hatched to total eggs set between the two breeds of layers. Dietary salt was able to reduce embryonic mortality of both fertile and total eggs set even at the highest level of inclusion (1.00%). Significant differences observed in shank length, drumstick and chick length indicated that dietary salt at higher levels had ameliorative effects on all the parameters except shank length. Inclusion of salt at higher levels than the control increased agility, chicks' length, chicks' weight, thigh and drumstick length in both IB and HB breed. Within the scope of this experiment, it could be concluded that dietary salt at higher levels than is currently being used in the diets of breeder layers could improve fertility and hatchability, reduce embryonic mortality and improve post-hatch performance of chicks.

Keywords: Artificial insemination, chicks, fertility, Harco Black, hatchability, Isa Brown, salt.

INTRODUCTION

One of the ways of improving livestock productivity is by Artificial Insemination (AI). According to Bakst and Dymond, (2013), artificial insemination in chicken is the process of introducing semen into the hen's reproductive tract with the help of humans. It has gained world-wide acceptance as a process of ensuring rapid genetic gains in livestock productivity and even in other animal species like the honey bees. Artificial insemination (AI) has not only made it easy for man to reduce the generation intervals of the existing livestock species bestowed on himby nature, it has also enabled him to rapidly improve on the existing germplasm through hybridization. This has made AI central to nearly all emerging protocols in the assisted reproductive technology (ART) aspect of animal biotechnology.

Many underlying factors have been known to determine reproductive success and by extension the success of AI. These factors include the environment, the genetic make-up of the livestock species and nutrition. The use of sodium chloride (NaCl) in the diet of any class of livestock species is a ubiquitous practice that transcends all physical or geographical barriers. This is as a result of the importance attached to the use of dietary salt (NaCl) in livestock nutrition. This has necessitated many research efforts directed at determining the requirement of dietary salt in the ration formulation of many species of livestock such as domestic chickens, swine, rabbit, sheep, goats and cattle (Berger, 2006). All these recommended requirements of NaCl in the diets of these species of livestock have been conceived with the hindsight of growth and general wellbeing of the animals as the principal determinants. However, pivotal to the overall productivity of livestock is the role of dietary salt on the reproductive indices especially those intricately connected with fertility, hatchability and post-hatch performance of the chicks. The dearth of information on the role of dietary salt on these reproductive indicators especially on the Isa Brown and Harco Black breeds of commercial layers necessitated this experiment.

MATERIALS AND METHODS

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm (Livestock Section) of the Federal University of Technology, Akure, Nigeria. One hundred and sixty (160) layers (80 Isa Brown and 80 Harco Black breeds) at 47 weeks in laywere each randomly assigned to four dietary treatments with four replicates per treatment and ten layers per replicate comprising 5 Isa Brown and 5 Harco Black hens in a 2 x 4 factorial experiment. Twenty-four (24) matured cocks (12 Barred Plymouth Rock and 12 ISA White) were procured and kept in a single cage for semen collection with which the layers were artificially inseminated. The feeding trial for the layers lasted for twelve weeks. The layers were kept in battery cages and were supplied with 125 grams of the diets per day per bird while water was given*ad libitum*. Table 1 shows the gross composition of the experimental diets for the layers

Table 1: Gross composition (g/100g) of the Layers diets

Ingredients	Diet 1	Diet 2	Diet 3	Diet 4
Maize	53.50	53.50	53.50	53.50
Fish meal	1.00	1.00	1.00	1.00
Groundnut cake	8.00	8. 8.00 8.00	8.00	8.00
Soybean meal	11.00	11.00	11.00	11.00
Wheat offal	16.00	15.75	15.50	15.25
Bone meal	2.75	2.75	2.75	2.75
Limestone	6.90	6.90	6.90	6.90
Salt (NaCl)	0.25	0.50	0.75	1.00
Premix	0.25	0.25	0.25	0.25
Lysine	0.15	0.15	0.15	0.15
Methionine	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated nutrients				
Energy (M.E. Kcal/kg)	2535	2531	2528	2525
Crude protein (%)	16.70	16.70	16.70	16.60
Crude fibre (%)	4.08	4.05	4.03	4.00
Calcium (%)	3.72	3.72	3.72	3.72
Phosphorus (%)	0.95	0.95	0.95	0.94
Sodium (%)	0.16	0.26	0.36	0.46
Chloride (%)	0.17	0.32	0.48	0.68

T1 = Diet with 0.25% dietary salt; T2 = Diet with 0.50% dietary salt; T3 = Diet with 0.50% dietary salt; T4 = 1.00% dietary salt; M.E. = Metabolizable energy

The cocks were fed with standard diets formulated along the four salt levels at 150g/day and were trained to respond to the abdominal massage technique prior to semen collection (Thatohatsi, 2009). Single ejaculate of semen was collected from each cock twice a week between 4:00 pm and 5:00 pm by abdominal massage method for the artificial insemination of the hens. The AI was performed using 1.0 ml syringes for the deposition of the semen as described by Thatohatsi (2009). Parameters like percentage fertility, embryonic mortality and hatchability of the eggs during the incubation process were determined while post-hatch performance parameters and morphometry of the chick's body weight, shank length; drumstick, agility and thigh length were recorded. All data collected were subjected to a two-way Analysis of Variance (ANOVA) in a Completely Randomized Design (CRD). The significant differences were separated using Duncan's Multiple Range Test (DMRT) on the Statistical Package for Social Sciences (SPSS) version 17 (SPSS, 2007).

RESULTS AND DISCUSSION

Table 2 shows the percentage fertility, hatchability and embryonic mortality of the artificially inseminated eggs collected from laying chickens fed varied levels of dietary salt. There were significant ($p<0.05$) breed, treatment

and interaction differences observed in number of fertile eggs and eggs hatched. Harco Black (HB) breed was superior to Isa Brown (IB) breed in number of fertile eggs (83.38±0.42 against 66.00±0.65) and eggs hatched (54.75±0.65 against 35.04±0.56). The significant differences observed in % fertility, % hatchability and % of eggs hatched to total eggs set in both breeds (Isa Brown and Harco Black) were similarly reported in the research of Jesuyon (2010). The differences could be due to the different genetic make-up of the birds. The use of dietary salt significantly improved number of fertile and hatched eggs about 31.58%. Dietary salt was able to improve number of fertile and hatched eggs in both IB and HB breeds. Harco Black was superior to IB in percentage fertility, percentage hatchability of the fertile eggs and percentage of eggs hatched to total eggs set. The IB breed equally had a higher embryo mortality of total eggs set when compared to HB. The use of dietary salt at the levels of 1.00% and 0.75% for IB and HB respectively reduced percentage embryonic mortality of total eggs set and hence improved the hatchability of eggs.

In the current study, dietary salt was able to reduce embryonic mortality in both fertile and total eggs set even at the highest level of 1.00% (T4). The inclusion of NaCl at 0.75 and 1.00% also increased the number of fertile and hatched eggs and reduced the number of unhatched eggs. In all, dietary NaCl at 0.75 and 1.00% improved fertility, hatchability while reducing embryonic mortality in these two breeds of commercial laying chickens.

Table 3 shows agility and body morphometry of chicks hatched from eggs of layers fed varied levels of dietary salt. Significant differences in agility were observed among the dietary treatments and in the interactions between breeds and treatments. There were breed differences ($p<0.05$) in shank length, drumstick and chick length in which IB recorded higher values for shank length and drumstick while HB had longer length of chicks than IB. Dietary salt improved drumstick and chick length. The use of dietary salt improved thigh length and equally improved thigh length of both IB and HB breeds. In the current study, dietary salt reduced the time taken by the chicks to revert to standing position when turned upside down, thus indicating improved agility. Also, significant differences observed in chicks' weight and body length indicated that dietary salt improved both weight and length of chicks even at the highest level of 1.00%. Meijerhof (2005) had reported the importance of chick's length as a more practical way to measure chick's development.

CONCLUSION AND APPLICATION

Harco Black (HB) breed of layers responded better to increased dietary salt levels than the Isa Brown (IB) breed in terms of improved fertility, hatchability and reduction of embryonic mortality. The inclusion of dietary NaCl at 1.00% increased the number of fertile eggs by about 31.58% relative to the control diet with 0.25% dietary salt. Dietary salt improved the number of fertile and hatched eggs in both IB and HB breeds but with a recommendation of 1.00% for IB and 0.75% level for HB so as to reduce embryonic mortality and hence improve hatchability. Increase in the levels of dietary salt improved chicks' agility and weight at hatching and would therefore enhance their post-hatch performance.

Table 2: Percentage Fertility, hatchability and embryonic mortality of Artificially Inseminated Eggs Collected from laying Chickens Fed Varied levels of Dietary Salt

Parameters		No of Egg Set	No. of Fertile Eggs	No. of Eggs Hatched	No. of Unhatched Eggs	% Fertility	% Hatchability of Fertile Eggs	% Hatched To Total Egg Set	%Embryonic Mortality of Fertile Eggs	%Embryonic Mortality of total Eggs Set
B										
IB		96.00±0.00	66.00±0.65^{b}	35.04±0.56^{b}	49.04±0.52^{a}	68.75±5.40^{b}	53.09±4.83^{b}	36.50±4.71^{b}	46.91±4.83^{a}	63.50±4.71^{a}
HB		96.00±0.00	83.38±0.42^{a}	54.75±0.65^{a}	30.00±0.53^{b}	86.46±3.50^{a}	65.06±4.40^{a}	56.25±5.40^{a}	34.94±4.40^{b}	43.75±5.40^{b}
T										
T1		48±0.00	33.25±0.75^{c}	20.00±0.91^{b}	22.00±1.04^{a}	68.75±6.25^{c}	60.61±6.00^{a}	41.67±7.61^{b}	39.39±6.08^{b}	58.34±7.61^{b}
T2		48±0.00	35.00±0.48^{bc}	19.00±0.48^{b}	23.00±0.48^{a}	72.92±3.99^{bc}	54.29±4.24^{b}	39.58±3.99^{b}	45.71±4.24^{a}	60.42±3.99^{a}
T3		48±0.00	38.50±1.50^{b}	23.75±1.65^{b}	18.50±1.50^{b}	79.17±12.50^{b}	60.53±11.28^{a}	47.92±13.77^{b}	39.47±11.28^{ab}	52.08±13.77^{c}
T4		48±0.00	43.75±0.25^{a}	27.75±0.85^{a}	16.00±0.41^{b}	89.59±2.09^{a}	62.79±7.04^{a}	56.25±7.12^{a}	37.21±7.04^{b}	43.75±7.12^{c}
B x T										
IBIIB	T1	48±0.00	27.99±0.00^{c}	14.00±0.50^{c}	28.00±1.00^{a}	58.33±0.00^{e}	50.02±7.14^{bc}	29.17±4.17^{c}	49.98±7.14^{a}	70.83±4.17^{a}
HB	T1	48±0.00	38.50±0.50^{bc}	26.50±0.50^{b}	16.00±1.00^{b}	79.17±4.17^{c}	68.42±1.67^{a}	54.17±4.17^{b}	31.58±1.67^{b}	45.83±4.17^{c}
IB	T2	48±0.00	32.00±0.00^{c}	18.50±0.50^{b}	24.00±1.00^{a}	66.67±0.00^{d}	56.25±6.25^{b}	37.50±4.17^{bc}	43.75±6.25^{a}	62.50±4.17^{b}
HB	T2	48±0.00	38.50±0.50^{bc}	20.00±1.00^{b}	22.50±0.50^{a}	79.17±4.17^{c}	52.63±7.78^{b}	41.37±8.34^{b}	47.78±7.78^{a}	58.34±8.34^{b}
IB	T3	48±0.00	28.00±1.00^{c}	12.00±1.00^{c}	28.00±1.00^{a}	58.34±8.34^{e}	45.84±20.84^{c}	25.00±8.33^{c}	57.14±20.84^{a}	75.00±8.34^{a}
HB	T3	48±0.00	48.00±0.00^{a}	34.50±0.50^{a}	8.00±0.00^{c}	100.00±0.00^{a}	70.84±4.17^{a}	70.84±4.17^{a}	29.17±4.17^{b}	29.17±4.17^{c}
IB	T4	48±0.00	44.00±0.00^{b}	26.50±0.50^{b}	18.50±0.50^{b}	91.67±0.00^{b}	59.10±4.55^{b}	54.17±4.17^{b}	40.91±4.55^{a}	45.84±4.17^{c}
HB	T4	48±0.00	42.50±0.50^{b}	28.00±2.00^{b}	14.50±0.50^{b}	87.50±4.17^{b}	66.67±15.91^{b}	58.34±16.67^{b}	33.34±15.91^{b}	41.67±16.67^{c}
LS										
B		NS	*	*	*	*	*	*	*	*
T		NS	*	*	*	*	*	*	*	*
B x T		NS	*	*	*	*	*	*	*	*

$^{a, b, c, d, e}$ = means plus standard error of means in the same column but with different superscripts are statistically ($p<0.05$) significant

1= Isa Brown; 2= Harco Black; T1= Diet with 0.25% salt; T2= Diet with 0.50% salt; T3= Diet with 0.75% salt; T4= Diet with 1.00% salt; B = Breed; T = Treatment; LOS = Level of Significance; B*T= Breed*Treatment

Table 3: Agility and Body Morphometry of Chicks Hatched from Eggs of Layers Fed Varied Levels Dietary Salt

Parameters		Agility(sec)	Weight(g)	Shank length(cm)	Drum stick (cm)	Thigh length (cm)	Chick length (cm)
Breeds							
IB		1.13±0.04	34.45±1.01	1.65±0.04^{a}	2.22±0.06^{a}	1.79±0.05	7.67±0.12^{b}
HB		1.14±0.04	34.27±1.39	1.58±0.03^{b}	2.12±0.08^{b}	1.78±0.06	7.91±0.08^{a}
Treatments							
T1		1.17±0.06^{a}	34.19±2.86^{b}	1.74±0.05^{a}	2.06±0.11^{c}	1.63±0.08^{c}	7.75±0.17^{b}
T2		1.02±0.02^{c}	32.48±1.08^{b}	1.64±0.04^{b}	2.12±0.10b^{c}	1.77±0.06^{b}	7.63±0.15^{b}
T3		1.14±s0.06^{b}	35.05±0.81^{a}	1.60±0.03^{b}	2.18±0.09^{b}	1.80±0.07^{b}	7.88±0.15^{a}
T4		1.21±0.04^{a}	35.73±1.37^{a}	1.49±0.04^{c}	2.33±0.05^{a}	1.93±0.06^{a}	7.92±0.11^{a}
Breed x Treatment							
IB	T1	1.22±0.10^{a}	30.75±1.01^{c}	1.85±0.03^{a}	2.25±0.14^{b}	1.55±0.03^{c}	7.50±0.29^{b}
HB	T1	1.13±0.07^{b}	37.63±5.29^{a}	1.63±0.03^{b}	1.87±0.09^{d}	1.70±0.15^{bc}	8.00±0.00^{a}
IB	T2	1.06±0.03^{b}	34.00±1.15^{b}	1.63±0.09^{b}	2.33±0.03^{a}	1.83±0.03^{b}	7.50±0.29^{b}
HB	T2	0.99±0.03^{c}	30.95±1.47^{c}	1.65±0.03^{b}	1.90±0.00^{c}	1.70±0.12^{bc}	7.75±0.14^{a}
IB	T3	1.04±0.02^{c}	35.20±1.73^{b}	1.60±0.00^{b}	2.00±0.06^{c}	1.80±0.06^{b}	7.75±0.14^{a}
HB	T3	1.24±0.09^{a}	34.90±0.49^{b}	1.60±0.06^{b}	2.37±0.09^{a}	1.80±0.15^{b}	8.00±0.29^{a}
IB	T4	1.22±0.04^{a}	37.87±2.05^{a}	1.53±0.07^{c}	2.30±0.10^{a}	1.97±0.07^{a}	7.93±0.23^{a}
HB	T4	1.19±0.06^{a}	33.60±0.75^{b}	1.45±0.03^{d}	2.35±0.03^{a}	1.90±0.12^{a}	7.90±0.06^{a}
LS		NS	NS	*	*	NS	*
B		*	*	*	*	*	*
T		*	*	*	*	*	*

B x T	NS	NS	*	*	NS	*

[a, b, c, d]= means plus standard error of means in the same column but with different superscripts are statistically ($p<0.05$) significant1= Isa Brown; 2= Harco Black; T1= Diet with 0.25% salt; T2= Diet with 0.50% salt; T3= Diet with 0.75% salt; T4= Diet with 1.00% salt.

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Influence of varied Photoperiod on the physiology and Growth of Gilts at Finisher Stage raised in the Humid Tropics

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Abstract: This study was carried out to investigate the influence of varied photoperiod on the growth performance characteristics of finisher gilts. Twelve crossbred (Large white x Landrace) finisher gilts with mean body weight of 32.23 ± 4.87kg were randomly allotted to three treatments with four replicates each (n=4). Pens were exposed to photoperiods of 12 h (12NL=natural light), 15 h (12NL+3AL) and 18 hours (h) (12NL+6AL), the experimental design was completely randomized design. Performance parameters measured were Feed Intake (FI), Final Weight (FW) and Weight Gain (WG), while Feed Conversion Ratio (FCR) was calculated weekly throughout the 8 weeks of the experiment. Photoperiod had significant effects on FW and WG across the treatments. The FW, and WG of finisher gilts in 12 h was significantly ($p<0.05$) higher compared to other photoperiods. The average FW value for gilts in 12 h was 67.57 ± 5.44kg/pig compared to 62.81 ± 4.10kg/pig for those in 18 h. The WG of pigs in 12 h was highest 4.17 ± 0.92kg/pig/week compared to 4.09 ± 0.80kg/pig/week for gilts in 15 h and 3.70 ± 0.85kg/pig/week for gilts in 18 h. There was no significant variation ($p>0.05$) observed in the FI and FCR value across the treatments. The rectal temperature was not significantly ($p>0.05$) different across the treatments while respiratory rate was observed to increase with increased photoperiod. It can therefore be concluded that increasing the photoperiod (hour of day-length) above 12 hours may not lead to positive impact on the growth performance of finisher gilts.

Key words: natural light, finisher gilts, performance, rectal temperature, respiratory rate

INTRODUCTION

In swine farming, temperature and light are viewed as major environmental factors affecting the physiology (Andersson et al 1998; Rivera et al 2005; Sancho 2006) with temperature being considered the most important factor. According to Delabbio (2015); Adebiyi and Adelowo (2017) light is a key environmental factor that influences and directs physiological processes in all animals. Light exposure involves three characteristics of artificial lighting programs: spectrum (colour), intensity and photoperiod (Delabbio 2015), photoperiod can be defined as the duration of natural daylight experienced by an organism (Adelowo and Adebiyi 2016). Photoperiod can be further separated into three components: a. Length of time of illumination (sometimes termed duration), b. The rate of change of this illumination (in time increments) over a specific period of time (daily or weekly), and c. Direction of this rate of change (whether increasing or decreasing) during the illumination period (Delabbio 2015). Pig's physiological responses to day length can be subtle, suggesting there may be wide variation in responsiveness of different breeds and population to duration of light (Taylor et al 2006). The environmental conditions of animal husbandry vary and consequently, the responsiveness to environmental factors such as photoperiod may vary, depending on the breed (Lincoln et al 1990) and the role of photoperiod in timing of reproduction varies not only between species but also between sexes and maturational stage reported by Taylor (2010). This study was conducted to investigate the effect of photoperiod on the physiology and growth of gilts at finisher stage raised in the humid tropics.

MATERIALS AND METHODS

The study was carried out at the Piggery Unit of the Teaching and Research farm, University of Ibadan, Oyo state, Nigeria. The location is 7° 27'N and 3° 45'E at altitude 200-300m above sea level, the climate is humid tropical with mean temperature of 25-29°C and the average annual rainfall of about 1250mm. The experiment was carried out for eight weeks. Twelve Large white x Landrace pigs with 32.2 ± 4.87 kg initial live weight were randomly allotted into three treatments consisting of 12h (12NL=natural light), 15h (12NL+3AL) and 18h (12NL+6AL). Each treatment was replicated four times with one gilt per replicate in a completely randomised design. Gilts were housed in a dwarf-walled, well-ventilated, cement-floor building and the sides were raised with planks of 3m to prevent the reflections of the light rays into other pens. Electrification of the pens that was used for increased photoperiods was done with a compact fluorescent energy saver full spiral 18w of 46 lumens per watt bulb installed in the pen for artificial light. The bulbs were suspended below the walls but above the animals to prevent reflections to other pens. On arrival, the finisher gilts were acclimatised for two weeks and treated against internal and external parasitic infestation (they were dewormed with Lyvamesol, administered based on their body weight and Ivermectin). During the 8 weeks of the study, the animals were fed twice (morning and evening) with the diet and water was provided in the various trough's *ad libitum*. Ambient temperature and relative humidity of the pens were measured to ensure the gilts were kept at their thermo-neutral zone with the aid of a thermo-hygrometer which was suspended in the pens.

Data collection and Statistical analysis: The performance data (initial, final weight, weight changes, feed intake and body weight gain) and physiological data; rectal temperature and respiratory rate of each animals were taken weekly. The feed conversion ratio was calculated from the average feed intake and the weight gain. The data was analysed using the statistical analysis of variance (ANOVA) procedure of SAS (2010) and significant level of α0.05 was used, means were compared using the Tukey HSD option of the same software.

RESULTS AND DISCUSSION

The results show that photoperiod had effect on the performance of the gilts, the gilts in the 12 hours photoperiod had the highest final weight (67.57 ± 5.44kg/pig) which increased significantly ($p<0.05$) compared to 18 hours (62.81 ± 4.10kg/pig) (Table 1). The average weight gains also varied with gilts in 12 h (4.17 ± 0.92/pig/week) having the highest value compared to gilts in 18 h (3.70 ± 0.85/pig/week). Photoperiod had no effect on the average feed intake of the gilts across the treatments.

Table 1. The effect of photoperiod on performance characteristics at finisher stage

Parameters	**Photoperiods**			**SEM**	**p value**
	12 h	15 h	18 h		
Initial weight(kg)/pig	32.2	32.2	32.2	0.74	0.363
Final weight(kg)/pig	67.6[a]	66.9[a]	62.8[b]	1.36	0.053
Average weight(kg) gain/pig/week	4.17[a]	4.09[ab]	3.70[b]	0.23	0.035
Average feed(kg)intake/pig/week	18.1	17.6	17.1	0.31	0.134
Feed conversion ratio	4.35	4.31	4.62	0.47	0.476

[ab] mean values without common superscript are different at $p<0.05$

Photoperiod had no effect on rectal temperature across the treatments ($p>0.05$) but had effect $p=0.043$ on the respiratory rate across the treatments (Table 2).

Table 2. The effect of photoperiod on rectal temperature and respiratory rate of gilts

Photoperiods					
	18h	**15h**	**12h**	**SEM**	**p value**
Rectal temperature, °C	39.5	39.5	39.4	0.049	0.924
Respiratory rate, breath/min	43.3[a]	41.5[b]	40.5[b]	0.73	0.043

[ab] mean values without common superscript are different at $p<0.05$

Increasing photoperiod in the rearing of finisher gilts in the humid tropics had negative effect on the growth rate and feed intake. It was observed in this study that weight gain and final weight decreases with increased photoperiod/artificial light. This agrees with the report of Dureau*et al.* (1996) in their studies with mini-pigs exposed to continuous 2,500 lux for up to 12 weeks after 4 weeks or more of continuous illuminance there was

20% reduction in body weight. It also agrees with earlier result in a study on weaned pigs conducted by Adelowo and Adebiyi (2016) that increasing photoperiod affects weaned pigs negatively but this is at variance with the report of Wheelhouse and Hacker (1981) that photoperiod is important in rearing of pigs for better performance but when pigs were not at their comfort zone the physiological processes are affected and this lowers the performance of the animals. Also in a study carried out by Barrel*et al.* (2000), they discovered that the interaction between circannual rhythms and light-dark cycle is dynamic and dependent on changes in day length, phases of sensitivity to photoperiod, the responses observed by these gilts may be connected with these interaction. At 12 hours natural light, the animals performed best, their respiratory rate were observed to be lower thus, natural light is ideal for their optimal performance in the humid tropics. The lower value of feed conversion ratio obtained in 12 hours photoperiod reflected better utilization of feed, hence better weight gain and final weight. According to the findings of Lorschy (1997) and Chiba (2004) a pig must maintain its deep body temperature at about 38°C and that the rectal temperature of pigs ranged between 38.5 to 40°C. The rectal temperature for the gilts in this study ranged from 39.4 ± 0.41°C to 39.5 ± 0.57. The respiratory rate observed was slightly higher (40.5 ± 2.79 breath/min for 12 h photoperiod) when compared with 20 to 30 breath/minute recommended by Lorschy (1997). Johnson *et al* (2015) observed that pigs stop eating when temperature is high which led to high respiratory rate because feed intake contributes to further heat production via energy metabolism. When pigs are not at their comfort zone, the physiological processes are affected hence, the growth rate decreases (Adebiyi and Adelowo, 2017).

CONCLUSION

From the results obtained in this study, it can therefore be concluded that increasing the photoperiod (hour of day-length) beyond 12 hours may not lead to additional positive impact on the weight changes of gilts at finisher stage. Furthermore, it was observed that the increase in photoperiod resulted in increase in respiratory rate which affected body metabolism and thus, lower the growth and performance of the gilts raised in the humid tropics.

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Serum Antioxidant Status and Reproductive Performance of Rabbit Does fed *Cassia tora* Leaf Meal Diets

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Abstract: The use of herbaceous plants as natural antioxidants has gained increasing interest as a result of the global trend of restricting the use of synthetic substances such as ascorbic acid, butylatedhydroxytoluene (BHT) that are suspected to be carcinogenic. Information is lacking on the effect of *Cassia tora* as a potent antioxidant on serum antioxidant status and reproductive performance of rabbit does in the semi-arid zone of Nigeria.Thirty, mixed breed nulliparous rabbit does age four months old with an average weight of 1.5kg were allocated to fivetreatments with the inclusion of *Cassia tora* leaf meal at 0, 5, 10, 15 and 20% and mated after 28 days of feeding. Catalase activity of does fed 5, 15 and 20% *Cassia tora* leaf meal were higher ($P<0.05$), Superoxide dismutase (SOD) activity of the pregnant does fed 10 and 20% *Cassia tora* leaf meal were also higher ($P<0.05$). The mean GSH of the pregnant does fed 0 and 5% *Cassia tora* leaf meal were higher ($P<0.05$) than other does. Conception rate, gestation length, litter size at birth and litter size at weaning were statistically ($P>0.05$) similar. Litter birth weight were higher ($P<0.05$) in 0 and 5% *Cassia tora* leaf diets. The litter weaning weight of kittens fed 0, 5, 10 and 15% *Cassia tora* leaf meal were higher ($P<0.05$). Percent litter mortality was lower ($P<0.05$) in 5, 10, 15 and 20% *Cassia tora* leaf meal. *Cassia tora* leaf meal can be included in the diet of rabbit does up to 15% for improved antioxidant status, weaning weight and low mortality rate.

Keywords: *Cassia tora*, serum antioxidant enzymes, litter weaning weight

DESCRIPTION OF THE PROBLEM

Farm animals are subjected to oxidative stress during the different physiological stages including reproduction. Reactive oxygen species (ROS) can be generated in the mitochondria and a variety of enzymes and are responsible for inflammation, neurodegenerative diseases, infertility and cancer (1). Nutrition plays an important role in protecting animal cells and tissues from oxidative stress caused by free radicals (2). Optimal antioxidant supplementation is necessary to maintain high productive and reproductive performance of farm animals (3).

Antioxidants are compounds that resist formation of free radicals and scavenge reactive oxygen species (ROS) by amplification of intercellular enzymes e.g. superoxide dismutase, glutathione peroxidase and catalase (4, 5). The richest sources of antioxidants are fruits, vegetables, cereals and legumes, tea, coffee, wine, beer, herbs and spices (6). Recently, the use of herbaceous plants as natural antioxidants has gained increasing interest as a result of the global trend of restricting the use of synthetic substances such as ascorbic acid, butylatedhydroxytoluene (BHT) that are suspected to be carcinogenic (7). *Cassia tora* leaf extract has significant total antioxidant activity (7) which may be responsible for its antioxidant activities. Information is lacking on the effect of *Cassia tora* as a potent antioxidant on serum antioxidant status and reproductive performance of rabbit does in the semi-arid zone of Nigeria.

MATERIAL AND METHODS

Experimental site: The study was conducted at the rabbit unit of the Teaching and Research farm of the Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria. Zaria is located within the Northern Guinea Savannah zone of Nigeria, at latitude, 11^0 9'45'N and longitude 7^0 38'68' E and an altitude of 610m above sea level (8).

Experimental animals, design and management: A total of thirty mixed breed nulliparous rabbit does of four months old with an average weight of 1.5kg were randomly assigned into five treatments each with six rabbit per treatment in a completely randomized design. *Cassia tora* leaf meal inclusion was 0, 5, 10, 15 and 20%. The does were offered the experimental diet for a period of 28 days and naturally mated.

Data collection: The reproductive parameters of the does measured include; conception rate, gestation length (days), Pre-weaning mortality (%), litter size at birth (n), litter size at weaning (n), litter birth weight (g), litter weaning weight (g), and mortality (%).

Conception rate = number of does conceived/total number of does mated x 100. Gestation length was measured by recording the interval between mating and kindling of each pregnant doe. Number of kits born was counted, weighed and recorded as litter size and weight. Number of litters born alive and number of litter born dead was also recorded. Litter weight at birth and weekly litter weight was measured using a sensitive weighing balance.

Statistical analysis: The data generated from this study was subjected to analysis of variance (ANOVA) using the Genera Linear Model (GLM) procedure of SAS (2002). Dunnette's test was used to compare means that were significantly different.

RESULTS AND DISCUSSION

Table 1 shows that the catalase activity of does fed 5, 15 and 20% *Cassia tora* leaf meal were higher (P<0.05) than other does. The mean superoxide dismutase (SOD) activity of the pregnant does fed 10 and 20% *Cassia tora* leaf meal were also higher (P<0.05). The mean GSH of the pregnant does fed 0 and 5% *Cassia tora* leaf meal were higher (P<0.05) than other does. The result generally shows an increase in the antioxidant enzymes with inclusion of *Cassia tora* leaf meal. This could be attributed to antioxidant activity of *Cassia tora* leaf meal which brings about a reduction in oxidative stress. Joyti *et al*. (2017) reported a significant increase in catalase and SOD concentration in broiler chickens treated with methanol extract of *Cassia tora* leaf. The low concentration of GSH in the rabbits does is not clear but may be due to individual differences.

Table 2 shows that litter birth weight was higher (P<0.05) in 0 and 5% *Cassia tora* leaf meal diets. The litter weaning weight of kittens fed 0, 5, 10 and 15% *Cassia tora* leaf meal were higher (P<0.05). This is an indication that the inclusion of *Cassia tora* leaf meal supported growth. The low litter weaning weight at weaning obtained in this study fed 20% *Cassia tora* leaf meal may be an indication that the weaned rabbits may not have been able to digest the high fibre content at that level. Rabbit does feed 5, 10 15 and 20% *Cassia tora* leaf had lower (P<0.05) litter mortality than does fed 0% *Cassia tora* leaf. The low mortality in the does fed the *Cassia tora* leaf meal diets could be attributed to the antioxidant properties of *Cassia tora* leaf (Santosh *et al.,* 2013). However, high percentage survival rate at weaning is also an indication of good nursing and mothering ability (Isaac *et al*. 2010).

Table 1: Serum Antioxidant Indices of Rabbit Does Fed Different Levels of Dietary *Cassia tora* Leaf Meal

	Inclusion Level of *Cassia tora* leaf meal (%)						
Parameters	**0**	**5**	**10**	**15**	**20**	**SEM**	**P Values**
CAT (ug/ml)	1.88^{b}	1.98^{a}	1.89^{b}	1.97^{a}	1.97^{a}	0.02	0.011
SOD (ug/ml)	5.09^{c}	5.41^{c}	7.50^{ab}	7.33^{b}	7.94^{a}	0.18	0.001
GSH (umol/l)	18.93^{a}	18.88^{a}	18.21^{b}	16.82^{c}	17.97^{b}	0.28	0.004

$^{(abc)}$Means with different superscript within the same row are significantly different at p<0.05, CAT- catalase, SOD- Superoxide dismutase, GSH-Glutathione peroxidase.

Table 2: Reproductive Parameters of Rabbit Does Fed Different Levels of Dietary *Cassia tora* Leaf Meal

	Inclusion Level of *Cassia tora* leaf meal (%)						
Parameters	**0**	**5**	**10**	**15**	**20**	**SEM**	**P Values**
CR (%)	63.33	66.67	66.67	65.00	71.67	6.24	0.91
GL (days)	30.17	29.83	30.00	29.67	29.83	0.48	0.96
LSB (n)	3.17	3.00	3.50	3.83	3.50	0.42	0.67
LSW (n)	2.33	2.00	2.33	2.33	2.17	0.48	0.98
LBW (g)	50.12^{a}	47.98^{a}	45.12^{b}	44.83^{b}	45.39^{b}	1.86	0.03

LWW (g)	780.55[ab]	853.89[a]	779.20[ab]	779.99[ab]	735.11[b]	56.99	0.04
Mortality (%)	50.00[b]	29.17[a]	29.17[a]	24.72[a]	38.88[a]	10.88	0.05

[(ab)] Means with different superscript within the same row are significantly different at P<0.05, CR- conception rate, GL-gestation length, LSB- litter size at birth, LSW- litter size at weaning, LBW- litter birth weight, LWW- litter weaning weight.

CONCLUSION AND APPLICATION

1. Rabbits fed*Cassia tora* leaf meal diets had increased catalase and superoxide dismutase activities.
2. Litter birth weight of does fed 0 and 5% *Cassia tora* leaf meal were higher
3. The litter weaning weight of does fed 0, 5, 10 and 15% *Cassia tora* leaf meal were higher.
4. Rabbit does fed 5, 10 15 and 20% *Cassia tora* leaf had lower litter mortality.
5.*Cassia tora* leaf meal can be included in the diet of rabbit does up to 15% for improved antioxidant status, weaning weight and low mortality rate.

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Effect of Season on Growth Performance of Bunaji calves in Early Wet Season

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Abstract: This study was conducted to investigate the effect of early wet season on the growth performance of Bunaji (Fulani white cattle); it was carried out at teaching and research Farm of Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria. Six Bunaji calves were used in which they were all male and the calves were about 10-12 month and allowed to raze in the after the sun rises and evening before they were confined into the paddock. Water intake was measured in the mid afternoon and evening while the growth parameters were taken every week such as Body length (BDL), Body circumference (BDC), Tail length (THL), Thoracic length (THL), Height at wither (HAW) and Body weight (BDW). It was observed that there was significant change in the body parameter of the animals during the early wet season ($p<0.05$). It was concluded that more benefit in terms of weight gain will not be attained during the early wet season.

Keywords: Bunaji

DESCRIPTION OF PROBLEM

The effect of seasonality in forage production on the growth of cattle is fundamentally the same in all those areas of the tropics where there is a definite dry season William *et al*., (2003). The practical result varies in accordance with the length and severity of the dry season. During the an exceptionally long dry season cattle may continue to lose of weight, some of the weight loss during the dry season may deduce from loss of water that would be retained in body tissue during wet season William, *et al*., (2003). Taiwo*etal*., (2005) reported that early wet season last from June to September inNorthern Nigeria and this is followed by hamattan season, a period of cool, dry weather which last from Mid-October to the late January. Increasing productivity is one of primary goals of ruminant production and growth is one of major concern to livestock farmer. Nutrition has a great influence on the growth performance of calves. Severe under nutrition can delay growth and development and consequently affect the weight.

MATERIALS AND METHODS

Experimental Site: this study was carried out at the cattle, sheep and goat unit of teaching and research farm, LadokeAkintola University of Technology, Ogbomoso. Ogbomoso is in derived savanna zone of Nigeria lies within the latitude $8^0$15'W and longitude $4^0$15'E. The area has an annual rainfall of 1247mm with latitude between 300-600m about the sea and while the mean temperature is about 27^0 (BATC, 2004), this study last for 6 months.

Experimental animal and management: six growing calves of Bunaji breeds of 10-12month were used for the experiment. The animals were acclimatized for 2 weeks, during the period of acclimatization the animals were treated with long active antibiotic, multivitamins, Iron-D and later dewormed with ivermectin. The initial body weight of the animal was determined by measuring their body part, the animals were restricted and were later allowed to graze throughout the period of the experiment and were being provided with water and medication.

Data collection: data collected include the following on weekly basis: Body weight (BW), body length (BL), Height at wither (HW), Tail length (TL), Body circumference (BC) and Thoracic girth (TG) by using measuring tape as described where there is no vet. Bill forse (6^{th}ed.) 314.

Experimental design: Completely randomized design.

Statistical analysis: Data were subjected to one-way analysis of variance using general linear model SAS 2000. The mean was separated using student T-test.

RESULTS AND DISCUSSION:

It can be observed that the white Fulani cattle responded to seasonal change and also show there was a significant difference ($p<0.05$) among the body parameters in respect of their growth.In table 1 there was significant difference ($p<0.05$) in the animal three on it body length which let us know that there been and increment in the body length of the animal and also there is significant difference ($p<0.05$) in animal two on its body circumference and there is significant difference ($p<0.05$) in the animal two, three and six on their tail length while body length, body circumference and tail length of all other animal show no much significant difference.
In table 1 it observed that there was no significant different ($p<0.05$) in the body parameters (tail length and height at wither) of the animals used in the experiment.
In the table 1 also, it shows that there was significant difference ($p<0.05$) in the body parameter (thoracic length) on animal one, two and three while other shows no significance ($p>0.05$) and the animal 1,3,4,5 and 6 are significant to each other in body weight except animal 2 which is not significant to others. The report in table 1 show that there was significant difference ($P<0.05$) in the water intake of the animals which indicate there was increased in rate water intake of the animal. The result support of Akingbade*et al.,* 2007 that season, climate, age, sex, physiological state of the animal, feed and animal itself effect water intake. The importance of body size as ameasure of growth in farm animal has led to the measurement of variables associated with body size such as linear body measurement (Udeh*et al*., 2011). The linear body measurements have been to evaluate growth performance and characterize breeds farm animals (Ozoje and Herbert, 1997; Ogungbayi*et al*., 2003) and also enable the breeder to understand the relationship between the body parameters (Udeh*et al*., 2011).

Table 1: Effect of early wet season on the growth performance of the Bunaji (white fulani) cattle. Significant differences (p<0.05) were observed on the body parameter.

	ANIMALS						
PARAMETER	**1**	**2**	**3**	**4**	**5**	**6**	**SEM**
BDL(m)	32.017^{ab}	32.00^{ab}	31.00^{c}	32.083^{ab}	32.35^{a}	31.560^{b}	0.1069
BDC	47.92^{b}	43.75^{c}	49.50^{a}	47.88^{b}	$47..33^{b}$	48.08	0.3170
TL	28.02^{a}	21.17^{d}	27.08^{b}	27.92^{a}	27.42^{ab}	26.42^{c}	0.4180
THL	15.17^{c}	15.13^{c}	15.50^{c}	14.50^{a}	14.00^{d}	15.75^{b}	0.1679
HAW	46.64^{a}	42.00^{d}	45.16^{b}	46.67^{a}	44.17^{c}	42.58^{d}	0.3220
WI(Lt)	14.12^{a}	14.70^{a}	13.43^{a}	13.32^{a}	14.07^{a}	14.88^{a}	1.0682
BDW(Kg)	68.05^{a}	56.52^{b}	69.40^{a}	67.87^{a}	66.88^{a}	67.17^{a}	0.8604

^{abc} Mean with different superscripts along a rows are significantly different ($p < 0.05$). SEM: Mean standard error of mean, BDL: mean body length, BDC: mean body circumference, TL: mean of tail length, THL: mean thoracic length, HAW: mean height at wither, WI: mean water intake, BDW: mean body weight.

CONCLUSION AND APPLICATIONS

There was significant difference in the body weight, body length, body circumference, thoracic length and water intake on the growth performance of white Fulani cattle was raised in early wet season had no negative effect on the growth performance of all animals because, there is availability of good forage but they are not enough in quantity and quality during the early wet season.

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Semen Characteristics of Adult Male Rabbit Fed Graded Levels of *Moringa oleifera* and *Centrosema pubescens* Leaf Meals

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Abstract: Semen quality of twenty four (24) 7-8 months old rabbit bucks weighing 2.8 – 3.0 kg fed a 50:50 *Moringa oleifera* (MO): *Centrosema pubescens* (CP) leaf mealsand maize-based diets at graded levels of 0% (0% MO: 0% CP)T_1, 5% (2.5% MO: 2.5% CP)T_2, 10% (5% MO: 5% CP)T_3 and 15% (7.5% MO: 7.5% CP) T_4 respectively were evaluated. Data on differences semen collected were used and variance analysis was performed. The ration was given at the varying levels of inclusion for 56 days. Semen samples were collected twice weekly between the hours of 8:00 – 10:00am using artificial vagina for 3 weeks. Immediately after collection, the ejaculates were taken to the laboratory where it was placed in a water bath at 30^{O}c, after which semen was evaluated. No significant difference was observed on all parameters measured. Semen was evaluated for volume, pH value, motility, sperm livability, abnormality, sperm cell concentration. The results revealed that *Moringa oleifera* leaf meal (MOLM) and *Centrosema pubescens* leaf meal (CPLM) had no adverse effect on epididimal sperm quality of rabbit bucks at levels up to 15% inclusion. This suggests feed rations at up to 15% could be fed without detrimental effects on production functions of male rabbits intended for breeding purposes.

Keywords: Semen quality, adult rabbit, *Moringa oleifera* and *Centrosema pubescens* Leaf Meals

INTRODUCTION

Reproductive inefficiency is the most limiting constraint to efficient rabbit production in the tropics (Boit *et al.*, 2005). In commercial rabbit farms artificial insemination (AI) is widely employed and this practicehas contributed to the increase in knowledge of spermatozoa metabolism and management of rabbit bucks. According to Boit*et al.,* (2005), there are many factors that affect seminal traits so it is important to define suitable standards to improve spermatozoa characteristics.

Semen is a mixture of spermatozoa produced by the testicles and seminal plasma secreted at different sites by the accessory glands and the epididymis which are combined at the same time of ejaculation.

Lavara, (2000) explained that semen evaluation must provide information on the fertilizing ability of spermatozoa. Thus, the most relevant parameters to be correlated with the fertility rate are the number of spermatozoa inseminated and their motility. These authors further reported that the use of a single attribute is not accurate enough to predict the fertilizing ability of semen. Consequently, the factors that affect the variation in seminal characteristics are genetic strain, feeding, health status, rearing condition, season, age, and collection frequency (Alvarinio, 2000).

The rabbit is described as a pseudo-ruminant; therefore, forages are major components of their diets. Apart from being used as components of the major diets in providing basic nutrients for rabbits, forages can be administered as a therapy toalleviate male infertility irrespective of the etiology of such diseases as well as help to boost sexual performance or libido (Bhatia, *et al.*, 2010).

Moringa oleifera belongs to the family moringaceae, which is well known for its medicinal properties (Mughal*et al*., 2000), nutritional virtues (Anwar, 2007) and antimicrobial effects (Faizi*et al*., 2000). Its oral extract serves as a supportive treatment in nutritional management to improve semen production in rabbit bucks and consequently help to increase reproductive performance of rabbit does mated with this semen (El Harairy*et al*., 2016).

*Centrosema pubescens*also called centro or butterfly pea is a legume in the family Fabaceae, genus centrosema. It isa highly relished andwidely used forage for livestock (Lukefah, 2009). This forage is reported to have a high nutritive value in terms of its protein and an outstanding rich mineral profile (calcium and potassium) Nworgu*et al.*,2013).

Dauda*et al*. (2009), asserted that the best way in assessing the suitability of feeding material for rabbit nutrition is to include them in graded levels in the diets at the same time as well as ensuring that all the nutrients required by the animals are supplied and the measure of performance ascertained so as to know the optimum inclusion level.

This study examines thesemen quality of rabbit bucks fed *Moringa oleifera* and *Centrosema pubescens* leaf meal.

MATERIALS AND METHODS

Experimental site: The study was carried out at the Teaching and Research Farm of Ignatius Ajuru University of Education, Ndele campus, Rivers state.

Experimental leaves and their processing: *Moringa oleifera* and *Centrosema pubescens*leaves were harvested around the Teaching and Research Farm of Ignatius Ajuru University of Education, Ndele campus, Rivers state. The leaves were air dried away from the direct sunlight to reduce the moisture content. The dried leaves were collected and grinded into powder form before incorporating it into the rabbit diets: *Moringa oleifera*leaf meal (MOLM) and *Centrosema pubescence* leaf meal (CPLM).

Experimental diets: Four experimental diets were formulated: T_1 – O% (MO: CP), T_2 – 5% (2.5% MO: 2.5% CP), T_3 – 10% (5% MO: 5% CP) and T_4 – 15% (7.5% MO: 7.5% CP). All treatments had 50:50% inclusions rate of *Moringa oleifera* leaf meal and *Centrosema* leaf meal respectively. The percentage composition of the experimental diets in presented in Table 1.

Experimental animal and theirmanagement: Twenty-four (24) male rabbits of mixed breeds with ages ranging from 7-8 months oldandweights ranging from 2.8 – 3.0 kg were randomly divided into four treatment groups of six rabbits each. The groups were randomly assigned to the four experimental diets, each having three replicates per treatment and two rabbits per replicate in a Completely Randomized Design (CRD). All management practices were observed, feed and water were given *ad libitum.*

Semen-Collection: Rabbit semen was collected once a week between 7.00am and 8.00am by means of a specially constructedartificial vagina, which was filled with a warm liquid (about 45°C) as described by Herbert, 1995 and George, et al 2017.Anexperienced doe wasplaced in the mating pen with the buck to stimulate libido and to increase sperm concentration. The constructed artificial vaginawas used for each collection and was collected under germ-freeenvironment to prevent bacterial and environmentalcontamination.

The animals were ejaculated once weekly for 2 months. Semen volume was read off the collection tube andrecorded in milliliters. Sperm motility was determined on freshly collected semen placed on a warm stage at 37^{o}c. TheSamples were diluted with a physiological saline solution and observations were made at ×400 magnification. Totalspermatozoa per ejaculate were derived by calculation.

Statistical analysis: The sperm parameters were taken and subjected to analysis of variance (ANOVA) for a Completely Randomized Design (CRD). Where differences were observed mean were separated using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Semen characteristics: Summaries of mean values of ejaculate volume, pH, gross sperm motility, sperm concentration, abnormal sperm percentage, live sperm percentage of rabbit bucks fed 0, 5, 10, 15 % of *Moringa oleifera* and *Centrosema pubescens* are presented in Table 3.

Semen pH was not significantly ($P< 0.05$) influenced by the treatments. There was no significant difference ($P> 0.05$) in spermatozoa motility among the four groups of rabbits fed MOLM and CPLM estimated by procedure of Peiretti (2005).There was not significant ($P< 0.05$) difference in sperm concentration (x10^6/ml) between

groups 1 – 4: T_1(156 ±3.54);T_2 (163 ±3.54); T_3 (161 ±2.52) and T_4 (161 ±2.64).There was no significant difference(*P*> 0.05) in the percentage of life spermatozoa among the groups.

There were a high percentage of normal cells in all the groups. No significant difference (*P*> 0.05) in mean percentage of abnormal sperm cells occurred among the groups. The common morphological abnormalities observed are free tail, coiled tail, bent tail etc.

The results show that the diets did not significantly influence sperm motility in the rabbits. This result contradicts with that of George *et al.,* (2017) who observed that *Moringa oleifera* leaf meal significantly influence sperm active motility. But it corroborates that of by Ajayi *et al*., (2009) who report on sperm motility of rabbits fed graded levels of sunflower meal. *Moringa oleifera* leaf meal and *Centrosema* leaf meal did not significantly influence sperm concentration in rabbits. This supports the assertion of Nwagwu and Nzekwe (2006) that feeding a concentration of forage and concentrate is better than feeding concentrate or forage alone with regards to productive and reproductive performance of bucks and does.

The live sperm percentage which shows sperm viability and higher fertilizing capacity did not change significantly (*P*> 0.05). This agrees with El Harairy *et al* (2016). The range of values (90.70, 93.70 %) for normal spermatozoa indicates sperm viability and the fertilizing capacity with rabbits fed the experimental diets.

Table 1: Percentage composition of experimental diets

	DIETS (%)			
Ingredients	**T_1**	**T_2**	**T_3**	**T_4**
GNC	7.4	7.4	7.4	7.4
Maize	52.00	52.00	52.00	52.00
PKC	10.00	10.00	10.00	10.00
Centroscema	0.00	2.5	5.0	7.5
SBM	15.00	10.00	5.00	0.00
Wheat Bran	10.00	10.00	10.00	10.00
Moringa	0.00	2.5	5.0	7.5
B/Meal	3.00	3.00	3.00	3.00
Lime Stone	2.00	2.00	2.00	2.00
Salt	0.30	0.30	0.30	0.30
Premix	0.30	0.30	0.30	0.30
Total	**100.00**	**100.00**	**100.00**	**100.00**

Table 2: Proximate nutritional composition of experimental diets

Nutrients	**Diets**			
	T_1	**T_2**	**T_3**	**T_4**
Crude protein %	17.07	17.09	17.06	17.06
Crude fibre %	9.24	9.25	9.34	9.51
Dry matter %	95.69	95.42	95.34	95.39
Calcium %	0.50	0.50	0.50	0.5
Phosphorus %	0.51	0.51	0.50	0.50
ME (kcal/kg)	2506.50	2521.51	2514.80	2514.10

Table 3: Sperm characteristics of rabbits fed MO and CP leaf meal

Parameters	**T_1 – Control 0% Inclusion**	**T_2 – 5% Inclusion**	**T_3 1% Inclusion**	**T_4 15% Inclusion**
Sperm motility	82.00 ± 3.52	77.68 ± 4.30	79.00 ± 0.58	78.00 ± 1.54
Sperm concentration(x10^6/ml)	156 ± 3.54	163 ± 3.54	161 ± 2.52	161 ± 2.64
Live sperm cells %	85.30 ± 2.40	90.00 ± 1.42	84.30 ± 0.89	83.30 ± 1.77

Dead sperm cells %	17.00 ± 2.08	10.32 ± 1.32	15.71 ± 1.20	10.07 ± 1.77
Normal Morphology %	93.00 ± 1.05	91.70 ± 0.68	94.33 ± 1.06	93.00 ± 0.59
Abnormal Morphology %	7.00 ± 1.08	9.33 ± 0.87	6.34 ± 0.68	7.00 ± 0.59
SV (ml)	0.57 ± 0.23	0.40 ± 0.06	0.33 ± 0.03	2.17 ± 0.17
Semen pH	7.50 ± 0.29	8.00 ± 0.00	8.00 ± 0.00	8.00 ± 0.00
Semen Appearance	Milky	Milky	Milky	Milky

CONCLUSION AND RECOMMENDATION

The study has established that *Moringa oleifera* leaf meal and *Centrosema pubescens* leaf meal do not have any adverse effect on epididimal sperm characteristics of rabbits and it can be included up to 15% levels in diets of growing rabbits.

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Monogastric Production/Nutrition

Assessment of Some Semen Characteristics and Their Correlation Co-Efficient Among Bull Genotype

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Abstract: The research assessed the semen characteristics and their correlation coefficients among bull genotype presented in a completely randomized design. The study was conducted at the Artificial Insemination Laboratory, Livestock Investigation Division, National Veterinary Research Institute, Vom, Plateau State, Nigeria.The semen was evaluated physically for volume, colour and pH, and microscopically for motility, concentration and percentage live and normal sperm cells. There was significant ($p<0.01$) difference in all semen characteristics by genotype except pH. The 50% Friesian x 50% Bunaji recorded higher semen volume, pH, motility, percentage live and normal spermatozoa. The 75% Friesian x 25% Bunaji gave best semen colour, while 100% Friesian had higher concentration. Most of the correlation coefficients between bovine semen characteristics were significantly moderate to high and positive. The values ofcorrelation coefficients could be used to a certain extent to relate the semen quality characteristics with one another as linearly related or not.

Keywords: Semen, Characteristics, Correlation, Coefficient, Bull.

INTRODUCTION

According to (2,8), low productivity among our indigenous breeds of cattle is alarming. This is a reflection of the absence of breeding and selection program for inherent genetic abilities in their economic traits such as: age at first calving, calving percentage, milk yield, length of lactation, birth weight, rate of daily live weight gain, mature body weight, gestation length, generation interval, and carcass killing-out percentage are low not only cattle but in almost all livestock species due to poor feeding quality, poor management, poor production methods, livestock diseases, poor veterinary services, lack of genetic improvement centers, poor regulatory framework as well as lack of financial and risk management support to the livestock owners in the country. The productivity of the livestock could be improved under more intensive and good management practices where dairy cattle showed a linear increase in milk yield as the exotic gene increase up to the 7/8 level, that is at 50% Friesian × Bunaji gives 168 kg, at 75% Friesian × Bunaji gives 1850 kg and at 7/8 it gives 2051 kg of milk in a lactation of about 260 days (8). This suggests that through good management practices and cross-breeding programme targeted on the following characteristics; meat quality, growth rate, milk yield, tolerance to prevailing climate conditions and diseases, temperament, feed conversion efficiency, ability to utilize vast available tropical forage, skin quality etc. with the exotic breeds, desirable quality traits stand the chance of enhancing and improving the country's livestock resources and productivity (8). The research assessed the semen characteristics and their correlation coefficient among different bull genotype as index for selection and improvement of livestock industry.

MATERIALS and METHODS

Experimental site: The research was conducted at the Livestock Investigation Division (LID), Artificial Insemination Laboratory of National Veterinary Research Institute (NVRI) Vom, Plateau State Nigeria.It is situated on latitude 09^0 44′north of the equator and longitude 08^0 45′East of the Greenwich Meridian.The average

annual rainfall is between 1300 and 1500 mm. The rainy season begin from late March to early October. The temperature annually ranges from 13. 9to 31. 90C.The mean relative humidity varies between 13.1 and 76.2% (10).

Experimental Animals: Three mature genetically different bulls namely; 100% Friesian; 75% Friesian × Bunaji; and 50% Friesian × Bunaji with weights of 500 to 850 kg, 5 to 7 years old and with a mean scrotal circumference of 36.6 cm were used as semen donors for the experiment. All bulls were maintained under uniform condition of feeding and management.

Data Collection: The experiment comprises of 3 bulls genotype presented in a completely randomized design (7). Semen samples were collected once in a week during early hours of the day using artificial vagina (3;12). The collected semen was placed in a water-bath at 37^0 C. Volume, colour, pH, percentage motility, concentration, and morphology of semen were determined for the period of 12 weeks.

Statistical Analysis: Data obtained were subjected to analysis of variance (ANOVA) using the general linear model in complete procedures of statistical analysis system (SAS) version 9.0 (15). Where significant difference was observed, means were separated using the Duncan Multiple Range Test (DMRT), (3). Means were expressed as the mean ± standard error of the mean (SEM).

RESULTS and DISCUSSION

The Effects of Breed on Semen Characteristics

Genotype: There was significant difference among genotypes in semen volume (Table 1). The range of semen volume in this study was higher than 4.1-7.6 ml observed by (5) in Holstein-Friesian x Zebu crosses. The observed range howeverwas within the 4-11ml reported by (9) in Jersey bulls. (5) also stated that semen volume is influenced by a number of factors such as the secretory activities of the sex glands, age, breed, body weight and size, scrotal circumference, nutrition, environmental conditions and season. Semen colour (creamy 1.44±0.72) which is best in this study was observed in 75% Friesian x 25% Bunaji. Creamy coloured semen had also been reported in Jersey and Friesian x Bunajibulls in NAPRI, Zaria (6, 4). (6) further stated that changes in semen colour is usually associated with urinogenital diseases. Semen pH is a measure of acidity or alkalinity (4). There was no significant difference among genotypes with regard to sperm pH. In the current study, the percentage motilities of the crosses were better than that of the pure Friesians. This agrees with the findings of (16,5, 11) that Sahiwal x Friesian bulls recorded 65-95% progressive motility as opposed to the pure Friesians with a range of 60-85%. (13) reported that in some mammals, sperm motility is suppressed by very low and high pH and calcium ions. Sperm concentration was significantly different by genotype. This agrees with (14). The values of 1471±37 x 10^6/ml for Sahiwal and 1131±38 x 10^6/ml for 50% Friesian x 50%Sahiwalreported by (14) are higher than those of the present study. However, the values of the current study are within the normal concentration range of 500 to 2500 x 10^6/ml (14). The overall mean percentage live sperm in this study is within the range of 70-90% which agreeswith the mean of 83.0% observed by (1). Similar to this study, (1) observed highest (81.25±0.64%) live sperm percentage in Holstein Friesian x Zebu crosses as compared to other genotypes including pure local breeds.

Correlation Coefficients Among Semen Characteristics: The moderate to high positive and negative correlation values obtained in this study (Table 2), means that most of the parameters can be used to indicate each other's values. The medium negative correlation between volume and colour and, medium positive value between per cent live and normally indicate that the correlations could be used, to a certain extent to relate the pairs to each other. Thus, increase in volume is expected to be associated with decrease in colour and vice versa. In the case of percentage live and normal sperm cells, an increase in the value of one will also result in the increase in value of the other. For colour and pH, pH and motility with fairly high, positive and significant relationships; increase in the value of one pair is more likely to be associated with the increase in that of the other. Fairly positive correlation coefficients have also been reported between sperm motility with pH and concentration by (1) in domesticated Banteng in Malaysia.

Table 1: Influence of genotype on Bovine semen characteristics

Breed	Parameter						
	volume (ml)	**Colour**	**Ph**	**Motility (%)**	**Concentration. (x10^{6}sperm/ml)**	**PL (%)**	**PN (%)**
Overall mean	8.398±1.96	1.182±0.54	6.911±2.43	76.897±16.45	578.602±518.24	89.014±7.05	93.399±4.38
100%Fr	8.933±1.52^b	1.000±0.00^c	6.819±0.12	73.281±13.71^b	635.68±559.48^a	88.667±8.07^b	92.167±5.17^b
75%Fr×25%B	6.667±1.13^c	1.438±0.72^a	6.766±0.14	78.067±13.15^a	501.12±447.45^b	87.818±7.41^b	93.865±4.66^a
50%Fr×50%B	9.595±1.81^a	1.108±0.49^b	7.149±4.20	79.344±20.82^a	599.01±534.40^a	90.557±5.04^a	94.167±2.62^a
Sem (±)	0.112	0.037	0.175	0.941	20.054	0.515	0.318
Los	**	**	NS	**	**	**	**

abc= Means within a column with different superscripts are significantly different, **= (p<0.01), Fr = Friesian, B = Bunaji, Sem (±) = Standard error of mean, Los= Level of Significance, NS= Not significant, pH = Potential hydrogen, PL= percentage live, PN= percentage normal, %= Percentage.

Table 2: Correlation coefficients between Bovine semen characteristics

	Volume	**Colour**	**pH**	**Motility**	**Concentration**	**PL**	**PN**
Volume		-0.322**	0.055^{ns}	-0.051^{ns}	0.168**	0.039^{ns}	-0.152**
Colour			0.432**	0.227**	-0.089*	0.029^{ns}	0.124**
pH				0.579**	-0.019^{ns}	0.058^{ns}	0.007^{ns}
Motility					0.229**	0.082*	0.111**
Concentration						-0.094*	-0.166**
Percentage Live							0.325**
Percentage normal							

*= (p< 0.05), ** = (p< 0.01), NS= Not Significant, pH= Potential hydrogen, PL= Percentage Live, PN= percentage normal, % = Percentage.

CONCLUSION: Therefore, inconclusion the result of the present study revealed that 50% Friesian x 50% Bunaji produced good quality semen parameters because the cross had produced better and higher percentage motile sperm, and percentage live and normal spermatozoa than other genotypes. The medium correlation values between some semen characteristics could be used to a certain extent to relate the pairs to each other.

RECOMMENDATIONS: The following points were outlined as recommendation statement emanating from the present research investigation.

1. The 50 % Friesian x 50 % Bunaji bull was excellent in most semen characteristic parameters evaluated as compared to other genotypestherefore; itshould be usedfor livestockimprovement program in Nigeria.
2. Some semen characteristics are positively related to certain extent with one another as increase in the value of one will result in increase in value of the other therefore, it is an important tool in selection.

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Haematology and Blood Chemistry of Rabbits Exposed to Dietary Kolanut Husk Meal (KHM)

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Abstract: A- 60 day feeding trial was carried out to evaluate the blood chemistry of rabbits fed varying levels of Kolanut husk meal (KHM) based-diets. Forty (40) cross-bred weaned rabbits of both sexes (20) bucks and 20 (does) were used in this study using a Completely Randomized Design (CRD). Five experimental diets were formulated to constitute T_1 (0% KHM control) and the replacement levels of KHM for maize at levels of 20, 40 and 80% for T_2, T_3, T_4, and T_5, respectively. Feed and water were provided *ad libitum*. At the end of the feeding trial, blood samples were collected from the prominent ear vein of the rabbits for the determination of haematological and serum biochemical characteristics using standard laboratory methods. Results of haematological parameters showed that most parameters were significantly ($P<0.05$) influenced by the dietary treatments except the mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC). The serum biochemical indices indicated that glucose content was significantly ($P<0.05$) influenced by dietary treatments with rabbits fed 80% KHM diet having significantly highest value (2.99mmol/l) compared to the control (2.05mmol/L). The Aspartate Transaminase (AST) was also significantly ($P<0.05$) different with the highest value at 80% KHM replacement with value (21.00 iu/l). All the haematological and serum biochemical characteristics of rabbits fed dietary KHM were within the normal/standard blood ranges for apparently healthy rabbits. The study therefore concludes that farmers can replace maize with up to 40% KHM in formulated diets meant for rabbits, without fear of compromising haematopoietic processes and chemistry.

Keywords: Rabbit, blood chemistry, kolanut husk, diet

DESCRIPTION OF PROBLEM

Rabbits are small bodied animals reared for meat and fur (Angora breed) as well as other by–products. They play an important role in meeting the protein needs of man. Rabbit meat serves as a healthy food for patients with coronary heart disease. The meat is very palatable, high in protein and low in cholesterol. Rabbits have short breeding cycle (about 30-31 days) and in terms of growth, they exceed ruminants and rank close to modern broiler chickens [1]. In performance, rabbits supersede other animals because of their biological qualities like short life cycle, prolificacy and conversion of feedstuffs not directly utilized by man to high quality meat at a very rapid rate. Due to the high cost of feeds which have hampered large scale rabbit production in Nigeria, it has become imperative to develop appropriate and cost-effective feeding systems for backyard and commercial production of rabbits [2; 3].

Agro by-products and forages are cheap and abundantly available in Nigeria [4] and are available all year round in many parts of the country. Studies on their chemical compositions revealed considerable information on their suitability as sources of nutrients for animals. The nutritional potential of forages and industrial by–products or wastes is particularly significant for rabbits. Many of the by–products traditionally used in Nigeria for rabbit feeding are green feeds from banana, sesbania, tridax, carrot waste and leaf by–products from cocoa, kolanut, groundnut usually husk meal are possible sources of feed ingredients [1; 3].

Kolanut (*Cola acuminata)* is an evergreen African tree, cultivated in the tropics. Nigeria is the world's largest producer of kolanut, the husk which constitutes over 50% of the kolanut fruit, has been a farm waste of no economic value to date. The crude protein content which is almost similar to that of maize suggests that it is possible to partially replace maize with kolanut husk meal. Kolanut husk meal contains high crude fibre and could be used to boost gut integrity and motility in rabbits. It is rich in nutrients (13% CP and 2,446.9 Kcal/kgME) [5]. There is paucity of experimental findings involving kolanut husk meal in rabbit production; this study was therefore designed to evaluate the effect of replacing maize with kolanut husk meal on the blood characteristics (haematology and serum biochemical indices) of rabbits.

MATERIALS AND METHODS

The study was carried out at the Rabbitry Unit of the Teaching and Research Farm, University of Calabar, Calabar, Cross River State. Calabar is located at latitude 3^0N and longitude 7^0E and it is situated at elevation of 98 metres above sea level. A total of forty (40) cross – bred weaned rabbits (6 weeks old) of both sexes (20 bucks and 20 does) were used in this study. The rabbits were sourced from the Unical rabbitry. They were managed based on standard experimental procedures. On arrival at the rabbitry, the animals were provided with anti- stress vitalyte. These rabbits were allowed to adjust for two (2) weeks before the commencement of the feeding trial, which lasted for 60 days. The rabbits were housed individually in wooden cages measuring 76 x 62 x 42cm and raised 25cm from the ground and placed in a standard rabbitry. Basic drinking and feeding troughs were provided in each cage. The composite kolanut husks were sourced from local plantations at Akpabuyo L.G.A, Cross River State. The raw kolanut husks were gathered and washed with water, sundried to constant weight and milled using hammer mill to obtain kolanut husk meal (KHM). Five experimental diets were formulated such that KHM replaced maize at 0, 20, 40, 60, 80 % levels for T_1, T_2, T_3, T_4 and T_5 respectively. The gross composition of experimental diets is presented in Table 1.

Table 1: Gross composition of experimental diets

Ingredient	**T1 LEVELS OF KHM 0%**	**T2 REPLACEMENT 20%**	**T3 40%**	**T4 60%**	**T5 80%**
Yellow maize	45.00	36.00	27.00	18.00	9.00
Kolanut husk meal	0.00	9.00	18.00	27.00	36.00
Soybean meal	16.00	16.00	16.00	16.00	16.00
Rice husk	18.00	18.00	18.00	18.00	18.00
Palm kernel meal	8.00	8.00	8.00	8.00	8.00
Wheat offal	10.00	10.00	10.00	10.00	10.00
Cray fish dust	1.00	1.00	1.00	1.00	1.00
Palm oil	1.00	1.00	1.00	1.00	1.00
Vit. & min. premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Bone meal	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis:					
Crude protein (%)	16.26	16.58	16.34	16.70	17.03
Crude fibre (%)	8.49	8.95	9.41	9.87	10.33
ME (Kcal/Kg)	2,599.20	2,519.72		2,440.24	2,360.76
2,281.28					
Determined analysis:					
%CP	15.00	15.26	16.62	16.75	16.80

The rabbits were assigned to the test diets using a Completely Randomized Design (CRD). Six rabbits were allocated to each dietary treatment with each rabbit serving as a replicate after balancing for body weight. On the 60th day, blood was collected from four rabbits (2 bucks & 2 does) per treatment and two (2) blood samples per rabbit into clean test tubes, one with an anticoagulant, Ethylene Diamine tetra Acetate (EDTA) for haematological analysis and the other without EDTA for serum biochemical analysis. The blood samples were collected with hypodermic needles and syringe from the prominent ear vein of the rabbits.

All haematological parameters were determined by conventional laboratory methods of [6]. Serum biochemical indices were assayed using standards laboratory methods [7]. All data that were obtained from haematological

and serum biochemical determinations in this study were subjected to-one-way analysis of variance (ANOVA) for CRD, and significant means were separated using the Least Significance Difference (LSD) method [8].

RESULTS

Haematological parameters: Result of the haematological parameters of the experimental rabbits is presented in Table 2. The result showed that most parameters were significantly (P<0.05) influenced by dietary treatments except mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC). The white blood cell counts (WBCs) were significantly (P<0.05) influenced by dietary treatments with rabbits fed diet 80% KHM having significantly higher value (26.00 $x10^3$/L) with the control having lowest value (20.05 $x10^3$/L). Red blood cell counts (RBCs) of rabbits fed diet 20% KHM had significantly higher value (3.307 $x10^6$/l). Haemoglobin was significantly (P<0.05) influenced, with rabbits fed 20% KHM having significantly higher value (13.89 g/dl) while those fed 80% KHM had lowest value (10.62 g/dl). Hematocrit was significantly influenced with rabbits fed 20% KHM having the highest value (38.90%) and 80% KHM with the lowest value (29.60%). Neutrophils were significantly (P<0.05) influenced by dietary treatments with rabbit fed diets 60% KHM having higher value (94.70%).

Serum biochemical indices

Result of the serum biochemical indices of rabbits is presented in Table 3. The result showed that glucose content was significantly (P<0.05) influenced by dietary treatments with rabbits fed 80% KHM having highest value (2.99 mmol/l). Significant (P<0.05) differences were also recorded for Aspartate transaminase (AST) with the highest value at 80% KHM replacement with value (21.00 iu/l) and lowest value at 20% KHM replacement level (11.00 iu/l).

Table 2: Haematological indices of rabbits fed replacement levels of kolanut husk meal for maize

Parameters	Diets					
	T_1	T_2 Levels	T_3 of	T_4 KHM	T_5 Replacement	SEM
	0%	20%	40%	60%	80%	
White blood cell counts ($X10^3$L)	20.05^{ab}	22.20^{c}	23.45^{b}	22.30^{b}	26.00^{a}	0.55
RBC ($x10^6$/L)	3.00^{b}	3.31^{a}	2.92^{b}	3.07^{b}	2.53^{b}	0.15
Haemoglobin	12.62^{b}	13.89^{a}	12.29^{b}	12.95^{b}	10.62^{b}	0.62
Hematocrit (%)	35.35^{b}	38.90^{a}	34.40^{b}	36.25^{b}	29.60^{b}	1.73
MCV (fl)	117.84^{a}	117.74^{b}	117.81^{a}	117.53^{b}	117.21^{b}	0.11
MCH (pg)	42.09	42.03	42.07	42.15	42.04	0.05
MCHC (g/dl)	35.72	35.72	35.72	35.71	35.87	0.26
Platelets ($x10^6$/l)	50.00^{a}	40.20^{b}	43.00^{b}	33.00^{b}	32.50^{b}	3.68
Neutrophils (%)	96.30^{b}	97.90^{a}	95.50^{b}	94.70^{b}	96.60^{b}	0.63

SEM: Standard error of mean $^{a, b, c}$ Means on the same row with different superscripts are significantly different (P<0.05)

Table 3: Serum biochemical indices of rabbits fed replacement levels of kolanut husk meal for maize

Parameters	Diets					
	T_1	T_2 Levels	T_3 of	T_4 KHM	T_5 Replacement	SEM
	0%	20%	40%	60%	80%	
Total chol. (mg/dl)	152.50	151.40	156.80	150.40	146.20	4.46
T. Protein (g/l)	3.43	3.56	3.06	3.77	3.04	0.35
Glucose (mmo/l)	2.05^{b}	2.47^{b}	2.60^{b}	2.26^{b}	2.99^{a}	0.17
AST (IU/L)	11.67^{b}	11.00^{b}	14.00^{b}	14.00^{b}	21.00^{a}	1.66
ALT (g/dl)	14.00	16.50	16.00	18.00	18.00	1.71

ALB (g/l)	2.19	2.28	1.96	2.41	1.95	0.23
GLO (g/L)	1.24	1.28	1.15	1.35	1.09	0.12

SEM: Standard error of mean

[a,b] Means on the same row with different superscripts are significantly different (P<0.05)

DISCUSSION

Haematological parameters: The changes in blood parameters reflect the physiological status of the animal. The result of the white blood cell counts was significantly (P<0.05) influenced by dietary treatments. The range (20.05 - 26.00 $x10^6$/L) recorded in this study for white blood cell was higher than the range (5 - 13 $x10^6$/L) reported by [9]. This disparity could be attributed to the phytochemical composition of kolanut husk. Significant (P<0.05) differences between diets were observed in red blood cell counts. The range 2.53 - 3.31 $x10^6$/L recorded in this present study was slightly lower than 3.8 - 7.9 $x10^6$/L reported by [9] and the low red blood cell counts maybe associated with iron deficiency, internal bleeding and some types of anaemia or vitamin deficiency [10], even though the rabbits in this study did not show any obvious sign of anaemia or other dysfunctions. The range of haemoglobin 10.62-13.89 g/dl reported in this study is in line with the normal range for rabbits (9.40-17.90 g/dl) reported by Medirabbit (2007). Increase in haemoglobin implies that the animals were able to transport oxygen to tissues for oxidation of ingested food so as to release energy for the other body functions [11].

Serum biochemical indices: The range of glucose content (2.05 – 2.99 mmol/L) recorded in this study is slightly lower than the range 4.2 – 8.9 mmol/l reported by [9]; this difference could be attributed to differences in feed materials. When glucose is lower than the normal range, it is an indication of hypoglycaemia while higher levels are indication of hyperglycaemia [12]. The AST range (11.00 – 21.00 iu/l) recorded in this study was in line with the range 10-98 iu/l reported by [9]. The KHM had reduced cholesterol at the highest level of 80% replacement. The values for total protein obtained were higher for rabbits fed 60% KHM. The range 3.04 – 3.77g/l obtained in this study was not in line with the range reported by [9]. Plasma protein helps to transport calcium, phosphorus and other substances in the blood by attachment to the albumin [10]. The Alanine transaminase, albumin and globulin values did not indicate significant (P>0.05) differences among the different levels of KHM in the diets, although rabbits fed 60% KHM recorded the highest value (18.00 g/dl, 2.41 g/l, 1.350g/l) respectively.

CONCLUSION AND APPLICATION

a) The study concludes that Kolanut husk meal is a valuable non –. conventional feedstuff.

b) Livestock farmers can replace maize with up to 40% Kolanut husk meal in diets meant for rabbits, without fear of compromising haematopoietic processes and blood chemistry.

c) Further investigation is suggested to determine the phytochemical composition, effects and mechanism of effects on the animals.

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ANIMAL PRODUCT AND PROCESSING TECHNOLOGY

pH of Beef Sausage as Affected by Time Postmortem on Yield and Keeping Quality of Sausage

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Abstract: Changes in pH affect storage and processing quality of meat and meat products such as sausage. Sausages are made from comminuted lean meat and fat mixed with salt, spices and other ingredients, then filled into a casing made of animal intestine or cellulose. Sausages are made from beef, veal, pork, lamb and poultry or from any combination of these meats. Without proper storage, the product quality reduced with time. There are needs therefore, to examine the effect of post-mortem time on spoilage of meat used in sausage production. The meat samples for sausage making were harvested and allotted to five groups viz; 0, 6, 12, 18, and 24 hours post-mortem, respectively. Each treatment group was replicated thrice in a factorial arrangement in completely randomized design. The sausage recipe used for all the treatment groups were Beef 65%, Lard 20%, Soybean binder 3.5% green spices 2.19%, dry spices 1.5%, ice water 4.5%, salt 2%, sugar 1%, Sodium nitrite 0.01% and phosphate 0.3%. The sausage was stored for 14days at $\pm 4^0$C. Sausage prepared was subjected to pH and microbial count. Data were analysed using descriptive statistic and ANOVA at $\alpha_{0.05.}$ There were significant ($P<0.05$) differences observed in pH value among the treatments and storage days. Similar result was obtained for the microbial count. As the time post-mortem and storage day increases, there was an increased in values obtained. 0 and 6-hour time post-mortem were recommended from this experiment to harvest meat for best yield and keeping quality of sausage.

Keywords: pH, Beef Sausage, Microbial Count, Keeping Quality, Time Post-mortem

INTRODUCTION

Many qualities of meat depend on its pH. Higher pH of meat is important with respect to maintaining color, holding water, and improving tenderness (Oshibanjo 2010). Generally, meat in the pH range of 5.4 to 5.6 has the most desirable properties for table cuts. Offer (1991) inferred that reduction in pH by 1 unit increased the rate of denaturation by 12 times. pH values as high as 6.9 result in several defects; the most obvious being its colour, which becomes progressively darker as pH increases (Young *et al.*, 2004). Acidic pH of meat is resulting into lower water holding capacity (WHC) with increased cooking and drip losses has also been reported to reduce the tenderness (Northcutt *et al.*, 1994) and result in PSE meat. Changes in pH, WHC, and rheological properties are reported to affect storage and processing quality of the meat (Oshibanjo 2010). The microbiological stability of high pH meat is poor, tenderness is more variable, and cooked flavour is inferior (Simmons *et al.*, 2000). This present study seeks to investigate the pH of freshly prepared and stored sausage as affected by time post-mortem.

MATERIALS AND METHODS

Location of the study: The experiment was carried out in the Meat Science Laboratory of Department of Animal Science, Faculty of Agriculture and Forestry, University of Ibadan.

Meat source: Semi-membranous muscle from matured (3 years old) bull was obtained immediately after slaughter before the onset of rigor mortis. The meat samples were allotted to five groups viz; 0, 6, 12, 18, and 24 hours post-mortem, respectively. Each treatment group was replicated thrice in a completely randomized design. Pig intestine and lard were purchased from Bodija abattoir. The meat samples, except for those of Zero (0) hour post-mortem were kept at 4^oc until used at 6, 12, 18, 24 hours post-mortem, respectively.

Sausage making procedures: The sausages were prepared according to a standard commercial method, using the recipe as follows. Beef 65% Lard 20%, Soybean binder 3.5% green spices 2.19%, dry spices 1.5%, ice water 4.5%, salt 2% sugar 1%, Sodium nitrite 0.01% and phosphate 0.3%.

Parameter measured

pH: The pH was determined by using a digital pH meter model PHS- 25 Microfield instrument England according to the method described by AOAC (2000). The pH value of sausage samples was determined by weighing 10 grams of sample into a blender with 90ml of distilled water and homogenised until smooth slurry was formed. The digital pH meter was placed in a buffer solution in order to allow equilibrium for two minutes before placing it into prepared slurry. An average of three readings was taken, to determine the pH value.

Microbial Count: Microbial count was done using the pour plate water method (Harrigan and Macanee, 1976). A sterile pipette was used to measure 1ml out to the 10^{-3} and 10^{-5} dilution and this was pipette into sterile Petri dishes, molten agar at 45 °C was poured into it. It was swirled gently for even distribution. The plate was inverted and incubated in an incubator at 30 °C. The total plate count was carried out after 24 hours.

Statistical Analysis: Data obtained were subjected to analysis of variance using SAS (2010). The means were separated using Duncan's Multiple Range Test of the same procedure.

RESULTS AND DISCUSSION

Table 1 shows the pH values of beef sausage as affected by time post-mortem. There were significant differences ($P < 0.05$) in pH values observed between treatments and storage days. For day 0, it was observed that as time post-mortem increase, there was a decrease in pH value with 6 hours post-mortem having the highest value, followed by 0 hours, 12 hours and 18 hours with 24 hours having the lowest pH value. A similar result was reported by Oshibanjo *et al.* (2013) that prerigor meat have higher pH value compared with sausage from post rigor meat which could be probably due to the fact that salting of pre-rigor meat reduces the rate of glycolysis. The salting of post rigor meat was not expected to affect the pH of meat since the ultimate pH had been reached before salting. But as the storage days increases, there was an increasing value in pH as the time post-mortem also increases. Similar result was reported by Deva and Narayah (1988), that increase in pH value could be due to increase in microbial load. Results of this present study are in agreement with the above result.

Microbial plate count values obtained was significantly ($P<0.05$) different. It was observed that, microbial load increases as the time post-mortem increased. Total plate count result obtained was in agreement with that of Agnihortri and Pal (2000) and Oshibanjo (2017). Higher values were reported by Dharrmaveer *et. al.* (2007). It was observed that as time post-mortem increase, total plate count increased. The result obtained could be due to increase in pH as the time post-mortem increased. The differences observed can be attributed to some eventual contamination and growth of microorganism in the postrigor meat.

Table 1: pH of Beef Sausage as Affected by Time Postmortem

Storage days	Time Postmortem (Hours)					
	0	**6**	**12**	**18**	**24**	**SEM**
0	6.35^{abj}	6.39^{aj}	6.37^{abk}	6.33^{abk}	6.29^{bk}	0.01
7	6.22^{dk}	6.34^{ck}	6.41^{bj}	6.44^{abj}	6.46^{aj}	0.02
14	6.54^{i}	6.58^{i}	6.55^{i}	6.61^{i}	6.67^{i}	0.01
SEM	0.05	0.04	0.03	0.04	0.06	

^{abcde} means with the same superscript on the same row are not significantly ($P > 0.05$) different

^{ijk} means with the same superscript on the same column are not significantly ($P > 0.05$) different

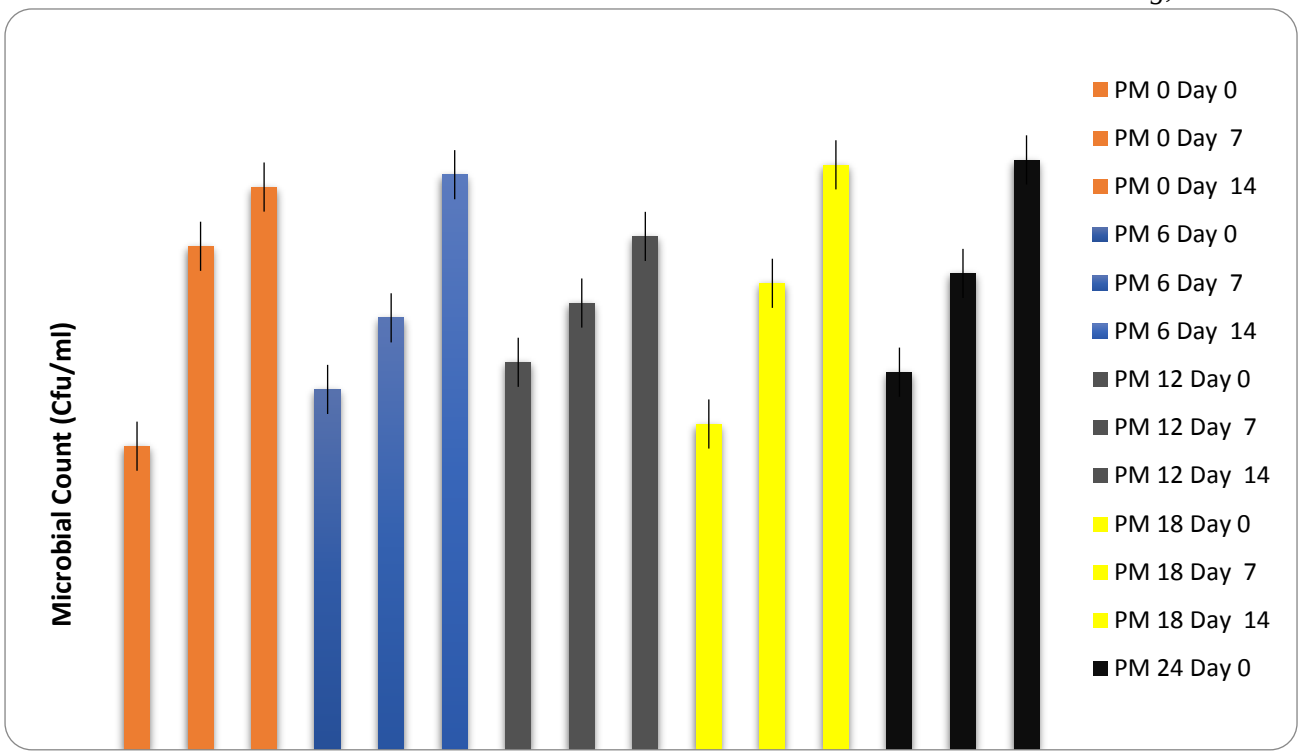

Figure 1: Microbial Count of Beef Sausage as affected by Time Post-Mortem
PM = Time Post-mortem

CONCLUSION

It is concluded from the results obtained in this study that the best time post-mortem to harvest meat for sausage making is between 0 and 6 hours to ensure its superior quality keeping and stability of shelf life.

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Assessment of Consumers Preference for Different Types of Meat in Kuje Area Council of FCT, Nigeria

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Abstract: The study was conducted with the aim of identifying the most preferred meat (fresh and processed) by consumers in Kuje Area Council of Federal Capital Territory (FCT). Structured sample survey interview papers were administered to randomly selected 100 respondents (Males and Females). Data collected include consumer's information, consumer's choice for meat preference among beef, mutton, chicken, fish, bush meat, pork, grass cutter and others (such as snail, turkey, goose, duck e.t.c).The data were analysed using simple percentage. Results show that majority of the respondents were males (55%) and females (45%) with most of the respondents within the age bracket of 25-40 years. The educational back grounds of the respondents were mostly tertiary education (45%), secondary school (19%), post degree (11%), primary school (5%) and none (11%). The results of the study show that consumers' preference is in the order beef (18%), chicken (18%), fish (17%), chevon (15%), mutton (14%), bush meat (7%), grass cutter (4%), rabbit (3%), pork (3%) and others (1%).The result also show that 24% of the respondents preferred each of *suya/balangu* and *kilishi* compared to stick meat/*Tsire*(20%),shredded meat/*dambunnama* (19%), and gas meat (11%).It is recommended that beef and chicken production and processing should be encouraged vis-avis the qualitative production of beef and chicken which will stimulate more customers and turn over.

Key words: Beef, *kilishi*, *Tsire*, mutton, Chevon and *Danbunnama*

INTRODUCTION

Animal production is very essential to food security and the development of any nation. Importance of animal production includes provision of foreign exchange, generation of employment for the citizens, source of protein which is essential for human nutrition andsource of honour and prestige. Other reasons include source of income for the citizens (farmer), source of farm power (draught power) for farm operations and transportation, source of raw materials for the clothing and shoe industry and by-products can be used in various other industries such as the cosmetic industry (1). The major importance of Animal husbandry is to provide animal protein from the consumption of meat. Major meats demanded from agricultural farms and the meat market stations include chevon, mutton and beef produced from goats, sheep and cattle respectively (ruminants). According to(2) livestock production is growing rapidly, which is interpreted to be the result of the increasing demand for animal products. Since 1960, global meat production has more than trebled, milk production has nearly doubled and egg production has increased by nearly four times. This is attributed partly to the rise in population, as well as to the increase in affluence in many countries. Global production and consumption of meat will continue to rise, from 233 million metric tons (Mt) in the year 2000 to 300 million Mt in 2020, as well as that of milk, from 568 to 700 million Mt over the same period as reported by (3). Egg production will also increase further by 30%. Meat is one of the most valuable products obtained from livestock **(**4**),**It is a source of high quality protein (5).It is acceptable in most parts of Nigeria where it is either consumed after cooking or processed into other food like *Tsire, Kilishi* and *Suya* (6). Consumer's preference for meat could be influenced by geography, race, ethnicity, social background, family composition and household income (7).

Several studies on household meat demand have been carried out around the world but relatively few studies have been carried out on household demand in Nigeria (8, 9, 10 and11). This study was conducted to assess the preference of consumers to different typesof fresh and processed meat in Kuje Area Council, FCT.

MATERIALS AND METHODS

The study was conducted in Kuje Area Council, FCT. The coordinates of Kuje Area Council is located between longitude $8^0$53'47^0N$7^0$14'35" E.8.89639^{0}N 7.24306^{0}E. It lies wholly within the geo-political region referred to as the middle belt and it forms part of the Guinea Savannah ecological zone (12). The area has average annual rainfall of 1308mm with average temperature of 26.6^{o}C. There are two major seasons in a year; rainy season which starts from April to Octoberand dry season starts from November to March.The data were collected through sample survey using questionnaires administered to randomly selected 100 respondents (Males and Females). Data collected include consumer's personal information, consumers choice for meat preference among beef, mutton, chicken, fish, bush meat, pork, grass cutter and others (such as snail, turkey, goose, duck, e.t.c) and consumer's preference for processed meat (kilishi, *Tsire*, *Suya/balangu*, gas meat among others). The data obtained were then carefully collatedand analyzed using simple percentage.

RESULTS

The results frompersonal data of the respondents were shown in Table 1. Results show that majority of the respondents were males with 55% and females were 45%and most of the respondents (61.36%)are within the age bracket of 25-40 years. The educational backgrounds of the respondents mostly were tertiary education (45%), secondary school (19%), post degree (11%), primary (5%) and none (11%).

Table 1: Distributions of Respondents Based on Gender, Age and Level of Education

Parameter	Frequency (%)
Sex:	
Male	55
Female	45
Age:	
Below 25 years	24
25-40 years	61.36
41-45	12.50
Over 55 years	2.3
Level of education:	
Post degree	19
Tertiary	45
Secondary	19
Primary	5
None	11

The results of respondents on meat consumption are presented in Table 2. Result shows that 95% of the respondents consumed meat while the remaining 5% of the respondent were not consuming meat. This could be as a result of health (3%) and financial reasons (1.2%) from the respondents.

Table 2: Distribution of Respondents Based on Consumption of Meat

Meat Consumption	Frequency (%)
Not consuming meat at all	5
Consumed meat	95

The result of respondents on most preferred type of meat is presented in Table 3. Resultshows that preference formeattype by the respondents is in the order beef (18%), chicken (18%), fish (17%), chevon (15%), mutton (14%), bush meat (7%), grass cutter (4%), rabbit (3%), pork (3%) and others (1%).

Table 3: Distribution of Respondents Based on Type of MeatConsumed

Meat type	Frequency (%)
Cattle (Beef)	18
Chicken	18
Fish	17
Goat (Chevon)	15
Sheep (Mutton)	14
Bush meat	7
Grass cutter	4
Rabbit	3
Pork	3
Others (Turkey, Duck, Goose e.t.c)	1

DISCUSSION

Preference for beef and chicken as observed in this study could be due to family composition, household income and cultural inclination with individual's towards consumption of qualitative meat as reported by (13 and 7). This result is consistent with the findings of (14) who reported that occupation of the house hold head could be a determinant factor for beef preference in Maiduguri metropolitan, north eastern, Nigeria.Percentage of meat consumers in this study corroborates the findings of (5)who reported that meat is a source of high quality animal protein. Meat can give half of the protein needed per day and the amino acids profile of this protein is such that it compensates the deficiency in the protein of vegetable and other cereal products (15). Global consumption of meat will continue to rise from 233 million metric tons (Mt) in the year 2000 to 300 million Mt in 2020, as will that of milk, from 568 to 700 million Mt over the same period (3). Egg production will also increase further by 30% (3). The highest percentage of *kilishi* consumption in this study could be attributed to quality of the processed meat. *Kilishi* can be stored in room temperature for several months and has more ash and protein content with low moisture content compared to dried raw meat (6).

CONCLUSION

This study concludes that majority of the respondents preferred beef and chicken, this may be as the result of availability, health reason, affordability and quantity. Majority also preferred *Suya/Balangu* and *Kilishi*. In addition, farmers within the study area should be considering consumer's preference in their production which will translate to improvement in their income as well as livelihood. Meat can also be processed into *Suya/Balangu* and *Kilishi* to increase shelf life and nutritional quality.

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Effect of Roselle (*Hibiscus sabdariffa*), Ginger (*Zingiber officinale*) and Garlic (*Allium sativum*) Extracts on Meat Quality of Broiler Chickens

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Abstract: An eight weeks experiment was conducted using 200-day-old broiler chicks to determine the effect of Roselle, Ginger and Garlic extracts on meat yield and meat quality of broiler chickens. The birds were assigned to five treatment groups, four replicates each and ten birds per replicate in a completely randomized design. The treatments were designed as T1, T2, T3, T4 and T5 with each treatment having four replicates, and each replicate contained 10 birds. T1 was designed as the control and birds on T1 were administered 100 % water and no plant extracts; T2, 4 g of roselle per litre of water; T3, 4 g of roselle and 4 g of ginger per litre of water; T4, 4 g of roselle and 2 g of garlic per litre of water and T5, 4 g of roselle, 4 g of ginger and 2 g of garlic per litre of water.Formulated diets were given both at the starter and finisher phases *ad libitum*. At the end of the experiment, Fourbroiler chickens per treatmentwere slaughtered to evaluate meat yield and meat quality characteristics. Results obtained show that carcass parameters were not significantly ($p>0.05$) influenced across the treatments except breast, drumstick, lungs and abdominal fat %. There were significant ($p<0.05$) differences in the result of pH, WHC, cooking yield and cooking loss across the treatments. The proximate composition of the meat of broiler chicken were not significantly ($p>0.05$) different. It was therefore concluded that inclusion of 4 g Roselleg extracts in the drinking water of broiler chickens produced better meat yield and meat quality characteristics.

Keywords: Effect, Roselle, Ginger, Garlic extracts, Meat quality, Broiler chickens

DESCRIPTION OF THE PROBLEM

Poultry which offers meat and egg (protein of animal origin) on account of its short generation interval and handy size, is expected to play a major role in providing adequate protein for the teeming populace (1). Apart from the fact that the total protein supply is insufficient, the quality of dietary protein available is low in developing countries compared to that consumed in developed countries. It is therefore necessary that farmers increase the production of livestock and its products to meet the basic needs of animal protein requirements in terms of quality and quantity (2). Meat quality is one of the economically important traits in chickens. According to Mcafee *et al*. (3), the major determinants of meat quality consist of toughness, tenderness, juiciness and flavour. Guan *et al*. (4) identified other factors that affect meat quality, such as, genetics, nutrition and environment. These factors integrate to give an overall assessment of meat quality by the consumer. Meat quality traits of poultry include proteins, total lipids, pH, colour, water holding capacity, texture, and sarcomere length (5). Additives in poultry diets are primarily included to improve efficiency of the bird's growth, prevent diseases and improve feed utilization. Therefore, this study was conducted to evaluatethe effect of Roselle (*Hibiscus sabdariffa*), Ginger (*Zingiberofficinale*) and Garlic (*Allium sativum*) extracts on meat quality of broiler chickens.

MATERIALS AND METHODS

The study was carried out at the Department of Animal Production Teaching and Research Farm, Federal University of Technology, Minna; which is the capital city of Niger State and lies within the Guinea Savannah zone of Nigeria. It is located within latitude 9°37' North and longitude 6°33' East (Niger State Agricultural Development Project, 2009). The plant parts used to obtain the plant extracts were purchased dried except garlic. The cloves were carefully removed and oven dried in the laboratory using an electric oven at 100°C for 24 hours. The ginger and rosellewere also oven dried at 80°C for 24 hours to ensure that they were properly dried. The

materials were later on crushed using an attrition mill and administered to the birds as five treatments as follows:T1 was the Control and was made up of 100 % water and no plant extracts; T2 was 4 g of roselle per litre of water; T3 was 4 g of roselle and 4 g of ginger per litre of water, T4 was 4 g of roselle and 2 g of garlic per litre of water and T5 was 4 g of roselle, 4 g of ginger and 2 g of garlic per litre of water. The treatments were prepared daily by adding all the required ingredients in water, boiling for about 20 minutes and sieving after cooling. A total of two hundred (200) day-old chicks were purchased from Chi Farms Ibadan, Oyo State. The birds were acclimatized for a week before they were randomly allotted to the five treatments (T1- T5), with four replicates per treatment, and each replicate made up of 10 birds. The birds were fed standard formulated diets of 24 % crude protein and about 3000 kcal/kg ME at the starter phase and 20 % crude protein and about 3000 kcal/kg ME at the finisher phase. The birds were fed ad libitum and administered the treatments in their drinking water for seven weeks. At the end of the experiment, four broiler chickens whose weight were closer to the average were selected from the treatments. The birds were fasted for 12 h, weighed individually, slaughtered by cutting the jugular veins, defeathered by dipping in boiling water of about 75ºC and eviscerated. Carcass was cut into parts and weighed using a weighing balance (camry®). Internal organs were separated and weighed using satorius® electronic scale. Weights of the carcass cut and internal organs were expressed as percentage of dressed and live weights respectively. Proximate composition of meat samples and pH were determined according to AOAC (6) methods. Cooking yield and water holding capacity were determined according to the methods ofCason *et al*. (7). Thawing loss was determined by calculating the difference in the pre-freezing and post-thawing weights. Data obtained on the meat yield and meat quality characteristics were pooled and subjected to one-way analysis of variance using SAS version (8).

RESULTS AND DISCUSSION

Table 1: Carcass characteristics of broiler chickens fed Roselle, Ginger and Garlic extracts

Parameter	T1	T2	T3	T4	T5	SEM
Live weight (g)	1150.00	1083.33	1183.33	1140.00	1083.33	19.47NS
Slaughter weight (g)	1103.31	1041.11	1092.33	1100.67	1046.71	0.76NS
Dressed weight (g)	915.31	896.99	890.14	902.44	903.83	5.80NS
Dressed (%)	82.96	86.24	81.49	81.99	86.35	7.80NS
Breast (%)	14.46^{a}	13.42^{ab}	12.78^{ab}	10.88^{b}	14.03^{a}	0.46*
Back (%)	5.33	5.00	5 19	5.18	5.38	0.19NS
Thigh (%)	6.32	6.28	5.98	5.97	6.09	0.79NS
Drumstick (%)	4.78^{ab}	4.42^{b}	4.52^{ab}	4.73^{ab}	5.11^{a}	0.99*
Wings (%)	5.59	5.45	5.39	5.50	5.53	0.15NS
Heart	0.43	0.65	0.54	0.54	0.62	0.39NS
Liver	1.30	1.60	1.79	1.04	1.75	0.13NS
Lungs	0.40^{c}	0.74^{a}	0.59^{ab}	0.43^{c}	0.56^{bc}	0.37*
Gizzard	2.29	2.83	2.43	2.68	2.09	0.13NS
Intestines	5.42	5.97	5.32	5.51	5.25	0.23NS
Abdominal fat	1.04^{ab}	0.54^{ab}	0.28^{b}	1.19^{a}	0.56^{ab}	0.13*

$^{a\,b\,c}$ Means within the same row with different superscripts are significantly different ($p<0.05$)SEM: standard Error of Mean, T1: Water only, T2: 4grams of roselle extract, T3: 4grams of roselle and 4grams ginger extracts, T4: 4grams of roselle and 2grams of garlic extracts, T5: 4grams of roselle, 4grams ginger and 2grams garlic extracts.

Table 2: Meat quality of broiler chicken given Roselle, Ginger and Garlic extracts

Treatments	T1	T2	T3	T4	T5	SEM
pH	5.51^{e}	5.91^{a}	5.63^{c}	5.68^{b}	5.58^{d}	0.36*
Cooking yield	30.00^{b}	31.00^{a}	29.00^{c}	29.50^{bc}	28.00^{d}	0.29*
WHC	50.00^{d}	70.00^{a}	55.00^{c}	50.00^{d}	60.00^{b}	2.01*
Thawing loss	20.00^{c}	38.00^{b}	50.00^{a}	20.00^{c}	15.00^{d}	3.55*

[a b c d e] Means within the same row with different superscripts are significantly different (p<0.05) SEM: standard Error of Mean, T1: Water only, T2: 4grams of roselle extract, T3: 4grams of roselle and 4grams ginger extracts, T4: 4grams of roselle and 2grams of garlic extracts, T5: 4grams of roselle, 4grams ginger and 2grams garlic extracts.

Table 3: Proximate composition of the meat of broiler chicken given Roselle, Ginger and Garlic extracts

Treatments	T1	T2	T3	T4	T5	SEM
Dry matter	92.80	95.00	94.65	93.10	94.75	0.44NS
Crude protein (%)	71.05	70.50	69.84	69.35	70.00	0.39NS
Lipid content (%)	10.00	10.55	12.50	12.50	12.00	0.48NS
Ash content (%)	6.25	6.25	6.50	6.50	8.00	0.43NS

SEM: standard Error of Mean, T1: Water only, T2: 4grams of roselle extract, T3: 4grams of roselle and 4grams ginger extracts, T4: 4grams of roselle and 2grams of garlic extracts, T5: 4grams of roselle, 4grams ginger and 2grams garlic extracts.

The results of carcass characteristics of broiler chickens supplemented with Roselle, Ginger and Garlic extracts are shown in Table1-. The higher significant (P<0.05) differences in T5 for both the breast and drum stick percentage might be because of high dressing percentage. This could be dependent on the dose and preparation. The relative weight of abdominal fat was significantly higher for broilers fed Roselle and Garlic extracts compared to other treatments. However, (9) and (10) reported that mixtures of garlic and ginger in broiler diet effectively reduced abdominal fat. Meat quality characteristics of broiler chicken given roselle, ginger and garlic extracts shown (Table2). The results revealed significant (P<0.05) differences in all the parameters measured. pH, cooking yield and water holding capacity were significantly (P<0.05) higher in T2. Thawing loss was significantly (P<0.05) higher in T3. The significant difference in pH, water holding capacity, cooking yield and thawing loss agrees with the findings of (11) who reported a significant effect of pH on cooking loss. In relation to this study, it was stated that poultry meat with low pH has been associated with low water holding capacity, which results in increased cooking loss and drip loss (12).

CONCLUSION

It was concluded that inclusion of roselle (4 g) as a growth promoter and antioxidant improved the breast, drumstick weights and meat quality characteristics of broiler chicken.

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Effect of growth promoters (zeranol and estradiol-17β) on carcass and sensory characteristics of zero-grazed White Fulani bulls

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Abstract: Twenty-seven stocker White Fulani bulls (18 to 24 months; 102.70 kg ± 1.84) were evaluated over 60daysin feedlot to determine the effect of zeranol and estradiol-17β as growth promoters on carcass and beef sensory characteristics. Cattle, finished on 14% CP ration, were allotted to non-implanted (control), estradiol- and zeranol-implanted treatments at nine animals/treatment in threereplicates of three animals each. Carcass characteristics of finished cattle were determined, liver samples were assayed for hormone residue and beef samples were assessed for eating qualities. Implanted animals had significantly ($P<0.05$) greater ribeye area and heavier live and hot carcass weights than non-implanted but similar ($P>0.05$) dressing % and relative weights of cut-up carcass parts and organs. Hormone residues of liver from implanted and non-implanted cattle were comparable and significantly lower than the maximum recommended safe limits, indicating that meat from implanted cattle pose no health risk for consumption. Consumer panelists preferred beef from implanted cattle for tenderness, juiciness and flavor and beef from estradiol-implanted cattle very much liked above that from zeranol-implanted or non-implanted cattle. Implanting finishing White Fulani cattle with estradiol is beneficial for improving carcass value and beef eating quality. Adoption of this management strategy or a modification may contribute significantly towards reducing the incessant herders-farmers conflict because of its low pressure on land resources.

Keywords: Anabolic agents, Indigenous cattle, Organoleptic evaluation, Stall feeding

DESCRIPTION OF PROBLEM

The current imperative for cattle ranching, as a remedy to deadly incessant farmers-transhumanceherders conflicts in Nigeria, demands urgent and pragmatic solution or validation. In order to discourage transhumancewith its stressors such aslow productivity and returns, disease transmission and unwanted crossbreeding (1), more beneficial and proven alternativesare required. One alternative is to zero-grazeanimals or keep under a feedlot system, which ensures adequate and continuous supply of nutrients. In addition, application of growth promoters (especially anabolic agents) by implantation or dietary supplementation, which improves growth rate and feed conversion (2; 3; 4), allowcattle to reach market weight earlier (5) or become heavier at same age with those without growth promoters (6; 7).

Use of anabolic implants such as zeranol and estradiol-17β, is long established in many other climes, especially USA (8) but not inNigeria.Further, there is little researchin Nigeria evaluating the effect of anabolic implants on performance of indigenous cattle in spite of the potential benefits. A potential of such application was given by (9) who reported relative positive effects of zeranol implantation on weight gain of Nigerian zebu fattening bulls of Sokoto Gudali and White Fulani. However, apart from improved growth performance and economical animal production, safety, quality and acceptability of products from implanted animals are equally important. Concerns about the safety of such products in terms of residues in products or organs are valid and must be evaluated (10). Therefore, the objective of this study was to evaluate the effect of anabolic steroid implants of zeranol and estradiol-17β on carcass and sensory characteristics of zero-grazed White Fulani cattle.

MATERIALS AND METHODS

A 60-day feedlot trial involving 27 White Fulani stocker bulls (average body weight 102.70 kg ± 1.84) was carried out at the Dairy Unit of the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife after 15-day acclimatization, treatment with broad-spectrum antibiotic (Oxytet L.A.), and internal (Ivomec) and external (Cypermethrin) parasites. Implants, 36 mg zeranol and 25.7 mg estradiol-17β (Ralgro® and Compudose®, respectively - Elanco Animal Health, USA) were placed with the use of the implanting gun between the skin and cartilage below the midline on the back side of the ear of each animal in a weighing restraint or chute. Implants were inserted 4 cm to implantation site after ear and insertion needle were disinfected, and earpalpated to ensure the pellet was inserted and securely placed. All animals were tagged and tattooed, given trace mineralized salt lick, water and fed the same finishing feedlot diet (Table 1) *ad libitum*

Table 1. Ingredient and chemical composition of the experimental feedlot diet

Ingredient composition		**Chemical composition**	
Item	% (As fed)	Item	%
Ground shelled maize	40.00	Dry matter	90.12
Wheat offal	30.00	Crude protein	14.01
Palm kernel cake	25.00	Crude fiber	6.70
Soybean meal	2.00	Ether extract	4.46
Groundnut cake	1.45	Ash	8.14
Bone meal	0.80	Nitrogen free extract	63.22
Mineral/Vitamin premix	0.25	ADF	19.11
Salt	0.50	NDF	53.30
Total	100.00	ME, MJ/kg DM*	11.84

*Calculated

containing 40% ground shelled maize as the main grain source. Animals were randomly allocated to three treatments (Zeranol-implanted, Estradiol-implanted and Non-implanted control) at nine animals per treatment, three animals per pen and three pens per treatment. Feed consumption was recorded weekly and animals weighed at the commencement of the feedlot trial and subsequently, every 14 days. At the end of the feedlot trial, three animals per treatment (one per replicate) were randomly selected, slaughtered, and carcass parts weighed and used for carcass evaluation comprising hot carcass weight (HCW); kidney, heart, liver, spleen, lungs, blood, head, bones, the four quarters, hump, neck and tongue weights. Dressing percentage was computed as (HCW/live weight) × 100. Growth implant residue was quantitatively determined for residual estrogenic activity in liver samples, from implanted and non-implanted cattle, at the Hormone Assay Laboratory, Obafemi Awolowo University Teaching Hospital Complex (OAUTHC) using an Enzyme Immunoassay Test Kit (Inteco Diagnostics, UK Ltd.). Residue values were compared to recommended maximum residue limits (MRLs), which are considered safe (11).

A consumer panel of 14 were selected from 20 students of the Faculty of Agriculture, Obafemi Awolowo University, Ile-Ife after subjecting them to a triangle test (12), which had three coded carbonated beverage samples, with two identical and the third odd. Those selected were able to identify the odd sample. Right and left ribeye muscle (between the 12th and 13th rib) from respective carcasses, previously frozen, were thawed at ambient temperature, cut into small pieces (2 × 2 cm), and cooked separately in moist-heat to internal temperature of 73°C for sensory evaluation as described by (13). The evaluation was carried out in a well-lit room with sufficient space for independent assessmentby each panelist. The panelists scored the beef on a nine-point Hedonic scale for tenderness, juiciness, flavor and overall acceptability (12). The panelists were trained on making inferences and recording the scores for each sample. After tasting each piece, the panelists were required

to chew cracker biscuits and rinse their mouths with water to prevent lingering taste from previous sample, and wait for 3 minutes before tasting the next sample.

Data obtained were subjected to statistical analysis using one-way analysis of variance of the General Linear Model Procedure of the Statistical Analysis Software (14), and the Fisher's least significantdifference was used to separate differences among the means at P<0.05.The data obtained based on the Hedonic scale were considered discrete and nominal, therefore, subjected to descriptive statistics to obtain mean scores of the assessments of meat samples from each treatment group per sensory attribute.Mean scores for each attribute were rounded to the nearest whole number in congruence with the Hedonic scale which is discrete. Interpretation of results was made based on the definition of each score on the Hedonic scale.

RESULTS AND DISCUSSION

Table 2 shows that estradiol and zeranol-implanted cattle had similar (P>0.05) but significantly (P<0.05) higher ribeye area and heavier live and hot carcass weights than those non-implanted. This is not surprising because most studies with anabolic growth promoters involving zeranol and estradiol have long confirmed their efficacy to improve growth rates and feed efficiency with varied body composition (15; 16).More specifically, studies have shown implants have a marked and significant enhancement on carcass weight over non-implanted cattle (17; 18).Growth implants had no significant (P>0.05) effect on dressing % or the cut-up parts of the carcass and internal organs except the lung (P<0.05). Inconsistencies sometimes occur in the response to implants. Zeranol has been found to sometimes have little effect on dressing % and ribeye area in some cattle (2) and the effect of estradiol may depend on the availability of good quality feed (5).The lung (%) of zeranol-implanted cattle was significantly (P<0.05) higher than that of estradiol-implanted cattle but similar(P>0.05) to that of the non-implanted cattle. This could not be explained from the data collected. However, since the lung (%) of estradiol-implanted was also similar to the non-implanted, no abnormality could be inferred. Table 2 also shows that the implant residue levels (estrogenic activity) in liver of implanted animals were not different from the non-implanted, neither critical, because they were insignificant compared to the maximum residue levels adjudged safe by FAO/WHO (11). In fact, concerns about the safety of such products for consumption have not been scientifically justified and it has been affirmed that the residue or steroidal activity from implantation are insignificant compared to normal human endogenous secretion or phytoestrogens from such plant foods as soybean oil, cabbage, peas and hen's egg (19).

Table 2. Effect of estradiol and zeranol implantation on carcass characteristics and liver residue levels of White Fulani bulls

	Treatment				
Parameter	**Non-implanted**	**Estradiol**	**Zeranol**	**SEM**	**P-value**
Live weight (kg)	206.33^{b}	249.67^{a}	249.33^{a}	11.68	0.03
Hot carcass weight (kg)	114.75^{b}	140.07^{a}	144.33^{a}	8.05	0.02
Dressing percentage	55.61	56.10	57.89	0.69	0.62
Ribeye area (cm^2)	33.10^{b}	45.10^{a}	43.0^{a}	3.70	0.03
Cut up parts (%)					
Head	6.19	5.46	6.07	0.22	0.45
Left fore quarter	24.12	26.66	26.66	0.58	0.22
Left hind quarter	19.34	18.68	18.73	0.50	0.87
Right fore quarter	26.95	26.53	25.54	0.32	0.19
Right hind quarter	19.45	18.55	18.23	0.34	0.18
Internal organs (%)					
Liver	3.01	2.86	3.58	0.25	0.49
Lungs	2.06^{ab}	1.68^{b}	2.44^{a}	0.13	0.03

Kidney	0.41	0.33	0.54	0.05	0.26
Heart	0.78	0.78	0.76	0.04	0.96
Spleen	0.60	0.51	0.41	0.05	0.19
Residue level (µg/kg)	0.01 ± 0.001	0.01 ± 0.001	0.02 ± 0.003		
[1]MRLs (µg/kg) for cattle liver	*	**	10		

[ab]Means on the same row with different superscripts are significantly different (P<0.05)

[1]MRLs = maximum residue levels (Codex Alimentarus (2017)); *Not implanted

**Codex Alimentarus (2017) = Residues resulting from the use of this substance as a growth promoter in accordance with good animal husbandry practice are unlikely to pose a hazard to human health.

Table 3 shows that beef from estradiol-implanted cattle was most highly rated for all sensory attributes evaluated through a 9-point hedonic scale for tenderness, juiciness and flavor and acceptability. This was followed by beef from zeranol-implanted cattle, which was preferred to non-implanted for tenderness, juiciness and flavor. Reports have been inconsistent on the effect of implantation on sensory attributes of meat. Implantation may be positive (20) without effect (21) or negative to sensory attributes of beef (22). The increase in sensory attributes for implanted cattle may be due to increase in marbling, suggested as response to increased lipogenic (acetyl CoA carboxylase and fatty acid synthetase) gene expression resulting from the anabolic agents (23). With respect to overall acceptability, beef from estradiol-implanted cattle was rated as 'like very much' and those ofzeranol-implanted and non-implanted cattle with an inferior rating of 'like slightly'. These results seem to indicate the good potential of estradiol as a growth promoter with positive effects on carcass and sensory characteristics of zero-grazed White Fulani bulls.

Table 3. Effect of estradiol and zeranol implantation on sensory attributes of ribeye muscle from White Fulani bulls[1]

	Treatment		
Parameter	**Non-implanted**	**Estradiol-implanted**	**Zeranol-implanted**
Tenderness	5.93 ± 0.47 (6)	7.07 ± 0.46 (7)	7.14 ± 0.57 (7)
Juiciness	5.29 ± 0.42 (5)	7.29 ± 0.41 (7)	6.57 ± 0.53 (7)
Flavour	6.29 ± 0.29 (6)	7.79 ± 0.21 (8)	6.71 ± 0.44 (7)
Acceptability	6.21 ± 0.28 (6)	8.07 ± 0.16 (8)	6.14 ± 0.59 (6)

[1]Comparison across each row was made using a 9-point Hedonic scale, which is discrete, strictly on the basis of rounding to whole numbers (in parentheses). Hedonic scale ranged from 1, extreme negative evaluation to 9, extreme positive evaluation; and 5 is neutral/undecided.

CONCLUSION AND APPLICATION

Carcass characteristics were positively influenced by growth implants (Estradiol and Zeranol) inimprovingribeye area and live and hot carcass weights, but did not affect dressing percentage, cut-up parts and internal organs of White Fulani cattle.Meat from implanted animals are safe and acceptable, as implant residue levels in liver were far less than the safe limit.Eating qualities (tenderness, juiciness, flavor and overall acceptability) were better enhanced by estradiol growth implant than zeranol implant relative to non-implanted White Fulani cattle.Use of growth implants as a management tool may contribute positively towards establishment of feedlots and semi-intensive beef cattle finishing programs, which require little land area, and reduce/end the endemic cattle herders/farmers conflicts in Nigeria.

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Quality Assessment of Retail Meat Cuts sold in Akure Town, Ondo State, Nigeria

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Abstract: This paper examines the quality of retail chicken and beef cuts sold in Akure, Ondo State, Nigeria. Meat samples (Thigh) were purchased randomly from five meat retailers once a week for five weeks. The samples were aseptically transferred to the laboratory for analysis. Proximate composition measures were carried out, which includes moisture, fat and crude protein contents; Total bacteria count, total coliform count, *Salmonella* counts, and *Escherichia* coli count were taken as measures of the bacteriological quality of the meat samples. The result obtained revealed that moisture, fat and crude protein content were within normal levels reported for chicken and beef meat. The oxidative stability of chicken meat and beef ranged from 0.35 to 0.51mgMDA/kg and 0.02-0.19mgMDA/kg. Total bacteria count ranged from 1.70×10^4 to 7.68×10^4cfu/g, and total coliform count ranged from 0.65×10^4 and 9.05×10^4cfu/g for chicken meat. Total bacteria count ranged from 4.88×10^4 to 14.90×10^4cfu/g, while total coliform count ranged from $1.28 \times 10^4$to 2.58×10^4cfu/g for beef meat. The *salmonella* count (SC) was between 0.05×10^4 to 0.70×10^4cfu/g, and *Escherichia coli* count (EC) ranged from 1.17×10^4 to 3.62×10^4cfu/g for chicken meat while the SC ranged from 0.08×10^4 to 1.0×10^4cfu/g, and *EC* from $0.08 \times 10^4$to 2.20×10^4cfu/g for beef. The study recommends that focuse should be placed on standard hygienic practices to ensure uncompromised quality during the production chain.

Keywords: Meat quality, safety, bacteria, chicken, Beef

INTRODUCTION

A major source of animal protein and amino acids which are unavailable in the plant is meat. FAO (2007) studies reveal that chicken meat contains 22.8% protein, 0.9% fat and 1.2% ash per 100g while beef lean contains 22.3% protein, 1.8% fat and 1.2 ash per 100g.

Consumers are at potential risk when bacteria are detected on meat cuts. Studies have shown that meat contains nutrients that support the growth of bacteria. Mishandling of meat and poultry products has resulted in a noticeable increase in foodborne illness and consumers of such products have recorded related diseases, which results in hospitalization and some cases of death. A ban has been placed on the importation of frozen poultry products by the Federal Government of Nigeria as a result of detection of Salmonella which causes foodborne illness, but smuggling remains a challenge in the country (Oseghale, 2015). Live animals are reservoirs for microorganisms found on the skin, feathers and alimentary canal (Kukay *et al*., 1996). Contaminated food and water are the primary sources by which the bacteria are spread (Clarence *et al*., 2009).

Today, meat contamination is a global issue, and attention must be placed on slaughtering, processing, storage, marketing and sales of meat available for human consumption. Thus, this study was conducted to assess the quality of retail chicken and beef cuts sold in Akure, Ondo State, Nigeria.

MATERIALS AND METHODS

Meat sample collection

Raw beef and chicken meat samples were purchased form 10 (5 each) randomly selected retailers at different locations within Akure town. The samples were aseptically collected once a week, for five weeks, into clean polythene bags. They were then transferred immediately in ice packs to the laboratory for analyses.

Analyses of meat samples

Proximate analysis of the meat samples was done according to AOAC (1995) and measurement of oxidative stability according to the thiobarbituric acid assay method (Pikul *et al.,*1989) but with little modification. The extent of oxidation expressed as mg malonaldehyde (MDA) per kg were derived from the regression equation (y=0.016 + 0.0628x: r =0.0997).

For the bacteriological analysis, four serial dilutions were done. All chemicals used were of analytical grade and were used according to manufacturers' specifications. Total viable bacteria, total coliform, *Salmonella* and *Escherichia coli* counts were determined using Nutrient agar, MacConkey agar, Deoxycholate citrate agar and Eosine methylene blue agar, respectively following the pour plate method as described by Sanders (2012).

Statistical analysis: Data generated were subjected to one-way analysis of variance and correlation analysis using SAS (2008) statistical package.

RESULTS AND DISCUSSION

Proximate Analysis and Oxidative Stability of Meat Samples in Akure, Ondo State.

Tables1 and 2 shows the result of the proximate analysis of meat samples. There were no significant differences between the moisture and protein content of the beef samples sold by the retailers but the fat content and oxidative stability were significantly different while all proximate analysis parameters and oxidative stability were significantly different for chicken meat samples sold by the retailers as shown in Table 1 and 2 respectively. The moisture content of beef samples ranged from 76.24% to 77.76%; fat content ranged from 4.66 to 5.44%; and crude protein content was between 21.55 to 24.72% while chicken meat values for moisture content ranged between 72.08 and 76.41%, fat content ranged between 5.61 and 7.90% and crude protein values were between 21.55 and 24.72%. Lawrie (1991) reported a range of 56-72% moisture content for chicken meat. According to Alonge (2005) and Holcman *et al.* (2003), the values obtained for fat content are 5.60% and 7.00%, respectively which is in harmony with the findings of this study. Average values of 73.1% for moisture, 2.8% for fat and 23.2% for crude protein was reported by Williams (2007). The averaged values obtained in this study were slightly higher than values reported by Williams (2007). The marginal variation in the fat contents of the beef samples can be attributed to the differentparts of the beef meat sold by the retailers. Also, the variations in the proximate analysis parameters for the chicken meat cut purchased from the retailers can be attributed to the varied origin, sex, breed, nutrition, and age of the chicken meat (Chen *et al*., 2006 and Musundire *et al.*, 2017).

Oxidative stability is measured in mg MDA/kg. The values for oxidative stability of chicken meat and beef ranged from 0.35 to 0.59mgMDA/kg and 0.02-0.19mgMDA/kg, respectively. The oxidative stability of chicken meat was higher than that of beef because of higher fat content (Adesua and Onibi, 2014), hence it's higher susceptibility to spoilage.

Bacteriological Quality Assessment

Tables 3 and 4 shows theoxidative stability of chicken meat and beef. Values ranged from 0.35 to 0.51mgMDA/kg and 0.02-0.19mgMDA/kg for chicken meat and beef, respectively. Total bacteria count ranged from 1.70×10^4 to 7.68×10^4cfu/g, total coliform count from 0.65×10^4 to 9.05×10^4cfu/g for chicken meat. Total bacteria count ranged from 4.88×10^4 to 14.90×10^4cfu/g, total coliform count from 1.28×10^4 to 2.58×10^4cfu/g forbeef meat. The*salmonella* count (SC) was between 0.05×10^4 to 0.70×10^4cfu/g, and *Escherichia coli* count (EC) ranged from 1.17×10^4 to 3.62×10^4cfu/g for chicken meat while the SC ranged from 0.08×10^4 to 1.0×10^4cfu/g, and *EC* from 0.08×10^4 to 2.20×10^4cfu/g for beef. The values for TBC and TCC in this study were high and it denotes a high rate of contamination. Furthermore, the values from this study exceed those reported by Ukut *et al.* (2010) for fresh beef sold in Calabar, Cross River State. Two bacteria of public health importance (*Escherichia coli* and *Salmonella spp*) were detected in the meat samples.

The presence of *Escherichia coli* and *Salmonella spp.* indicates contamination and poor hygiene both at the abattoir and at retail selling points as these bacteria are mainly found in the gastro-intestinal tracts or faeces of cattle and human (Charles, 2012). It is a fact that the presence of bacteria in raw meat does not always mean food poisoning. Clean water should be used during meat processing and for cleaning of tables and other tools in retail stalls.

Table 1: Proximate analysis and oxidative stability of the beef samples

Retailer	Proximate analysis			Oxidative Stability (mgMDA/kg)
	Moisture (%)	Protein (%)	Fat (%)	
1	77.76	23.23	4.68^{c}	0.09^{b}
2	76.65	24.72	5.01^{b}	0.10^{b}
3	76.24	22.83	5.44^{a}	0.02^{c}
4	76.61	21.55	4.66^{c}	0.03^{c}
5	76.59	24.71	5.48^{a}	0.19^{a}
(SEM)	0.67	0.44	0.22	0.01
Statistical significance	NS	NS	*	*

$^{abc:}$ Means with different superscripts within a column are significantly ($p \leq 0.05$) different. NS = Not significant ($P \geq 0.05$), * = Significant ($p \leq 0.05$)

Table 2: Proximate analysis and oxidative stability of chicken samples

Retailer	Proximate analysis			Oxidative Stability (mgMDA/kg)
	Moisture (%)	Protein (%)	Fat (%)	
1	76.41^{a}	23.22^{b}	5.64c	0.52^{b}
2	73.90^{b}	24.72^{a}	7.27^{b}	0.59^{a}
3	73.77^{b}	22.83^{b}	7.08^{b}	0.50^{b}
4	73.79^{b}	21.55c	5.61^{c}	0.56^{a}
5	72.08^{c}	24.71^{a}	7.90^{a}	0.35^{c}
(SEM)	0.38	0.45	0.29	0.03
Statistical significance	*	*	*	*

$^{abc:}$ Means with different superscripts within a column are significantly ($p \leq 0.05$) different. NS = Not significant ($P \geq 0.05$), * = Significant ($p \leq 0.05$)

Table 3: Bacteriological quality assessment of the beef samples (cfu/g)

Retailer	Total viable bacteria count (TBC)	*Escherichia coli* count	Total coliform count (TCC)	Total *Salmonella* count
1	14.90 x 10^{4a}	0.77 x 10^{4b}	1.62 x 10^{4}	0.88 x 10^{4}
2	6.60 x 10^{4b}	0.55 x 10^{4b}	1.28 x 10^{4}	0.08 x 10^{4}
3	7.62 x 10^{4b}	1.03 x 10^{4b}	2.40 x 10^{4}	0.90 x 10^{4}
4	4.88 x 10^{4b}	0.08 x 10^{4b}	2.58 x 10^{4}	1.00 x 10^{4}
5	8.45 x 10^{4b}	2.20 x 10^{4a}	2.12 x 10^{4}	0.77 x 10^{4}
SEM	2.89	0.48	0.88	0.40
Statistical significance	*	*	NS	NS

$^{ab:}$ Means with different superscripts within a column are significantly ($p \leq 0.05$) different. NS = Not significant ($P \geq 0.05$), * = Significant ($p \leq 0.05$)

Table 4: Bacteriological quality assessment of the chicken samples (cfu/g)

Sample	Total viable bacteria count (TBC)	*Escherichia coli* count	Total coliform count (TCC)	Total *Salmonella* count
1	4.10 x 10^{4c}	0.30 x 10^{4c}	0.65 x 10^{4c}	0.20 x 10^{4b}
2	6.23 x 10^{4b}	1.73 x 10^{4b}	7.52 x 10^{4b}	0.25 x 10^{4b}
3	7.30 x 10^{4a}	3.62 x 10^{4a}	9.05 x 10^{4a}	0.70 x 10^{4a}

4	1.70 x 10^{4c}	1.38 x 10^{4b}	1.25 x 10^{4c}	0.05 x 10^{b}
5	7.68 x 10^{4a}	1.17 x 10^{4b}	8.30 x 10^{4a}	0.12 x 10^{4b}
SEM	0.69	0.33	0.96	0.17
Statistical significance	*	*	*	*

[abc:] Means with different superscripts within a column are significantly ($p \leq 0.05$) different. NS = Not significant ($P \geq 0.05$)

CONCLUSION

The moisture and crude protein contents of the meat samples were within the acceptable range, but the bacterial analysis showed a high degree of contamination as *Salmonella* and *Escherichia coli* were present in the meat samples. The extent of contamination reveals that abattoir workers and retail sellers lack hygiene. Prevention of bacterial contamination of meat and regular microbiological analysis should be carried out by inspectors at commercial processing facilities to ensure the safety of consumers.

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Chemical Composition and Sensory Attributes of Broiler Chicken fed Diets Supplemented with *Moringa oleifera* Seeds

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Abstract: Two hundred and fifty 1-day old broiler chicks were randomly allotted to five diets wherein Full-fat Soyabean (FS) was replaced with 3-hour Water-soaked Moringa Seed Meal (WMSM) at 0.0, 25.0, 50.0, 75.0 and 100.0% for T1, T2, T3, T4 and T5 respectively. Two birds per replicate were used in the Proximate analysis of the raw meat samples for the determination of Crude Protein (CP, %), Ether Extract (EE, %), Ash (%) and Dry Matter (DM, %). The quality attributes of the cooked meat were determinedin terms of Taste, Color, Tenderness, Juiciness and the Overall Acceptability by a taste of panel. using standard procedures. Data were analysed using descriptive statistics and ANOVA at $\alpha_{0.05.}$

The CP of T1 (20.73±0.7), T2 (22.48±0.4), T3 (21.39±0.8), T4 (24.31±0.4) and T5 (24.58±0.7%) were similar. Thebirds on T5 had the least EE (3.56%) while T1 had the highest value (13.68%). The overall acceptability was higher in T1 (6.67±0.5) while T5 had the least acceptability (4.40±0.5).

Inclusion, *Moringaoleifera* seed in the diets reduce the fat content of the meat samples which can be recommended for human

Keywords: *Moringaoleifera*, Ether extract, Crude protein, Overall acceptability

INTRODUCTION

The economy of Nigeria is in a state of depression, the result of which food items, particularly animal protein has become too expensive for an average Nigerian, and as such resulting in malnutrition and its associated diseases (Ogbe and Affiku,2012).

The high cost of animal production in terms of housing, feed, drugs and vaccine has greatly reduce number of farmers going into large scale livestock production. Consequently, man has to look for a cheaper source of plant protein for poultry feeds.

Products derivable from poultry production ranges from major product like egg and meat to by-product such as; feathers, intestinal organs and bones.

An important factor in the continued growth of the poultry industry among others is the perceived health value of poultry meat in human diets which can only be achieved in disease-free birds (Kruchten, 2009). However, commercial poultry possess limited natural resistance and immunity against colonization or infection by pathogenic microorganisms. Thus, antimicrobial feed additives have made a tremendous contribution to profitability of intensive husbandry and provision of nutritious poultry products.

As a result of this, development of alternative antimicrobial agents that will improve the production of livestock and will not have residual effect on poultry meat is of great importance (Ogbe and Affiku,2012). *Moringa oleifera* seed is important in poultry nutrition, therefore this study was conducted to determined the chemical compositions and meat attributesof broiler chicken meat fed diets supplemented with *Moringa oleifera* seed.

MATERIALS AND METHODS

Experimental Procedures and Processes: Two-hundred-and-fifty-day old broiler chicks were obtained from a reputable farm and the experiment lasted eight weeks which included an initial two (2) weeks of brooding period. On arrival, the chicks were individually weighed and randomly allotted to five dietary treatments of 50 chicks per treatment, and each treatment replicated 5 times (10 chicks per replicate) in a completely randomised design.

The chicks were offered different feeds according to each treatment and clean water was given *ad libitum.* Routine vaccination procedures were followed.

Composition of the Experimental Treatments: Five treatments were used for this experiment. The treatment containing 100% full-fat soyabean was taken as the control (T_1), Treatment two (T_2) contained 25% three hours water-soaked moringaseed meal, Treatment three (T_3) contained 50% three hours water-soaked moringa seed meal, Treatment four (T_4) contained 75% three hours water-soaked moringa seed meal and Treatment five (T_5) contained 100% three hours water-soaked moringa seed meal. The dietary composition used for this experiment is shown in Table 1.

Table 1: Composition of broiler finishers fed water-soaked *Moringa oleifera* Seed

Ingredients (%)	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**
Maize	50.00	50.00	50.00	50.00	50.00
Wheat offals	14.90	14.90	14.90	14.90	14.90
Full fat soyabean	20.00	15.00	10.00	5.00	0.00
Moringa seed meal (soaked)	0.00	5.00	10.00	15.00	20.00
Fish meal	1.00	1.00	1.00	1.00	1.00
Palm kernel cake	7.00	7.00	7.00	7.00	7.00
Palm oil	2.00	2.00	2.00	2.00	2.00
‘others	5.40	5.40	5.40	5.40	5.40
Total	**100**	**100**	**100**	**100**	**100**

‘others” DCP 2.0, Limestone 1.55, Table salt 0.30, Vitamin premix o.25, L-lysine 0.35, DL-M ETHIONONE 0.25

Parameters Measured

Chemical composition of the meat samples: At the end of the experiment, the raw meat samples were subjected to proximate analysis. Ten birds from each treatment were slaughtered and the feathers removed without using hot water to avoid exaggeration for the moisture content of the meat. The meat from the breast, thigh and drumstick were used to determine the crude protein, crude fibre, ether extract, ash and dry matter by the procedure of the AOAC (1990).

Sensory Attributes were carried out by cutting 100g meat sample from the breast muscle of birds from each treatment to determine their quality in terms of taste, color, tenderness, juiciness and the overall acceptability of the meat by a taste of panel. The meat samples were cut into ten small pieces which was tied in transparent nylon and labeled properly. The pieces of meat were cooked without salt in boiling water for 20 minutes. After cooling each meat was cut into 10 pieces and served to ten taste judges one treatment after the other. After tasting from each treatment, the assessors were served cracker biscuits which neutralised their taste bud before taking another treatment. The scores were recorded on questionnaires that were given to them.

Statistical analysis: Data were subjected to analysis of variance (ANOVA) using SAS (2003) version and means were separated using Duncan Multiple Range Test Descriptive statistics were done using the software package of SAS (2003).

RESULTS

Chemical Composition of Meat Samples: The chemical composition of the meat samples of broiler chickens fed Moringa seed meal in table 3 shows that there were significant differences ($p<0.05$) among the treatments asT1 (control diet)had the highest values on dry matter(36.51%) andEther extract (13.68%) and T5 (100% MOSM) had the least values of 29.45% and 3.56% respectively while T2 (25% MOSM), T3 (50% MOSM) and T4 (75% MOSM) were at the middle. For the Ash content, T5 (100% MOSM) had the highest values of 1.75% compared to other treatments.

Table 3: Proximate compositions of broiler meat samples

Parameters (%)	T_1	T_2	T_3	T_4	T_5	SEM
Crude protein	20.73[d]	22.48[b]	21.39[c]	24.31[a]	24.58[a]	0.41
Ash	1.43[c]	1.42[c]	1.61[b]	1.31[d]	1.71[a]	0.14
Ether extract	13.68[a]	10.62[b]	8.55[c]	7.17[d]	3.56[e]	0.91
Dry matter	36.51[a]	35.39[b]	32.86[c]	31.43[d]	29.45[e]	0.69
Nitrogen-free extract	64.16[d]	65.48[c]	68.45[b]	67.21[b]	70.18[a]	1.50

[abcde]Means along same row with different superscripts are significantly different (P<0.05)

Sensory Evaluation of Meat Samplesof Broiler Chickens Fed *Moringa oleifera* Seed Meal

The sensory evaluation of meat from broiler chickens fed *Moringaoleifera* seed are shown in table 3. The overall acceptability showed that as the inclusion level of *Moringa* seed meal increased, the quality of the meat also reduced. It was noticed on the aroma that T4 (75% MOSM) and T5 (100% MOSM) had the highest values of 6.33 and 6.58, respectively. T4 (75% MOSM) and T5 (100% MOSM) had the highest flavour values of 5.35 and 6.20, respectively. The control diet had the higher tenderness and juiciness than other treatments.

Table 3: Sensory Attributes of Broiler Chicken Meat Fed *Moringa oleifera* Seed

Parameters	T_1	T_2	T_3	T_4	T_5	SD
Aroma	3.33	3.17	4.33	6.33	6.58	2.58
Colour	6.33	6.67	6.00	6.00	5.68	1.75
Flavour	5.00	4.67	5.00	5.35	6.20	2.55
Tenderness	6.67	6.00	4.65	5.67	4.50	3.22
Juiceness	5.65	5.00	2.65	3.00	2.85	3.62
Overall acceptability	6.67	5.33	5.00	5.00	4.40	2.47

Chemical Compositions of Meat Samples from Broiler Chickens Fed *Moringa oleifera* Seed: This study agrees with Makkar and Becker (2009) who reported that *Moringaoleifera* seeds soaked in water for 20-30 minutes increased the crude protein, ash contents and reduced the ether extract of broilers meat. Also, Mupangwa*etal*. (2010) treated *Moringa* seeds with heat and included in the diets of Nile Tilapia fish at 0,5 and 10.0% levels, they concluded that 10% inclusion level increased the crude protein and Ash contents of Tilapia fish and reduced the fat content and dry matter levels.

Sensory Attribute of Meat Samples of Broiler Chickens Fed *Moringa oleifera* Seed

The increase in flavor and aroma of meat obtained from broiler chickens fed *Moringa oleifera*seed could be because of the aromatic substances in the seed meal as reported by Makkar and Becker (2009) who observed some attractive aromatic substances in water-soaked *Moringaoleifera* seed.

Meat for T1 (control) birds had the highest values on tenderness, thickness and over all acceptability than other treatments, while treatment 5 (100%MOSM) had the least values. These results show that organoleptic test approves T1 (control) and T2 (25%MOSM) acceptable for human consumptions due to the reduction in the fat content.

CONCLUSION

Inclusion of *Moringaoleifera* seed in the diets reduce the fat content of the meat samples.

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Growth Performance, Carcass Traits and Economics of Production of Broilers Fed Maize Replaced with Biscuit Waste Diet

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Abstract: There is a continuous rise in the cost of conventional feed ingredients due to competition between human and livestock for grains and legumes seeds. One hundred, five weeks old broilers were used to evaluate the dietary replacement value of Biscuit Waste Meal (BWM) for maize on growth performance, carcass traits and economics of production of broiler chickens. Biscuit waste replaced maize in broiler diet at 0, 10, 20, 30 and 40 %. Broilers were randomly allotted into five treatment groups of two replicates with ten birds per replicate and fed the experimental diets for five weeks. Results showed that the inclusion of biscuit waste in broiler diet significantly ($p<0.05$) increased the feed intake and weight gain of the birds when compared with those fed maize based diet. Diets exert no significant ($p>0.05$) effect on dressed carcass, thigh, drumstick, neck and hearts of the tested birds however; the diets influenced the per cent weight of breast muscle and back of the birds. Price per kilogramme feed produced reduced with increased level of biscuit waste in the diets. Also, price per kilogramme broiler produced was significantly ($p<0.05$) lower in birds fed 30% level when compared with those on maize-based diet. It could therefore be suggested that biscuit waste could be used to replace maize up to 30% level without any deleterious effect on the growth and carcass attributes of broilers.

Keywords: Dietary replacement, Feed intake, Price and Weight gain.

INTRODUCTION

Poultry production holds a prominent place in the economy of many developing countries including Nigeria. The need to improve their production becomes more important with increasing population and demand for animal protein. Bonsu *et al.,* (2012) reported that the importance of poultry to the social-economic development of a country cannot be over emphasized because birds have faster gestation period than other animals to produce meat and egg for human consumption. However, in most developing countries the rate of population has not corresponded with the growth of the poultry industry and therefore raise food security problem.

The major problem faced in animal production is feed supply. There is a continuous rise in the cost of conventional feed ingredients due to competition between human and livestock for grains and legumes seeds. (Amaefule *et al.,* 2004).

Unfortunately, poultry production in Nigeria is adversely affected by fluctuation in supply of good quality feed due to inadequate local production of feedstuffs, unavailability of some ingredient, competition between animal and man for the limited conventional feed stuffs and general inflationary trend in the country due to the inconsistent economic policies of government.

Maize is expensive and high in demand for consumption by human, animal and for industrial uses. The cost of maize is relatively high and this makes it the major contribution to the increasing cost of poultry production. Hence, there is the need to look for an alternative feedstuff, mainly those that can either replace maize or can be incorporated at certain level in the diet to achieve a comparable worth (Udidibie *et al.,* 2012). Such non-conventional feed stuff should not be in great demand as human food or having any industrial use and should be readily available and not subjected to the dictate of season (Agiang *et al.,* 2004).

There is little or no information on the possibility of incorporating biscuit waste in broiler diet. Therefore, this research work aimed at assessing the growth performance, carcass trait and economics of production of broilers fed maize replaced with biscuit waste meal diet.

MATERIALS AND METHODS

Five experimental diets were formulated such that maize was replaced with biscuit waste at 0, 10, 20, 30 and 40%

Table 1: Percentage Composition of Experimental Diets

Ingredients	Levels of maize replaced with BWM (%)				
	0	**10**	**20**	**30**	**40**
Maize	65.00	58.50	52.00	45.50	39.00
Biscuit Waste Meal	0.00	6.50	13.00	19.50	26.00
Concentrate	27.50	27.50	27.50	27.50	27.50
Wheat offal	7.50	7.50	7.50	7.50	7.50
Total	**100**	**100**	**100**	**100**	**100**

One hundred, five weeks old broilers were used for the experiment. The birds were randomly allotted into five groups of two replicate with ten birds per replicate. Birds were placed on five experimental diets after the initial weight were determined. Feed supplied to the birds were weighed and the leftover was weighed on daily basis to determine the daily feed intake of the birds. Weights of birds were taken on weekly basis throughout the five-week experimental period. At the end of the experiment, four birds were randomly selected from each treatment, making a total of twenty birds. These were slaughtered following the conventional method. The slaughtered bird was bled, scalded in warm water and defeatherd. Defeatherd carcass were later eviscerated and cut into primal parts. Weights of internal and external offal were taken along with the primal parts.

Data collected on feed intake, weight gain, cost indices parameters, weights of primal parts and offal were subjected to Analysis of variance (ANOVA) and differences between means were determined using Duncan's Multiple Range Test with the aid of Statistical Package for Social Sciences (SPSS) version 20.

RESULT AND DISCUSSION

Table 2: Effect of Maize Replaced with Biscuit Waste Meal on Growth Performance and Economics of Production of Broiler Chicken

	Levels of maize replaced with BWM (%)					
Parameter	**0**	**10**	**20**	**30**	**40**	**SEM**
Total weight gain (g)	1307.50^{a}	1262.50^{a}	1507.50^{b}	1590.00^{b}	1295.00	27.04
Weekly weight gain (g)	261.50^{a}	252.50^{a}	301.50^{b}	313.50^{b}	259.00^{a}	5.41
Daily weight gain (g)	36.93^{a}	36.07^{a}	43.07^{b}	44.79^{b}	36.99^{a}	0.79
Total feed intake (g)	3777.50^{a}	3915.00^{bc}	4190.50^{d}	3972.50^{c}	3879.00^{b}	18.67
Weekly feed intake (g)	755.50^{a}	783.00^{bc}	838.00^{d}	794.50^{c}	776.00^{b}	3.73
Daily feed intake (g)	108.00^{a}	114.85^{c}	119.73^{d}	113.50^{c}	110.72^{b}	0.55
Feed gain ratio	2.98^{bc}	3.26^{c}	2.86^{ab}	2.61^{a}	3.05^{bc}	0.59
Feed efficiency	0.34^{a}	0.33^{a}	0.36^{ab}	0.39^{b}	0.33^{a}	0.06
Price/kg feed	155.50^{e}	145.75^{d}	136.00^{c}	126.60^{b}	116.50^{a}	1.38
Price/kg bird produced	462.38^{c}	474.69^{c}	388.44^{b}	329.17^{a}	354.99^{ab}	9.61

$^{abcd:}$ *Mean value carrying different super script differ significantly (P>0.05).*

SEM: Standard Error of the Mean

Result on the effect of maize replaced with biscuit waste meal on the growth performance and economics of production of broiler chicken is as presented in Table 2. The result shows that the total weight gain, weekly weight gain and daily weight were significantly ($p<0.05$) higher in birds feed 20 -30% levels of maize replacement when compared with the lower levels. This result is different from that of Alozie (2016) who reported higher weight in birds fed control diet of 0% level of orange pulp meal and reported that value was not different from replacement at 10 – 20% levels.

The total, weekly and daily feed intake were observed to be significantly ($p<0.05$) different among the treatments. Feed intake was observed to be significantly ($p<0.05$) higher in the broiler chickens fed 20% replacement when compared with the control diet. This result is similar to that of Ogungade (2004) who replaced maize with dried cassava meal at varying levels; he reported that feed intake is significantly ($p<0.05$) higher in birds fed 20% replacement levels and significantly ($p<0.05$) lower in birds fed with control diet.

The feed gain ratio was significantly ($p<0.05$) different across the levels of replacement. It is higher at 10% replacement and lower at 30% level of replacement when compared with the control. Feed efficiency was observed to be significantly ($p<0.05$) higher in birds fed 30% level when compared with those on 10-20% levels. This result is similar to that of Oluremi *et al.,* (2010) who fed broiler chickens with orange peel meal in place of maize, reported that feed efficiency was significantly ($p<0.05$) higher in 20% level of replacement when compared with 5 – 15% levels of replacement.

The price/kg feed decreases with the increasing levels of replacement of maize with biscuit waste. The price/kg bird produced is significantly ($p<0.05$) different across the treatment and it is at the highest at 0 and 10% levels of replacement and lowest at 30% level of replacement. The least price/kg bird produced was obtained at 30% level of replacement, hence for optimum growth and economics of production, maize in broiler diet can be replaced with biscuit waste at 30% level of replacement.

Table 3: Effect of Maize Replaced with Biscuit Waste on Carcass Characteristics of Broiler Chicken

	Levels of maize replaced with BWM (%)					
Parameter	**0**	**10**	**20**	**30**	**40**	**SEM**
Live shrunk weight (kg)	2.20	2.30	2.46	2.34	2.21	0.05NS
Dressed carcass weight (kg)	1.63	1.68	1.84	1.71	1.59	0.03NS
Defeathered weight (kg)	2.05^{ab}	2.16^{ab}	2.31^{b}	2.13^{ab}	1.98^{a}	0.05
Thigh weight (%)	14.97	16.81	16.46	15.36	15.79	0.38NS
Drumstick weight (%)	15.40	15.47	15.35	14.64	14.05	0.30NS
Breast muscle weight (%)	35.66^{b}	31.91^{ab}	32.08^{ab}	31.78^{ab}	29.09^{a}	0.86
Back weight (%)	15.38^{a}	16.38^{ab}	18.15^{a}	18.79^{a}	19.64^{b}	0.44
Wing weight (%)	11.15^{a}	11.86^{ab}	11.50^{a}	11.28^{a}	13.21^{b}	0.27
Neck weight (%)	6.24	6.90	6.61	6.42	7.52	0.4NS
Gizzard (%)	2.49	2.71	2.51	2.04	2.43	0.14NS
Liver (%)	2.63^{b}	2.03^{a}	1.98^{a}	1.76^{a}	1.92^{a}	0.08
Intestine + content (%)	6.31^{b}	5.01^{ab}	5.7^{ab}	4.51^{a}	5.19^{ab}	0.24
Shank (%)	3.65	4.23	3.77	3.60	3.68	0.17NS
Pluck (%)	0.63	0.61	0.49	0.53	0.58	0.02NS
Head (%)	2.24	2.23	2.12	2.05	1.94	0.13NS
Fat (%)	2.20	1.75	2.28	1.82	1.92	0.11NS
Heart (%)	0.37	0.36	0.32	0.38	0.38	0.01NS

^{a,bc}: Means within row carrying different superscripts differ significantly (P 0<0.05)
NS: Not Significant, SEM: Standard Error of Mean

The effects of maize replaced with Biscuit Waste Meal on the carcass characteristics of broiler chickens is as shown in Table 3 reveals that there is no significant difference ($p>0.05$) in live shrunk, dressed carcass weight, thigh, drumstick, and neck per cent of birds fed control diet when compared with the experimental diets. This shows that the experimental diet did not exert any significant influence on live shrunk weight, dressed carcass weight, shank, thigh, neck and drumstick of the birds. This result is similar to that of Olayemi and Robert (2000) who reported that there was no significant difference ($p>0.05$) in dressed carcass, live weight, thigh, neck, and drumstick percentage among the treatment groups of birds fed maize replaced with wheat offal diet.

However, defeathered weight is higher in birds fed 20% level of replacement compared with those fed 0 and 40% while breast muscle is significantly ($p<0.05$) higher in birds fed control diet (0%) compared with 30 and 40% levels of inclusion. This result is contrary with report of Medegu *et al.* (2010) that no significant ($p>0.05$) effect was observed in defeathered and breast muscle percentage of broiler fed maize replaced with sorghum diet.

Significant differences were observed in the percentage weight of back. Wing weight is significantly ($p<0.05$) higher in birds fed 40% level of maize replacement when compared with birds on control diet. This is in conformity with the report made by Ribal *et al.*, (2009), that there is significant difference ($p>0.05$) in back weight and wing weight of broiler chickens fed cassava peel-based diet. Difference in the weight of pluck and head were not significant across the levels of replacement. Fat weight per cent were not significantly ($p<0.05$) different among five treatments. This result is similar to the report of Medegu *et al.* (2010) who reported no significant ($p>0.05$) different in abdominal fat among chicks fed millet, sorghum and maize based diet and concluded that millet and sorghum can be well utilized to produce broiler chicken with superior carcass quality compared to maize.

Organ weights such as gizzard and heart have no significant ($p>0.05$) difference across the level of replacement. This is similar to the findings of Oloyo (1991) who reported no significant ($p>0.05$) difference in gizzard and heart weights when replacing maize with millet and guinea corn in broiler chicken diet. Liver and intestinal full of content is significantly ($p<0.05$) lower in broiler fed experimental diet when compared with control.

CONCLUSION

It could therefore be concluded that maize replaced with biscuit waste in broiler diet significantly ($p<0.05$) increased the weight gain of broilers at 20–30% level of replacement. Feed intake was significantly ($p<0.05$) higher in birds fed experimental diets when compared with those on maize-based diet. Biscuit waste inclusion in broiler diet exerts no effect on dressed carcass, thigh, drumstick, neck, and heart percent weight of broilers. However, the diet influenced the per cent weight of breast muscles, back and neck of the birds. Price/kg feed produced decreased with increased levels of biscuit waste meal in the diets and Price/ kilogram bird produce was also significantly ($p<0.05$) lower in birds fed 30% level of maize replacement when compared with those on maize-based diet.

RECOMMENDATIONS

Based on the result of this research work, it could be recommended that biscuit waste could be used to replace maize in broiler diet up to 30% level without any deleterious effect on the birds.

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Influence of Late Quantitative Feed Restriction on Carcass Traits, Fat Deposition, and Meat Quality in Broiler Chickens

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Abstract: This study evaluated the effects of quantitative feed restriction at finisher phase on carcass traits, muscle fatty acids, and oxidative stability in broiler chickens. One hundred, day old Arbor acre chicks were fed *ad libitum* for four weeks. Thereafter, the broiler chickens (BW 860±15 g) were randomly assigned to either *ad libitum* feeding (Unrestricted, UR) or 80% of *ad libitum* feeding (20% feed restriction, RS) for four weeks. Each treatment was replicated five times with 10 birds per replicate. The UR birds had heavier ($p< 0.05$) live and carcass weights than RS birds. Dressing percentage and the percentages of prime cuts did not differ ($p>0.05$) between treatments. There was a 71% reduction in abdominal fat in RS birds relative to UR birds. Treatments had no effect ($p>0.05$) on pH and cooking loss of breast meat. Drip loss, carbonyl content, and TBARS values were lower ($p<0.05$) in RS meat than UR meat. The percentages of C12:0, C18:3n-3, C22:5n-3 and C20:5n-3 was higher ($p<0.05$) in RS meat than UR meat. The UR meat had higher ($p<0.05$) total fatty acids and C18:2n-6 than the RS meat. It can be concluded that a 20% feed restriction at finisher phase reduced carcass fat and improved the water holding capacity, oxidative stability, and nutritional quality of breast meat in broiler chickens.

Keywords: Carbonyl, Cooking Loss; Drip Loss; Fatty Acids; TBARS

INTRODUCTION

The improvements in nutrition and management strategies and genetic progress have led to a rapid growth rate in the modern-day broiler chickens [1]. This rapid growth rate is unavoidably associated with increased fat deposition, high mortality, and high incidence of metabolic diseases and skeletal disorders [2]. These situations most commonly occur with broilers that consume feed *ad libitum* [1, 2]. Thus, feed restriction has been proposed to reduce these problems [1]. Nonetheless, feed restriction could have some negative effects like chronic hunger, boredom and feeding frustration, increased aggression and overdrinking [1]. The negative effects of feed restriction would be more severe in younger birds due to high metabolic requirement resulting from rapid growth at this stage [1, 2]. Thus, full feeding of broiler chicks for several weeks before any restriction program has been suggested for adequate frame size, vigorous growth and uniform flock body weight [3]. Moreover, substantial fat deposition in broilers occurs at finisher stage [3]. There is dearth of information on the effects of late feed restriction on muscle fatty acids and oxidative stability in broilers. Thus, the objective of this study was to determine the effect of late quantitative feed restriction on carcass traits, fat deposition, fatty acids, oxidative stability, and meat quality in broiler chickens.

MATERIALS AND METHODS

Experimental birds, Management, slaughter, carcass and meat quality analyses: One hundred, day old Arbor acre chicks were purchased from a reputable hatchery. The chicks were fed broiler starter *ad libitum* for four weeks. Thereafter, the broiler chickens (BW 860±15 g) were randomly assigned to either *ad libitum* feeding (Unrestricted, UR) or 80% of *ad libitum* feeding (20% feed restriction, RS) for four weeks. Each treatment was replicated five times with 10 birds per replicate. The proximate and fatty acid composition of the experimental diets are presented in Table 1. At the end of the trial, all birds were slaughtered, defeathered, and eviscerated. Carcass analysis was conducted as described by Sola-Ojo et al. [4]. Muscle pH, drip and cooking losses, protein

oxidation and lipid oxidation were determined as described by Adeyemi et al. [5]. The extraction and analysis of fatty acids followed the procedure described by Adeyemi et al. [5].

Statistical Analysis: Data obtained from the trial were subjected t-test using the SAS software.

RESULTS AND DISCUSSION

Table 1: Chemical and fatty acid composition of dietary treatments

Parameter (%)	Starter	Finisher
Crude protein	22.78	20.45
Ether extract	3.90	4.72
Crude fibre	3.89	4.42
Ash	3.55	2.80
Energy (kcal/kg)	2977.79	3132.21
Fatty acids (%)		
C14:0	2.07	2.07
C16:0	21.64	21.00
C16:1n-7	0.52	0.52
C18:0	5.53	5.64
C18:1	24.19	23.55
C18:2 n-6	44.07	44.59
C18:3 n-3	1.70	1.80
∑SFA	29.17	28.71
∑UFA	70.48	70.46
Total FA (g/kg DM)	**2.34**	**2.47**

Table 2: Mean carcass and meat quality traits in broiler chickens subjected to different feeding regimen

Parameter	Treatments		SEM	P-value
	Unrestricted	Restricted		
Live weight (g)	2060.00^{a}	1840.00^{b}	32.21	0.023
Carcass weight (g)	1440.00^{a}	1260.00^{b}	21.04	0.003
Dressing %	69.92	68.47	1.42	0.103
Abdominal fat (%)	0.95^{a}	0.23^{b}	0.03	<.0001
Drumstick (%)	8.01	8.43	0.33	0.397
Thigh (%)	7.82	8.40	0.81	0.296
Breast (%)	28.41	28.61	1.53	0.963
Back (%)	26.37	27.18	1.16	0.300
Head (%)	4.15	4.70	0.17	0.157
Leg (%)	3.46	3.38	0.25	0.352
Neck (%)	3.81	4.22	0.22	0.224
Liver (%)	2.33	2.59	0.08	0.381
Wing (%)	5.56	6.25	0.26	0.109
pH	5.75	5.80	0.20	0.120
Carbonyl (mmol /mg protein)	3.79×10^{-6a}	1.02×10^{-6b}	6.55×10^{-7}	0.028
TBARS (mg MDA /kg)	0.05^{a}	0.02^{b}	0.0001	0.001
Drip loss (%)	8.05^{a}	6.81^{b}	0.93	0.031
Cooking loss (%)	25.24	26.09	1.89	0.154

[a, b] means with different superscripts along the same row are significantly different ($p<0.05$).

Table 3: Mean fatty acids (% of total fatty acids) in breast muscle of broiler chickens subjected to different feeding regimen

Parameter	Treatments		SEM	P-value
	Unrestricted	Restricted		
C12:0	0.12[a]	0.23[a]	0.01	0.023
C14:0	1.07	1.10	0.05	0.647
C14:1	0.22	0.27	0.04	0.473
C16:0	22.35	23.26	1.79	0.755
C16:1	0.58	0.73	0.03	0.078
C18:0	16.15	16.77	1.48	0.788
C18:1n-9	22.64	23.75	1.63	0.353
C18:2n-6	24.46[a]	20.39[b]	1.28	0.019
C18:3n-3	1.80[b]	2.53[a]	0.09	0.017
C20:4n-6	8.30	7.75	0.38	0.439
C20:5n-3	0.67[b]	1.00[a]	0.02	0.025
C20:6n-3	0.71[b]	1.17[a]	0.18	0.027
C22:6n-3	0.80	0.93	0.16	0.771
n6:n3	8.23[a]	4.98[b]	0.21	0.002
PUFA/SFA	0.93	0.82	0.13	0.430
Total FA (mg/g)	3.12	2.96	0.21	0.104

[a, b] means with different superscript along the same row are significantly different ($p<0.05$).

The carcass and meat quality attributes of broiler chickens subjected to different feeding regimen are presented in Table 2. Birds fed *ad libitum* had heavier ($p< 0.05$) live and carcass weights than birds subjected to feed restriction. These findings could be attributed to the availability of nutrients necessary for tissue accretion in the UR birds relative to the RS birds. This observation is consistent with those of previous studies [3, 6]. Dressing percentage did not differ between treatments. This suggests that feed restriction had no effect on carcass yield in broiler chickens. The RS birds had lower ($p<0.05$) abdominal fat than the UR birds. The reduction in abdominal fat could be due to the lower hepatic acetyl-CoA carboxylase activity, a rate-limiting enzyme for fatty acid synthesis [6]. This may limit hepatic triglyceride synthesis causing lower serum triglyceride concentration and hence reduces fat accumulation in the body [6]. Feed restriction did not affect the muscle pH, and cooking loss of breast muscle in broiler chickens. Nonetheless, the breast muscle of RS chicken had lower TBARS, carbonyl, and drip loss values. This could be due to the reduced abdominal fat and intramuscular fat in the RS chickens relative to the UR chickens. Thus, the higher body fat (particularly the unsaturated fatty acids) in the UR chickens foists oxidative challenge thereby predisposing the meat to lipid oxidation and protein oxidation. The increased lipid oxidation and protein oxidation could be responsible for the higher drip loss in the meat of the UR birds [5].

The fatty acid composition of breast muscle in broiler chickens subjected to different dietary treatments is presented in Table 3. The UR meat had higher ($p<0.05$) C18:2n-6 but lower C12:0, C18:3n-3 C20:5n-3 and C22:5n-3 than the RS meat. The lower C12:0 in the UR meat suggests a lower *de novo* synthesis of C12:0 caused by the increase in the concentration of C18:2n-6. The higher concentration of C18:2n-6 in the UR meat could be due to the higher phospholipids and neutral lipids in the muscle. C18:2n-6 is preferentially deposited in muscle phospholipids and neutral lipids [7]. Similar reasons could be adduced for the lower concentration of C18:3n-3 in the UR birds. The higher concentration of the 20:5n-3 and C22:5n-3 in the RS meat could be due to the higher concentration of their precursor, C18:3n-3.

CONCLUSION

A 20% feed restriction at finisher phase reduced abdominal fat, drip loss, lipid oxidation, protein oxidation and enhanced the nutritional quality of breast muscle in broiler chickens.

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LIVESTOCK ECONOMICS AND EXTENSION

Growth Performance and Economics of Fattening West African Dwarf Rams Using Ammonium Sulphate-Fortified Diets

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Abstract: The study was conducted to evaluate the effect of feeding ammonium sulphate-fortified diets on the economic benefits of fattening West African Dwarf (WAD) rams. Sixteen West African Dwarf rams weighing 12.8±0.12 kg were randomly assigned to four experimental diets containing 0g/kg (control), 2.5g/kg, 5.0g/kg and 7.5g/kg levels of ammonium sulphate designated as T1, T2, T3 and T4 respectively. Each ram was fed at 5% of its body weight with ration containing 60% of experimental diet and 40% wilted guinea grass. A significant ($P<0.05$) difference was observed in daily weight gain (g/day), dry matter intake (g/day), feed conversion ratio, cost of feed (#), cost of feed consumed (#) and cost of feed per kg weight gain. Daily weight gain (g/day) of 19.60 (T1) and 21.95 (T4) was obtained for WAD rams fed non-ammonium sulphate-fortified diets (T1) and ammonium sulphate-fortified diets (T4), respectively, with feed consumed at #16,464:00 (T1) and #29,569:00 (T4) for 105 days. It was concluded that ammonium sulphate fortified diets (T4) significantly increased daily weight gain of WAD rams which can be used in fattening of rams for festive period.

Keyword: Economics, Ammonium sulphate-fortified diets, West African Dwarf (WAD) rams

INTRODUCTION

Feed shortage constitutes a serious problem that is particularly prevalent in developing countries. In response to the increasing cost of conventional feedstuffs coupled with high demand of grains for human consumption, a large number of researchers have been investigating new approaches to sustainable growth in animal production. Among these approaches is the use of alternative high-quality feed resources at a minimum cost. The use of unconventional, readily available, and cheaper sources of feedstuff in animal ration (Etela *et al.*, 2008). The objective of this study was to evaluate the economic returns of fattened West African Dwarf (WAD) ramswith or without ammonium sulphate-fortified diets (viable source of sulphur and nitrogen).

MATERIALS AND METHODS

Experimental site and diets: The study was conducted in sheep unit of the Teaching and Research Farm, University of Ibadan, Nigeria. Sixteen West African Dwarf rams weighing 12.8±0.12 kg were randomly assigned to four experimental diets containing 0g/kg (control), 2.5g/kg, 5.0g/kg and 7.5g/kg levels of ammonium sulphate designated as T1, T2, T3 and T4 respectively. Brewers dry grain (60kg), palm kernel cake (23kg), dicalcium phosphate (1kg), oyster shell (2kg), salt (2kg), growers premix (1kg), urea (1kg) and dry cassava peel (60kg) were mixed and the experimental diet was then mixed with 0, 2.5, 5.0 and 7.5g/kg levels of ammonium sulphate.

Economic analysis: The current market price of the various feed ingredients was used to compute the total cost of feed that was consumed within the fattening period and feed cost per kilogram weight gain. Total weight gains were used to determine how profitable or otherwise it was to fatten rams with or without ammonium sulphate. Cost of capital required for pens, depreciation and labour were not considered.

Chemical analysis: Proximate analysis of samples was carried out by AOAC (2005) procedure. Acid detergent fibre (ADF) and Neutral Detergent fibre (NDF) were determined in all the feed ingredients according to Van soest (1991)

Sample and statistical analysis: Data collected were subjected to Analysis of Variance (ANOVA) using SAS (2002). Significant differences between treatment means were separated using Least Significant differences (LSD) of the same package.

RESULTS AND DISCUSSION

Performance of rams fed Ammonium sulphate-fortified diets

Table 2 shows the performance of WAD rams fed ammonium sulphate-fortified diets. The initial weights ranged from 11.75 (T3) to 12.25 (T4) kg while the final weight ranged from 19.60 in T1 to 21.95kg for those on T4. The daily weight gain ranged from 70.00g/day in rams on T1 to 90.00g/day for those on T4. Daily weight gain was significantly ($P<0.05$) different among the rams fed ammonium sulphate-fortified diets (Table 2). The rams on ammonium sulphate-fortified diets performed better numerically than those on T1. The dry matter feed intake ranged from 752.38 in T4 to 996.18g/day in T1. Rams on control (T1) had a higher intake (996.18g/day) than those on T4 (752.38g/day). The DM intake through experimental diets differ ($P<0.05$) significantly between T1 (0g/kg) and rams fed ammonium sulphate-fortified diets (T2, T3, T4). But T1 is significantly higher ($P<0.05$) than T3 5.0g/kg which was also higher than T2 (2.5g/kg) in rams fed ammonium sulphate-fortified diets (Table 2). Total DM intake was similar between T2, T3 and T4 in rams fed ammonium sulphate-fortified diets, but was significantly lower ($P<0.05$) in T2 compared to T1. The feed conversion ratio ranged between 9.10 for rams fed T4 to 15.12 for those fed T1. The feed conversion ratio was highest ($P>0.05$) in T1 (15.12) and best (lowest) in T4 (9.10). This is an indication of proper utilization of the feed by the rams on T4 (7.5g/kg) ammonium sulphate-fortified diet. There was no significant ($P>0.05$) difference for initial weight but there were significant ($P<0.05$) difference for final body weight, daily weight gain, dry matter feed intake and feed conversion ratio. However, rams fed ammonium sulphate-fortified diets at 7.5g/kg have higher numerical values than those fed the control diet. This is an indication that ammonium sulphate-fortified diets promote sulphur and nitrogen utilization in WAD rams.

Table 1: Chemical analysis of Ammonium sulphate fortified diet and *Panicum maximum.*

PARAMETERS (%)	T1	T2	T3	T4	SEM	*P. maxi.*
Dry Matter	94.90	94.73	94.05	94.91	0.25	38.50
Crude Protein	11.01^{c}	11.95^{c}	12.28^{b}	14.91^{a}	0.37	7.81
Ether Extract	0.62	0.70	0.63	0.78	0.01	0.70
Ash	12.04	12.30	12.19	12.80	0.02	8.94
NDF	30.35	31.71	31.67	30.06	0.02	60.00
ADF	25.20	26.58	25.96	25.34	0.01	38.00
ADL	6.16	6.18	6.12	6.14	0.03	7.19

a,b,c: Means within rows with unlike superscripts are significantly different from each other ($P<0.05$). T: Treatment, T1: 0g/kg $(NH_4)_2SO_4$, T2: 2.5g/kg $(NH_4)_2SO_4$, T3: 5.0g/kg $(NH_4)_2SO_4$, T4: 7.5g/kg $(NH_4)_2SO_4$, SEM: Standard Error Mean, NDF: Neutral Detergent Fibre, ADF: Acid Detergent Fibre, ADL: Acid Detergent Lignin, *P. maxi.: Panicum maximum*

Table 2: Performance of WAD rams fed Ammonium sulphate-fortified diets

PARAMETERS	T1	T2	T3	T4	SEM
Ammonium sulphate (g/kg)	**0.00**	**2.50**	**5.00**	**7.50**	
Initial Body Weight (kg)	12.25	12.25	11.75	12.50	0.88
Final Body Weight (kg)	19.60^{b}	19.82^{b}	20.15^{a}	21.95^{a}	0.68
Daily Weight Gain (g/day)	70.00^{b}	72.05^{b}	80.00^{a}	90.00^{a}	1.00
Dry Matter Intake (g/day)	996.18^{a}	741.54^{b}	752.38^{b}	759.23^{b}	1.20
Feed conversion Ratio	15.12^{a}	10.13^{b}	9.19^{b}	9.10^{b}	1.18

a,b,c: Means within rows with unlike superscripts are significantly different from each other ($P<0.05$). T1: 0g/kg $(NH_4)_2SO_4$, T2: 2.5g/kg $(NH_4)_2SO_4$, T3: 5.0g/kg $(NH_4)_2SO_4$, T4: 7.5g/kg $(NH_4)_2SO_4$, SEM: Standard Error Mean.

The weight gain values of the rams fed ammonium sulphate-fortified diets at 7.5g/kg might be due to the adequate protein in the feed, which was comparable with the protein requirement and dry matter (DM) intake required for small ruminant growth (Devendra, 1980). Also, the higher level of weight gain in T4 might be due to more effective utilization of the feed and protein quality of the diet. The feed utilization by the ram fed T4 was the best and poorest in rams fed T1 which might be attributed to fortification with ammonium sulphate in the diets and DM intake by the experimental rams which is higher than the range (0.10-0.25kg) for WAD rams reported by El-Hag and Kurdi, (1986). Also, Thomas *et al,* (1951) demonstrate that the addition of inorganic sulphate to a sulphur deficient purified ration improved weight gain and the nitrogen and sulphur retention of sheep. The tendency for a negative effect of control (0g/kg) T1 on live weight change may be due to reduction in muscular development as a result of depletion of the sulphur-containing amino acids necessary for formation of sulphur-amino acids (Onwuka *et al.,* 1992). Promkot *et al.,* (2007) report that goats on low sulphur, cassava-based diets had the greatest weight losses as compared to sulphur supplemented groups. It was shown by Ferreiro *et al.,* (1977) that addition of 1g ammonium sulphate per kg of fresh sugar cane improved daily gain significantly on a ration composed otherwise of only sugar cane and urea. The DWG values were similar to 7.20kg when increase in the level of $(NH_4)_2SO_4$ fortified diet at $(NH_4)_2SO_4$ persistently improved final weight gains and DWG, respectively. The improvement in gain was directly related to the DMI. The increase in DWG of rams with increasing level of $(NH_4)_2SO_4$ fortified diets and DMI could be attributed to increased protein supply to rumen microbes for effective utilisation of $(NH_4)_2SO_4$ fortified diets which made nutrients available for the rams' absorption. The significant differences in the growth rate across treatments were also possibly due to differences in nutrients composition of the diets and DMI. The dry matter intake of rams on T1 was highest with value of 996.18g/day. Dry matter intake obtained in this study ranged from 759.23 (T4) – 996.18 (T1) g/day which negate the report of Adegbola *et al.* (1998) who report a lower value of 627-697g/day for 6 months old West African dwarf sheep fed grass supplemented with concentrate. De carvalho *et al*., (2017) also identify an increased feed intake and performance in sheep with the addition of a legume to a grass diet. The improvement in intake is an indication of softening effects of $(NH_4)_2SO_4$ in the experimental diets from 741.54 (T2) – 759.23 (T4) g/day. However, the highest feed intake value obtained on ammonium sulphate-fortified diet 759.23 (T4) g/day might be as a result of palatability and the nature of the diet containing ammonium sulphate. Morgan and Lewis, (1961) stated that the voluntary feed intake of any animals is a primary determinant of the nutrient digestibility and productivity. Mc Donald *et al.,* (1995) reported that nutrient intake is the most important factor that affects animal performance. The smaller the feed conversion ratio (FCR), the more efficient animals are in converting feed to meat (Smeaton, 2003). The present results revealed the ability of rams on T4 (9.10) to consume less feed but utilized and converted the feed to more flesh than rams on T1 (15.12).

Table 3: Economicsanalysis of feeding Ammonium sulphate-fortified diets to WAD rams

PARAMETERS	**T1**	**T2**	**T3**	**T4**	**SEM**
Ammonium sulphate (g/kg)	**0.00**	**2.50**	**5.00**	**7.50**	
Cost/kg of feed (#)	24.69^{d}	30.94^{c}	37.90^{b}	43.44^{a}	0.67
Cost of feed consumed (#)	$16,464^{d}$	$19,676^{c}$	$25,039^{b}$	$29,569^{a}$	0.45
Cost of feed consumed (#)/day	156.80^{d}	187.39^{c}	238.47^{b}	281.61^{a}	0.03
Daily weight gain (kg/day)	0.07^{c}	0.07^{c}	0.08^{b}	0.09^{a}	0.01
CFC (#/day)/DWG (kg/day)	10.98^{d}	13.49^{c}	19.08^{b}	25.35^{a}	0.05

T: Treatment, T1: 0g/kg $(NH_4)_2SO_4$, T2: 2.5g/kg $(NH_4)_2SO_4$, T3: 5.0g/kg $(NH_4)_2SO_4$, T4: 7.5g/kg $(NH_4)_2SO_4$, SEM: Standard Error Mean, Daily Weight Gain: DWG, cost of feed consumed: CFC.

The economic efficiency of feeding the experimental diets with or without ammonium sulphate-fortified diet is presented in Table 3. The cost/kg of feed differed significantly ($P<0.05$) among the treatment group, although it was cheaper producing diet 1(without ammonium sulphate) fortification than treatments 2, 3 and 4. The cost of feed per kg weight gain was statistically different across the dietary treatment groups. The higher feed (dry matter) intake in WAD rams observed on treatment 1 significantly influenced the cost of feed consumed. The inclusion of ammonium sulphate in treatments 2, 3 and 4 significantly increased the cost of feed per kg weight gain of the WAD rams.

CONCLUSION

Conclusively, ammonium sulphate is a valuable source of sulphur and nitrogen which can be incorporated at 7.5g/kg into the diets of WAD rams, this will inversely have increased daily weight gain of WAD rams which can be used in fattening of rams for festive period.

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Performance and Profitability Analysis of Broilers Chickens fed graded levels of Baobab *(Adansonia digitata*) pulp meal at the Finisher Phase

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Abstract: The experiment was conducted to evaluate the performance of broiler chickens fed graded levels of baobab (*Adansonia digitata*) pulp meal (BPM) at the finisher phase. Three hundred broiler (Anak) chickens were allotted to five treatments replicated thrice with 20 birds per replicate in a completely randomized design (CRD). The inclusion levels of the BPM in the diets were 0, 5, 10, 15 and 20% for treatment 1 (Control), 2, 3, 4 and 5, respectively. The experiments lasted for four weeks. Data collected were subjected to analysis of variance and significant differences among treatment means were compared using the Dunnet Test. Results showed a significantly lower feed intake (103.37-104.69g) ($P<0.05$) in birds fed 10, 15 and 20 % baobab pulp meal (BPM). Higher ($P<0.05$) daily weight gains of (47.21-47.55g) were recorded in birds fed 0%, 5% and 10% BPM. Birds fed 0%, 5% and 10% BPM were more efficient in feed utilization (2.17-2.22). It can be concluded that Baobab pulp can be included infinishing diets up to 20% but the optimum levels of inclusion was 5%.
Keywords: Baobab, Broiler, Economic, Finisher, Performance and Pulp

INTRODUCTION

The prices of animal products are beyond the reach of the average Nigerian owing to the increase in the production and maintenance cost of farm animals. This has necessitated the renewed interest in g the incorporation of neglected or underutilized energy feedstuff in broiler feed. Several workers have emphasized the need for the use of unconventional feedstuff as an alternative feed ingredient, as well as the use of human and industrial waste as livestock feed ingredients (Durunna *et al*., 1990; Fanimo *et al*., 2007). Not much has been done in evaluating the potential feed value of some multipurpose tree products such as baobab *(Adansonia digitata).* Medugu *et al*. (2011) reported that the tremendous decrease in poultry production is as a result of high cost of protein and energy feedstuffs especially cereal grains (maize) which form the bulk of energy in poultry feeds. The high cost of convetional protein and energy feedstuffs is as result of the competition between human and animals for the available feed resources coupled with constant drought. The objectives of the study is todetermine effect of feeding baobab (*Adansonia digitata*) pulp on the performance and the cost of production of broiler chickens.

MATERIALS AND METHODS

Source of Baobab Fruit: Baobab fruit used for this experiment were harvested at mature stage which was indicated by the hard brown colour of the ectoderm from the trees using locally made equipment aroud Mamudo, Danchuwa, Alaraba and Mele in Potiskum Local Government area of Yobe State, Nigeria.

Processing: Dried baobab fruits were processed by cracking open the hard shell of the baobab fruits using a small hammer to remove the inner contents (epicarp), and pounded using a mortar and pestle while the seed and pulp were separated using a sieve. The pulp was slightly milled and separated from the unwanted coarse material using a fine mesh.

Experimental Site: The feeding trialwas conducted at the Teaching and Research farm (Poultry unit) of the Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University Zaria. Zaria is located within the Northern Guinea Savannah of Nigeria with an average annual rainfall, relative humidity and temperature of 1,100 mm, 75% and 24.4^{O} C respectively, on Latitude 11º 12'N and Longitude 7º 33'E at an altitude of 610m above sea level (Ovimap, 2014).

Experimental design and management: Three hundred (300) broiler chicks (Anak) were purchased from Zarm Farm. The birds were vaccinated against Newcastle disease (intra ocularly) on the day of arrival and brooded together for three days using kerosene stoves and electricity bulbs as sources of heat and light. They were fed a

common diet during this period. The birds were subsequently weighed and allotted to five dietary treatments. The birds were housed in a deep litter system in a completely randomized design. The treatments were replicated three times with twenty chicks per replicate. The feeding trial lasted for eight weeks. Feed and water were provided *adlibitum*.

Experimental diets: The composition and calculated analysis of the experimental diets are presented in Tables 1. The test ingredient was included in the broiler finisher diets at 0, 5, 10, 15 and 20% representing treatments 1 (control), 2, 3, 4 and 5, respectivelyThe diets were isonitrogenous (20% CP) and isocaloric (2950 Kcal/Kg) and met the recommended crude protein and metabolisable energy requirements as stated by NRC (1994). The diet was fed for four (4) weeks.

Parameters determined in the experiment

Performance: The bird's performance such as feed intake, weight gain, feed conversion ratio were measured weekly while mortality was recorded as it occurred and the cost of experimental diets were calculated based on the prevailing market price at the time of the experiment.

Profitability of Production: The profitability of broiler production was estimated using budget analysis and profitability ratios (Adeoti and Olawumi, 2013). The budget analysis involves the deduction of the total variable cost (Naira) from the total revenue of live birds (in Naira) to obtain the gross margin for each bird. The total variable costs of production are the cost of day old chicks, labour, feed, veterinary service, medication and other miscellaneous expenses. That is Gross margin is equal to Gross revenue minus Total variable cost. It was calculated by the given formula as follows:

$$GM = \sum_{i..1}^{n} PiYi - Ci$$

Where: GM = Gross margin

Pi = Price per Kg of meat

Yi = Total live weight in kilogram of meat

Ci = Total variable cost incurred on bird

I…n = Total number of birds.

The profitability ratios include the benefit cost ratio (BCR), the profitability index (PI) and the rate of return on investment (ROI). Calculated as follows

Benefit cost ratio (BCR) = $\frac{TR}{TC}$

Profitability index (P1) = $\frac{NP}{TR} = \frac{GM}{TR}$

Rate of return on investment (ROI) = $\frac{NPX\ 100}{TC} = \frac{GMX\ 100}{TC}$

Where: TR = Total revenue (value of the total live weight of a broiler), TC = Total cost of production of a broiler, NP = Net profit of a broiler production

Data analysis: All data collected were subjected to analysis of variance (ANOVA) using the General Linear Model Procedure of SAS 9.2 (2002). Significant differences among treatment means were compared using Dunett multiple ranged in the SAS Package.

The model for this design was as follows:

$X_{ij} = \mu + t_i + e_{ij}$

Where: Xij = any observation made in the experiment, μ = the population mean, t_i = Effect due to treatment added or treatment effect, Eij = Experimental error.

RESULTS AND DISCUSSION

The effects of feeding graded levels of baobab (*Adansonia digitata*) pulp on finisher birds areshown in Table 2. The average daily feed intake ranged from 103.37 – 109.80g. Significantly ($P<0.05$) higher values of 107.88g and 109.80g daily feed intake were recorded in birds fed 15% and 20% BPM while no significant ($P>0.05$) differences were observed in birds fed 0%, 5% and 10% BPM in daily feed intake. The increase in feed intake

observed was due to sweetness of the pulp. Pulp is very sweet depending on the species and geographical location and the pulp sweetness is provided by fructose, sucrose and maltose contents of the pulp. According to Murray *et al.* (2001), sugars in the baobab pulp account for about 35.60% of the total carbohydrate content, which explained the noticeable sweet taste of the pulp and definitely increased feed intake of the birds.

Table 1: Composition and calculated analysis of the experimental diet (finisher).

	Inclusion levels of baobab pulp meal (% BPM)				
Ingredient (%)	**0**	**5**	**10**	**15**	**20**
Maize	55.50	50.50	45.45	39.15	33.95
Baobab Pulp Meal	0.00	5.00	10.00	15.00	20.00
G/nut cake	15.15	15.25	16.00	16.80	17.00
Soybeans meal	15.00	15.00	15.00	15.00	15.00
Maize offal	10.00	10.00	10.00	10.00	10.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	0.30	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.30	0.20	0.00	0.00	0.00
*Pre-mix	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated					
ME (Kcal/Kg	2952.55	2956.25	2955.76	2955.67	2960.14
Crude protein	20.28	20.23	20.14	20.24	20.16
Crude fibre	3.55	3.79	4.07	4.35	4.59
Ether extract	4.07	4.27	4.50	4.73	4.93
Calcium	1.10	1.12	1.14	1.16	1.18
Av. Phosphorus	0.63	0.63	0.63	0.63	0.63
Lysine	1.11	1.12	1.17	1.18	1.24
Methionine	0.51	0.53	0.56	0.58	0.60
Cost (₦/Kg)	89.70	79.56	76.49	75.40	74.62

*Bio-mix finisher supplied/kg: Vit.A = 2125IU, Vit.D3 = 375IU, Vit.E = 2.50mg, Vit.K_3 = 0.375mg, Vit.B_1 = 0.400mg, Vit.B_2 = 1.00mg, Niacin = 5.00mg, Panthothenic Acid = 1.25mg, Vit.B_6 = 0.375mg, Vit.B_{12} = 0.003mg, Folic Acid = 0.125mg, Biotin H2 = 0.188mg, Choline 0.225mg chloride = 43.75mg, Cobalt = 0.05mg, Copper = 0.75mg, iodine = 0.25mg, Iron = 5.00mg, Manganese = 10.00mg, Zinc = 7.50mg, Selenium = 0.05mg, Anti-oxidant= 0.313mg, BPSM = Baobab pulp-seed meal, G = Ground, Av. = Available

Table 2: Performance of broiler chickens (finisher) fed graded levels of baobab pulp meal.

Parameter	**Inclusion levels of baobab pulp meal (% BPM)**					**SEM**
	0	**5**	**10**	**15**	**20**	
Live weight (g)	749.20	749.21	749.24	749.18	750.00	4.70
F /I/Day (g)	103.37^{b}	104.64^{b}	104.69^{b}	107.88^{a}	109.80^{a}	1.92
Final Weight (g)	2080.50^{a}	2076.40^{a}	2071.00^{a}	1959.40^{b}	1928.50^{b}	38.46
W/G/Day (g)	47.55^{a}	47.40^{a}	47.21^{a}	43.22^{b}	42.09^{b}	2.72
FCR	2.17^{a}	2.22^{a}	2.22^{a}	2.55^{b}	2.62^{b}	0.07
Feed Cost (₦)	89.70	78.56	76.49	73.40	71.62	
T/Feed Cost (₦)	257.36	230.14	224.11	221.63	220.24	
C/Red. (₦)	0.00	27.05	33.25	35.40	37.12	
Cost/Gain (₦/g)	0.19	0.17	0.18	0.18	0.19	
Mortality (%)	1.27^{a}	0.63^{c}	0.95^{b}	1.25^{a}	1.27^{a}	0.02

^{abcd} = Means within row with different superscript differ significantly (P<0.05).

F/I = Feed intake; FCR = Feed conversion ratio; T = Total; C = Cost; W = Weight; G = Gain

Table 3: Economic analysis of broiler chickens fed graded level of baobab pulp meal

Parameter	**Inclusion levels of baobab pulp meal (% BPM)**					
	0	**5**	**10**	**15**	**20**	**SEM**

L/W (g)	2052.40[a]	2076.40[a]	2071.00[a]	1959.40[b]	1928.50[b]	40.66
T/F/C (₦)	381.21[a]	347.07[b]	339.03[c]	336.40[c]	337.40[c]	3.38
T/P/C (₦)	679.54[a]	645.40[b]	637.42[c]	634.73[c]	635.73[c]	3.38
TR (₦)	1,231.40	1,245.80	1,200.50	1,175.60	1,157.10	76.78
GM (₦)	551.90[b]	600.41[a]	563.16[b]	540.91[bc]	521.37[c]	23.53
BCR	1.82[c]	1.93[a]	1.88[b]	1.85[b]	1.82[c]	0.04
PI	0.45[b]	0.48[a]	0.47[a]	0.45[b]	0.45[b]	0.01
ROI (%)	81.51[c]	93.01[a]	88.31[b]	85.14[b]	81.97[c]	3.61

[abc], = Means within row with different superscript differ significantly (P<0.05).L/W = Live weight; T/F/C = Total feed cost; TR = Total revenue; GM = Gross magin; BCR = Benefit cost ratio; PI = Profit index; ROI = Rate of return on investment.

The values recorded in this study for final weight and daily weight gain ranged from 1928.50 – 2080.50g and 42.09 – 47.55g, respectively. Significantly (P<0.05) higher values 2080.50g, 2076.40g and 2071.00g final weight were recorded in birds fed 0%, 5% and 10% respectively while significantly (P<0.05) lower values 1959.40g and 1928.50g final weight were recorded in birds fed 15% and 20% BPM, respectively. The differences observed across the treatment groups 1, 2 and 3 in daily weight gain were not significant (P>0.05). The result of this study agree with the finding of Bolu and Olutunde (2009) who reported that proportionate increase in weight gain when birds are fed with increasing levels of baobab fruit pulp. But finding disagree with the work of Adeosun *et al.* (2013) who reported significant (P<0.05) decrease in final, total and daily weight gain when baobab pulp fed to layers beyond 10.5% and also Sola-Ojo *et al.* (2013) who reported insignificant (P>0.05) effects of diets was observed in the final weight, total weight gain and average daily gain of broilers fed dietary levels of Baobab pulp. Feed conversion ratio (FCR) recorded ranged from 2.17 – 2.62 (Table 2). Significantly (P<0.0) higher values 2.55 and 2.62 were recorded in birds fed 15% and 20% BPM while significantly (P<0.05) lower values 2.17, 2.22 and 2.12 were recorded in birds fed 0%, 5% and 10% BPM. This implies that feed utilization efficiency was better at 0% BPM, 5% BPM and 10% BPM, inclusion level, while poor utilization of feed was observed at 20% BPM and 15%BPM inclusion. The insignificant (P>0.05) difference observed between birds fed 0% BPM, 5% and 10% BPM is a testimony of the efficacy of BPM to replace conventional feed stuff in broiler diets up to 10% BPM as FCR is a good indicator of how well livestock utilize feed intake for weight gain. This agrees with the work of Egbewande *et al.* (2012) who reported non-significant (P>0.05) differences among layers fed diets containing baobab pulp, amaranthus leaves and tiger nut seed which significantly (P<0.05) influenced the birds positively. The feed cost per kilogram of feed, total feed cost, cost reduction and cost per Kilogram gain ranged from ₦71.62 - ₦89.70, ₦220.24 - ₦257.36, ₦0.00 – ₦37.12 and ₦173.42 – ₦193.29 respectively. Higher cost of feed (₦89.70), total feed cost (₦257.36), and zero cost reduction and cost per kilogram gain (₦193.29) were recorded in birds fed 0% BPM lower values were recorded in test diet (BPM) The cost of feed was proportionally related to the BPM inclusion level, this showed that the cost of producing one kilogram of feed reduced as the inclusion level of BPM increase. This is also in line with the main objectives of usage of unconventional feed stuffs as reported by some workers (Bawa *et al.,* 2003 and Abeke *et al.,* 2008). This result also agreed with the value reported by Nworgu *et al.* (1999) (₦81.27 – ₦93.91) and Nworgu (2002) ((₦69.90 – ₦97.82), but lower than the values reported by Jegede (2006) ((₦137.48 – ₦157.62). The variation could be due to test ingredients used, cost of feed stuff and season of the year the experiment was carried out. The mortality recorded in this study ranged from 0.63 – 1.27%.

The profitability index indicates that for every one naira earned as revenue, 45 kobo, 48 kobo 47 kobo, 45 kobo and 45 kobo were returned as profits in the present study. The total feed cost for this study ranged from 52.07-56.10% of the total cost of production and this was lower than 75 - 80% reported by the previous workers (Nworgu *et al.,* 1999 and opera, 1999). The reduction in the total feed cost recorded in this study was as a result of the drop in the prices of maize and baobab pulp used in feed formulation. The cost of day-old chicks constituted 19.13-20.48% of the total cost of production which is lower than 24-25% of the total cost of production (Adeoti and Olawumi, 2013). The difference might be due to differences in the source of day-old

chicks and time of the purchase and the cost of medication was 2.10-2.25% of the total cost which was lower than 4% of the total cost of production (Khan *et al*., 2004). The benefit cost ratio ranged from 1.82 to 1.93 which is higher than 1.34 reported by Mohsin *et al*. (2008) for broiler production and the profitability index ranged from 0.45-0.48 which was within the range of 0.48-0.52 reported by Nworgu (2007). The rate of return on investment (81.57-93.01%) fell within the range reported by Ngworgu (2007) who reported a range of 76.2-106.04%. No significant (P>0.05) differences were observed in all mention parameters among the treatment groups except for birds fed 0% BPM and 10% BPM which was significantly (P>0.05) lower than the other treatment groups. Higher total revenue gross margin, benefit cost ratio, profit index and rate of return on investment was found in birds fed 5% BPM and lower in bird fed 20% BPM but insignificant (P>0.05) differences were observed, this implies that profitability was higher at most level of BPM inclusion compared to 0% BPM.

CONCLUSION

It can be concluded that Baobab pulp can be included in broiler chickens diets up to 20% but the optimum levels of inclusion was 5%, It has the reduced feed cost of broiler chickens thereby increasing profitability and protein supply to the greater populace.

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Influence of Seasons on Egg Production and Supply in Greater Port Harcourt City, Nigeria

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Abstract: Seasonality in smallholder chicken egg chain in Greater Port Harcourt City (GPHC) was studied. Six each of wholesalers, retailers and institutional consumers, three intercity traders, and the Chairman, Poultry Association of Nigeria, Rivers State, were interviewed. Focus group discussion was carried out with eight egg producers. Thematic analysis and Microsoft Excel were used to analyze data. Results indicate egg production in GPHC is grossly inadequate. This encourages influx of eggs from other parts of Nigeria. School calendar, Christmas, end-of-year and New Year holidays highly influence egg supply and demand. Also, smallholder egg production is poorly planned, causing seasonal scarcity and glut. Resolving the challenges to benefit all stakeholders requires that smallholder farmers plan their production, minimize costs, and increase local production to supply competitively priced eggs year-round.

Keywords: Festivals, glut, inter-city trade, seasonal calendar, school calendar, vacation

INTRODUCTION

Variations in climaticseasons affect performance of laying birds in the tropics andegg marketing and profitability in Nigeria(Schulte-Drüggelte and Thiele , 2013; Oguntunji *et al*., 2015).High ambient temperature varies with climatic seasons, stress laying birds and reduces egg production(Guobadia, 1997), while climatic conditionssupports high production during low eggdemand resulting into egg glut.On the other hand, low egg production induced by unfavorable climatic conditions is associated with rising demand andscarcity.Effect of climaticand man-made seasons on demand and marketability of eggs are still serious problems.Seasonal variation in price of eggs due to change in demand and supply at different times of the year could be large (Omar, *et al.*, 2013) and mayerode smallholders' income. Proper egg marketing ensures even supply of eggs at stable pricesacross the year (FAO, 2003). But, Nigerian egg market is poorly organized (Adedeji *et al*., 2014) and unable to stabilize seasonal variability. Solution to the challenge needs understanding of dynamics of the problem and actionable data that reveals upgrading opportunitiesthrough egg chain seasonality analysis (USAID, 2008).Such analysis has not been reported in GPHC. This study assessed influence ofseasons onsmallholder egg value chain in GPHC.

MATERIALS AND METHODS

'Smallholder' in this study refers to producers having ≤10,000 laying birds. This research was theory-building and exploratory. Desk study was carried out to identify stakeholders and reviewliterature. One-on-one in-depth interviews was done with 22 stakeholders (three each of hawking wholesaler, sedentary wholesaler, supermarket, small street shop, boarding school, fast food chain, and intercity trader and Chairman of Poultry Association of Nigeria) inthree (Obio-Akpor, Oyigbo and Etche) Local Government Areas (LGAs) out of the eight LGAs in GPHC.Focus group discussion (FGD) was conducted with eight purposively selected farmers (3 females and 5 males) for deeper insight on someissues.Microsoft Excel and thematic analysis were used to analyze data.

RESULTS

Data gathered from FGD and interviews were used to construct a seasonality calendar showing patterns of climatic season, egg production, demand and supply in GPHC (Figure 1).

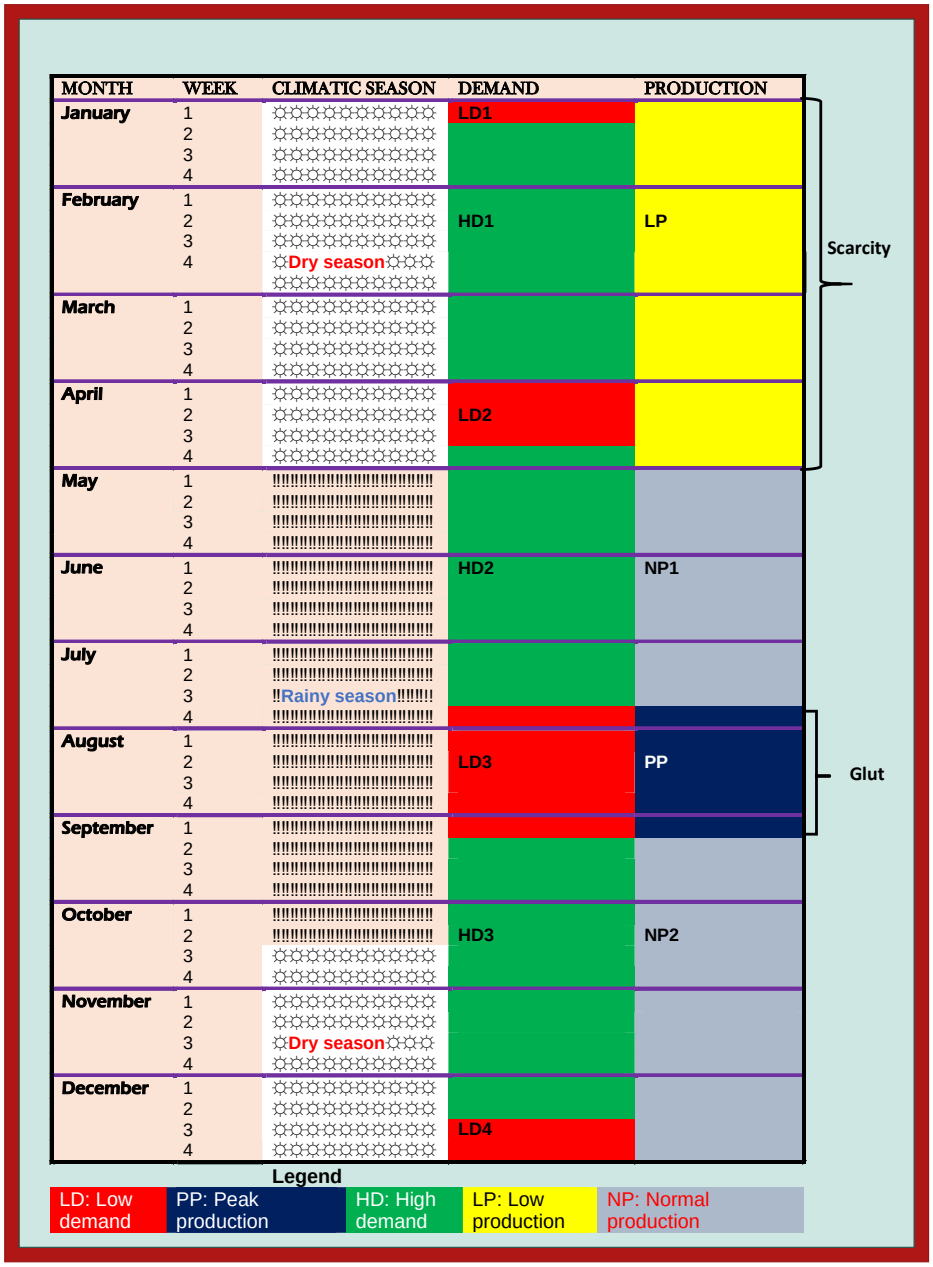

Figure 1: Seasonality of egg production, demand and supply in Greater Port Harcourt City

LD1: Low demand season I. It is first week of January. Most people that travel for Christmas, end-of-the-year, New Year and schools' vacation are not yet back. Demand is low.
HD1: High demand season I. It begins second week of January to fourth week of March. Most people are back from vacation. Schools have resumed for Second Term. Households buy eggs to prepare food for their school children. Demand is high.
LP: Low-production season. It begins from first week of January to end of April. Ambient temperature is high and limits productivity of layers. There is mass culling of old layers in December to target huge demand for poultry meat in Christmas, end-of-year and New Year festivities. Birds that will begin laying by next January are not yet stocked. Industrial farms exploit this gap by planning their production. There is egg scarcity at this period, increasing prices by 6-13%.

LD2: Low-demand season II. It starts from second week to third week of April. Schools have vacated for the Second Term. Demand is low.
HD2: High-demand season II. It begins from fourth week of April to third week of July. Schools are in session for the Third Term. Demand is high.
NP1: Normalized production season I. It begins from fourth week of May to third week of July. Pullets stocked between January and February have started laying. Local production in GPHC has started picking up and fully normalizes by the end of this phase. Also, ambient temperature is cooling as rains have started fully. This is good for layers' productivity. Production is normal.
LD3: Low-demand season III. Begins from fourth week of July till first week of September. Schools are on long vacation for the Third Term. Demand is low.
PP: Peak production. Starts from fourth week of July to first week of September. Birds stocked earlier in the year have started laying. Weather is cool and good for layers' productivity. Glut is observed in the chain by intermediaries bringing in eggs from other cities without realizing local production has peaked.
HD3: High-demand season III. It starts from second week of September to second week of December. Schools have resumed for the First Term. Demand is high.
NP2: Normalized production season II. It begins in the second week of September and ends by last week of December. Weather is cool and good for layers' productivity. Influx of eggs from outside GPHC has been adjusted to peak local production.
LD4: Low-demand season IV. It begins in third week of December till early January of the following year. People have started travelling out of city for Christmas, end-of-the year and New Year vacations. Demand is low.

DISCUSSION

Analysis of seasons in value chains identifies seasonal opportunities for chain improvement and investment (USAID, 2008). In Figure 1, egg production increased in rainy season when weather is cool and temperature is within the birds' comfort zone, but reduced during dry season when hot weather causes heat stress. This agrees with several literatures which demonstrate that high ambient temperature in the dry seasonreduces egg production by layers in humid Nigeria (Guobadia, 1997; Malau-Aduli *et al*., 2003; Oguntunji *et al*., 2015). This creates opportunity for introduction of practices to manage seasons with proper planning to ensure rainy and dry seasons are exploited to benefit birds and farmer(Guobadia, 1997).

Also, findings indicate that mass culling of old layers in December without stocking pullets that will start laying by January of new year causes egg scarcity and 13% price increasein first half of new year. Thereafter, egg glut occurs at the middle of the year when unrestrained influx of eggs from other cities combines with peak local production. Production normalizes between May-December except August. This agrees with literature that seasonal egg price variation occurs due to change in demand and supply at different times of the year (Omar *et al*., 2013) because climatic seasons influence egg consumption (Karthikeyan and Nedunchezhian, 2014).

The demand for eggs increases when schools are in session and decreases when they are on holidays. Also, Christmas, end-of-the-year and New Year vacations reduce demand for eggs. In Nigeria, this agrees with literature but reports from India indicate that New Year and Christmas increase egg demand and prices from November to December (Karthikeyan and Nedunchezhian, 2014). Differences may have resulted from use of the eggs for the celebrations in India compared to Greater Port Harcourt City where low demand is occasioned by reduction in population in the city as people migrate to their villages thus reducing demand for eggs. Also, in GPHC, festivals are celebrated with meat and fish not eggs.

These dynamics are opportunities for production planning to ensure even supply of eggs across the year at stable prices (FAO, 2003) by varying production schedules to maximize income from egg, reduce costswhile considering seasonal price cycles, preferences of middlemen and consumer needs. Optimal culling schedule calls for keeping the current flock in production if their weekly contribution margin exceeds expected weekly contribution margin of a new flock while considering seasonal variation in monthly egg income (Schulte-

Drüggelte and Thiele, 2013). Another opportunity may be to vertically integrate production to narrow seasonal variation in production and price (FAO, 2003).

CONCLUSION

Egg production in GPHC is poorly planned and inadequate to satisfy demand, hence, causing seasonal scarcity, influx of eggs from other parts of Nigeria, and glut. School calendar, Christmas and New Year vacations highly impact egg demand and supply. To resolve the problems, smallholder farmers could plan production, reduce costs and increase supply of competitively priced eggs year-round.

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Fetal Lossesamong Pregnant Cows Slaughtered in Bauchi Central Abattoir and the effects on Cattle Population in the State

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Abstract: A study was carried out to investigate the number of fetal losses due to the number of pregnant cows slaughtered in Bauchi central abattoir, Nigeria. The abattoir was visited monthly for one year using the check list to determine the number of cows slaughtered with pregnancy according to breeds. Slaughtered animals were monitored during the early and late rainy season, early and late dry season, respectively. Data collected were analyzed using simple percentages. The results showed that cows slaughtered during the early to late rainy seasonwere mostly white Fulani (62) in the month of August followed by July (51), October (40), June (27),May (23)and September (17), respectively. Majority of SokotoGudali breeds were slaughtered in July (29) and June (25). The Red Bororo and the crosses had insignificant slaughtered figures. During the early to late dry season whiteFulani breed recorded a higher number January (69), February (57), November (47), October (33), (31) and (23) for December and March respectively. SokotoGudali slaughtered figures were almost similar to that in early to late rainy season. The highest slaughter of Red Bororo was in January (18). Percentage fetal losses during the early to late rains were 23.74 and 22.35% in the months of July and August. The figures for early to late dry season were 23.90 and 22.93% (for November and December, respectively). It was concluded that increase in fetal losses will drastically reduce the cattle population in the state thereby leading to a decline in animal protein intake in Bauchi State.

Key words: Abattoir, Breed, Cows, Fetal Losses, Slaughter

INTRODUCTION

Over 50% of the national meat supply is contributed by cattle while the remaining 40-50% comes from other classes of livestock, (i.e. 35% from sheep and goats ,10% from poultry and the rest from pigs, donkeys, horses, camels and bush meat (FAO, 2003). There are about 14 million cattle in Nigeria (RIM, 2016) and 90% of the larger population of the cattle is concentrated in the northern region of the country, which is more favourable for large ruminants' husbandry (Osinowo, 2002). Bauchi state has a cattle population of 1.8 million (M.A.N.R., 2016).These animals are mostly owned by the Fulani pastoralists. The livestock sector in Nigeria has generally been characterized by low supply of meat and other animal products which has led to a wide spread rise in prices in most products (Duru *et al.*, 2015). Several factors such as inadequate nutrition, prevalence of disease, failure to harmonize crop and animal farming in agricultural practice and inadequate knowledge of sound herd management have been suggested to be responsible for low supply of meat and other animal products (Fetuga, 1997).The effects of these have led to the low level of animal protein intake by Nigerians. Lufadeju *et al.* (1997) reported that 90% of protein source consumed by Nigerians are vegetable source which shows that animals protein is below the minimum recommended level for daily maintenance of health. Meat from ruminant animals contributes substantially to the total protein intake. The habit of slaughtering pregnant animals is seen as a great wastage that needs urgent attention to curtail (Duru *et al.*, 2015).Such unhealthy practices were carried due to poor economy (finance)on the part of most farmers, inadequate law preventing the slaughter of in-animals, inadequate knowledge by majority of farmers to identify the pregnant animals at the early stage , poor ante mortem inspection by meat inspectors, ignorance on the part of the butchers , livestock owners and middlemen to know the economic and social implications of slaughtering in-animals. It is important to ensure ante-mortem inspection of animals, to certify animals, not pregnant before slaughter so as to reduce wastage. If fetal wastage is allowed to continue uncontrollably it will have great implication on the population of cattle and therefore herd size in Nigeria (Oyekunle*et al.*,1992). This will in turn reduce the access of an average Nigerian to proteins of

animal origin such as beef and milk. The objective of this study is to identify the different breeds of cows slaughtered; the number slaughtered with pregnancy hence fetal wastage at the Bauchi central abattoir.

MATERIALS AND METHODS

Bauchi central abattoir is located about 5km off Bauchi- Gombe road. The local government is the capital city of Bauchi state and is one of the twenty local governments of the state. It is the largest in terms of land mass. It is bordered to the south by Tafawa Balewa Local Government, to the West by Toro, North by Ganjuwa and to the East by Alkaleri Local Government. It is located between latitudes $9^0 3^1$ and $12^0 3^1$ North and longitudes $8^0 50^1$ and 11^0 east (Wikipedia 2017).The research was conducted by visiting the abattoir once every month in the rainy seasons (May to October 2016) and dry season (November to April; 2016/2017). Data collected using the check-list were analyzed using simple percentages and means.

RESULTS AND DISCUSSIONS

Table 1: Breeds of cows slaughtered during the early and late rainy season.

	May	**June**	**July**	**August**	**September**	**October**
White Fulani	23	27	51	62	17	40
SokotoGudali	18	25	29	15	6	17
Red Bororo	7	6	5	3	3	3
Crosses	0	1	0	0	0	0
Total	**48**	**59**	**85**	**80**	**26**	**60**

Table 2: Breeds of cows slaughtered during the early and late dry season

	May	**June**	**July**	**August**	**September**	**October**
White Fulani	47	31	69	57	23	33
SokotoGudali	12	20	21	31	13	11
Red Bororo	18	6	10	11	5	9
Crosses	2	0	3	0	0	0
Total	79	57	103	99	41	52

Table 3: Mean slaughter, fetal losses and percentages of the fetuses of cows during the early and late rainy seasons

	Average Monthly Slaughtered	**No of fetal losses**	**Means**	**Percentages**
May	56.84	48	1.55	13.41
June	63.80	59	2.63	16.48
Juy	78.06	85	2.74	23.74
August	68.77	80	2.58	22.35
September	37.27	26	0.87	7.26
October	67.16	60	1.94	16.76

Table 4: Mean slaughter, fetal losses and percentages of the fetuses of cows during the early and late dry seasons

	AverageMonthly Slaughtered	No of fetal losses	Means	Percentages
May	74.23	103	3.43	23.90
June	76.20	99	3.41	22.97
Juy	87.45	41	1.32	9.51
August	79.45	52	1.73	12.06
September	61.32	79	2.63	18.33
October	59.15	57	1.84	13.20

The results of slaughtered cows during the early to late rainy season (Table 1) showed that October(60) and August (62) had the highest number of slaughter and the breed mostly slaughtered were the white Fulani and SokotoGudali indicating that the two breeds were more abundant in the area than other breeds such as the Red Bororo.The report agreed with the findings of Taiwo *et al.* (2012) where white Fulani recorded the highest (37.6%) number of slaughtered cattle in Lafenwa abattoir followed by SokotoGudali and Red Bororo 27% each. January and February had the highest number of slaughtered animals (103 and 99 animals, respectively) during the early to late dry season slaughters (Table 2). This is attributed to the period when herdsmen and nomads are yet to move southwards because pastures and cropresidues are still available. Also July and August months had the highest mean average monthly slaughter of cattle (78.06 and 68.77, respectively) and number of fetal losses (23.74 and 22.35%, respectively) (Table 3). This is higher than 8.72% of pregnant cows slaughtered from January to April in Zango abattoir of Sabon Gari Local Government (Duru *et al.*, 2015). The mean slaughter of cattle during the early to late dry season (Table 4) was higher 438.15 than that in the early to late rainy season 371.90 (Table 3).This indicates that majority of families had the purchasing power to buy more meat in the dry period than during the farming season. The high percentage fetal losses in the months of November 23.90 and December 22.90% is buttressed by the fact that the period coincided with Christmas celebrations which agreed with (Matthew, 1992).

CONCLUSION

The high fetal losses in Bauchi central abattoir in both seasons are very alarming because proper checks are not normally carried by the meat inspectors. Post mortem inspections are hardly done as most meat inspectors do report late.Ignorance on the economic loss to the farmer and the nation and the effect on large livestock population will invariably affect the much needed animal protein intake recommended by FAO.

RECOMMENDATION AND ACKNOWLEDGEMENT

The economic dangers of slaughtering pregnant animals with no regards to the rapid increase in human population (cattle in particular) should be made public.

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Perception of Cattle Handlers with Regards to Temperament Traits of *Bunaji* Cattle

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Abstract: The study was carried out to assess the socio-economic background and the perception of cattle handlers with regard to temperament traits of *Bunaji* cattle. Ninety-six (96) questionnaires was analysed from one hundred (100) structured questionnaires administered to handlers of *Bunaji* cattle in Kajuru, Giwa and SabonGari Local Government Areas of Kaduna State respectively. It was observed that fewer (11.50%) females were involved in handling. Majority of the handlers were literate (56%), and havebeeninvolved in rearing of Bunajifor more than ten (10) years (57%) period. Majority of the handlers (32.29%), perceived Bunajicattle as moderately temperamental, while others viewed *it* to be calm (27.08%), nervous (25%), and very nervous (13.5%). Nervous, because they are more reactive, difficult to manage and posing a latent safety threat. Handlers of *Bunaji* cattle identified that the animal exhibits temperament which could pose danger to their handling temperament practices. The bulls and cows were more temperamental than the calves. The respondents also believed that temperament is heritable and can be selected against. Temperament traits in Bunaji cattle could thus be incorporated into a breeding program.

Keywords: Bunaji, Temperament trait, Handling, Dairy cattle

DESCRIPTION OF PROBLEM

Cattle temperament is defined asthe individualbehavioural and physiological differences in response to a stressor or an environmental challenge that is consistent over time or contexts (1). Cattle response to handling manifests itself in a variety of way which constitute an important component of behavioral genetics (2,3). Animals may be sociable, aggressive or emotional by struggling, attempting to escape, vocalize, defecate, increase respiration rates, show changes in their ear, head and tail positions and facial expressions and be more or less motivated to move away from the handling area or handler. Consequently, cattle may steps, kicks or flinches in response to milking procedure(4).Temperament is a functional trait usually associated with workability and has effects on the cattle'ssociability with groups and to human's contact (5)**.**Improving the dairy herd for temperament trait is thus important from both safety and economic standpoint because cattle's which are safer to handle during routine management and several human contact (5,6) have higher productivity such asmilk yield as opposed to cattle with the more aggressive temperament (7,8)**.**The genetic basis for temperament traits has been investigated such that moderate heritability estimates, vast variations in the major handling temperament traits, identification of quantitative trait loci (QTL) have made temperamental traits open to selection (5). There is therefore the need to assess the perception of the handlers of *Bunaji* cattle with regards to handling and milking to establish basis for subsequent genetic improvement for temperament traits. The major aim of this research is to carry out a survey to assess perception of *Bunaji* cattle handlers as regard to temperament traits.

MATERIALS AND METHODS

Purposeful sampling method was employed as 100 questionnaires were served to *Bunaji* cattle handlers comprising 15 Animal Scientist, 10 Veterinary doctors, 15 cattle traders, 45 herders, and 15 crop farmers to assess the socio-economic characteristics and handlers' perception of Bunaji cattle in regard to temperament. The respondents were domiciled in Kajuru, Giwa and SabonGari Local Government Areas (LGAs) of Kaduna state. Field data was obtained using rapid (rural) participatory appraisal (PRA) approach (9)**.**

Data Analysis: The primary data obtained was analysed using simple descriptive statistics such as frequency, and percentage in Microsoft® Excel.

RESULTS AND DISCUSSION

Table 1**:** Ninety-six (96) questionnaires were analysed comprising Animal Scientist (13.54 %), Veterinary doctors, (9.38 %), cattle traders (15.63 %), Herders (47.92 %) and crop farmers (13.54%) respectively. It was observed that fewer (11.50%) females were involved in handling (Table 1), and the reasons proffered by the respondents for this result were; women are involved mostly in situation where there are no capable men who will assist their husbands, and secondly, the form of aggression posed by Bunaji cattle makes it difficult for women to handle and that was the more reason why females were seen selling milk in the neighbouring communities. More than half of the respondents that were involved in the handling of Bunajiwere literate in western education; this is because they viewed cattle business as lucrative in making ends need, whereas, those considered to be unfortunate in western education (43.75%) were into cattle handling because they inherit it from their parent and it is been considered as prestige. This has been explained in literatures as reasons why most herders stick to a particular breed of cattle like the Kuris, SokotoGudali, Rahaji, Muturu and others in Nigeria (10). The variation of handling experiences and in herd sizes (Table 1), gave a wider perspective of Bunaji cattlehandlers as regards their knowledge oftemperament traits.

The perceived temperament of Bunajicattle varied among their handlers (Figure 1). The handlers had been passively selecting against highly temperamental Bunajiover time (56.25%) because more than half of the respondents (51%) perceived temperament as a trait as they observed that the offspring of the cows seems to exhibits the same character with their dams (11). It has been reported (11) thatcattle keepers have been indirectly selecting cattleby breeding only cows which are calm when in contact with people by culling the highly temperamental (8), which mayhave safety implications (5,7,12)**.** It was also observed (Table 2) that most aggressionson the farm is caused by bulls and cows (65 %) especially when carrying out health related activities (37.50%) as shown in Table 2. A high (46.88%) incidence of aggression occurswhen the Buanjiare to be restrained for routine management operations (6.13)**.**

	Parameter	**Anim. Scientist**	**Vet. Doctors**	**Cattle Traders**	**Herders**	**Crop farmers**	**Total**	**(%)**
a	**Handlers**	13(13.54)	9 (9.38)	15 (15.63)	46 (47.92)	13 (13.54)	96	100.00
b.	**Sex**							
	Male	11(11.45)	8 (8.33)	14 (14.58)	41 (42.70)	11 (11.45)	85	88.58
	Female	2 (2.08)	1 (1.04)	1 (1.04)	5 (5.21)	2 (2.08)	11	11.46
	Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96 (100.00)**	
c	**Age (years):**							
	1 - 10.	0.00	0.00	0.00	3 (3.13)	0.00	3	3.13
	11-20.	0.00	0.00	0.00	4 (4.17)	0.00	4	4.17
	21-30.	8 (8.33)	9 (9.37)	6 (6.25)	16 (16.67)	5 (5.21)	44	45.83
	> 30	5 (5.21)	0.00	9 (9.38)	23 (23.96)	8 (8.33)	45	46.88
	Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96 (100.00)**	
d	**Academic qualification**							
	Non-formal	0.00	0.00	3 (3.13)	38 (39.58)	1 (1.04)	42	43.75
	Primary	0.00	0.00	3 (3.13)	4 (4.17)	3 (3.13)	10	10.42
	Secondary	0.00	0.00	3 (3.125)	3 (3.125)	**6 (6.25)**	12	12.50
	Tertiary	13(13.54)	9 (9.37)	6 (6.25)	1 (1.04)	3 (3.12)	32	33.33
	Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96 (100.00)**	
e.	**Experience (years)**							
	< 1	1 (1.04)	0.00	1 (1.04)	1 (1.04)	3 (3.13)	6	6.25
	1—5.	4 (4.17)	8 (8.33)	2 (2.08)	2 92.08)	4 (4.17)	20	20.83
	6 –10.	5 (5.21)	1(1.04)	4 (4.17)	3 (3.13)	2 (2.08)	15	15.63
	➢ 10	3 (3.12)	0.00	8 (8.33)	40 (41.67)	4 (4.17)	55	57.29
	Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96 (100.00)**	

Table 1: continued

	Parameter	Anim. Scientist	Vet. Doctors	Cattle Traders	Herders	Crop farmers	Total	(%)
f	**Herd size**							
	< 50	9 (9.37)	4 (4.17)	14 (14.59)	25 (25.05)	13 (13.54)	64	(66.67)
	51-100.	0.00	1 (1.04)	1 (1.04)	13 (13.49)	0.00	15	15.63
	➢ 100	4 (4.17)	4 (4.17)	0.00	9 (9.38)	0.00	17	17.71
	Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96 (100.00)**	

Values in parenthesis ( ) stands for values in percentages.

Table 2: Test of Knowledge and Perception of Handlers to Temperament Traits in Bunaji Cattle

Parameter	Anim. Scientist	Vet. Doctors	Cattle Traders	Herders	Crop farmers	Total	(%)
Temperament perception							
Very calm	0.00	0.00	0.00	**1 (**1.04)	0.00	**1**	1.04
Calm	1 (1.04)	0.00	2 (2.08)	18 (18.75)	5 (5.21)	**26**	27.08
Moderate	7 (7.29)	5 (5.20)	6 (6.25)	9 (9.37)	4 (4.17)	**31**	32.29
Nervous	5 (5.21)	4 (4.17)	2 (2.08)	11 (11.46)	2 (2.08)	**24**	25.00
Very nervous	0.00	0.00	4 (4.17)	7 (7.29)	2 (2.08)	**13**	13.54
no response	0.00	0.00	1 (1.04)	0.00	0.00	**1**	1.04
Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13(13.54)**	**96**	**(100.00)**
Is temperament Heritable?							
Yes	12 (12.50)	9 (9.37)	9 (9.37))	16 (16.67)	3 (3.12)	49	51.04
No	0.00	0.00	2 (2.08)	10 (10.41)	2 (2.08)	**14**	14.58
don't know	1 (1.04)	0.00	4 (4.17)	20 (20.84)	8 (8.33)	**33**	34.38
Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96**	**(100.00)**
Do you select Bunaji based on temperament?							
Yes	9 (9.38)	4 (4.17)	7 (7.29)	26 (27.08)	8 (8.33)	54	56.25
No	3 (3.13)	5 (5.21)	6 (6.25)	18 (18.75)	2 (2.08)	34	35.42
No response	1 (1.04)	0.00	2 (2.08)	2 (2.08)	3 (3.33)	8	8.33
Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96**	**(100.00)**
Most temperamental							
Bulls > Cows > Calves	5 (5.21)	7 (7.29)	9 (9.38)	18 (18.74)	8 (8.33)	47	48.96
Cows > Bulls > Calves	5 (5.21)	1 (1.04)	4 (4.17)	15 (15.62)	0.00	25	26.04
Cows > Calves > Bulls	1 (1.04)	0.00	0.00	3 (3.33)	0.00	4	4.17
Calves > Bulls > Cows	1 (1.04)	1 (1.04)	0.00	8 (8.33)	3 (3.33)	13	13.54
Don't know	1 (1.04)	0.00	2 (2.08)	2 (2.08)	2 (2.08)	7	7.29
Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96**	**(100.00)**
Most risky management practice							
Loading/weighing/ear-tag/dr	1 (1.04)	0.00	8 (8.33)	0.00	2 (2.08)	11	11.46
Dehorning/castration./foot tr.	1 (1.04)	2 (2.08)	3 (3.33)	1 (1.04)	4 (4.17)	11	11.46
Pregnancy examination	1 (1.04)	0.00	0.00	0.00	0.00	1	1.04
Parasites control	1 (1.04)	0.00	0.00	34 (35.42)	1 (1.04)	36	37.50
Vaccination/medication/dos	3 (3.33)	2 (2.08)	4 (4.17)	8 (8.33)	6 (6.25)	23	23.96
Udder cleaning/ milking	2 (2.08)	0.00	0.00	3 (3.33)	0.00	5	5.21
All of the above	4 (4.17)	5 (5.21)	0.00	0.00	0.00	9	9.38
Total	**13 (13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96**	**(100.00)**
Places of cattle aggression							
On handling facilities	4 (4.17)	5 (5.21)	9 (9.38)	24 (25.00)	3 (3.33)	45	46.88
On the field at grazing	6 (6.25)	3 (3.33)	3 (3.33)	15 (15.63)	2 (2.08)	29	30.21
In pens or yards	3 (3.33)	1 (1.04)	3 (3.33)	7 (7.29)	8 (8.33)	22	22.92
Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96**	**(100.00)**

Values in parenthesis ( ) stands for values in percentages, tr: trimming, dos: dosing, dr: draft.

CONCLUSION

Handlers of *Bunaji* cattle identified that the animal exhibits temperament which could pose danger to their handling temperament practices. The bulls and cows were more temperamental than the calves. The respondents also believed that temperament is heritable and can be selected against. Temperament traits in *Bunaji* cattle could thus be incorporated into a breeding program.

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Consumers' Preference and Perception on Meat among Public Servants in Ibadan South West Local Government Area

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Abstract: The study characterized the types of meat consumed, potential determinants of meat consumption, as well as the forms preferred by Public Servants of Research Institutes within Ibadan South West Local Government Area, Oyo State. 200 questionnaires were distributed and 137 were returned and analyzed for the study. Questions bothering on the types of meat consumed, the reason for the choice of preferred meats, the forms of meat consumed and locations where they buy meat. Simple percentages and frequencies were used in the analysis of the results. The most consumed meat type was cow meat (95%) while the least consumed meat type was quail meat. Top among the factors that determined the choice of meat were nutrient (23%), and taste (19%). The commonest form of meat consumption is at its boiled state (68%) while the least consumed forms were roasted (17%) and grilled meat (10%). In the study, 93% of the respondents indicated that they buy meat from local markets, while 7% indicated they buy meat from meat shops and supermarkets.

Keywords: Choice, Consumption, Meat, Perception, Public Servant

INTRODUCTION

Food is an important aspect of human existence and survival. Meat and meat products are rich sources of nutrients that enhance human growth and development. According to Pereira and Vicente (2013), meat has high value biological protein and vitamin and facilitates the development of the gastrointestinal tract, cranio-dental features (teeth, jaw, etc.) and posture. Its consumption in adequate quantities ensures normal functioning of the immune system, mucous membranes and metabolic processes (Biesalski, 2005).

Protein is necessary for the growth, maintenance and repair of all body tissues. These proteins can be derived from either animal or plant source. Nutritionists have suggested that animal proteins have superiority over plant proteins because animal proteins contain all the essential amino acids, as opposed to plant proteins which can be deficient in one or more of these essential amino acids (Britton, 2003; Oloyede, 2005).

In Nigeria, meat, fish and animal products are the fourth most commonly consumed food group (88.9%) by households. Its consumption lags behind grains and flours (97.2%), oils and fats (96.8%) and vegetables (96.7%). The type of meat consumed in Nigeria and other developed countries is affected by consumer's preference, the standard of living, religious belief, culture, income, food habit, colour, flavour, age, sex, socio-economic factor and individual variations (Desmond, 1990). Meat as a significant portion of the normal diet, contributes more than 15% to daily energy intake, 40% to daily protein intake, and 20% to daily fat intake (Hiza et al., 2008).

It is on the background of this that this study has been designed to estimate the relative perception of respondents on variousmeat types, as well as determine factors which influence the consumption of meat products by households in the study area.

MATERIALS AND METHODS

The target group was public servants in research institutes in Ibadan Southwest Local Government area of **Ibadan Municipality**. National Centre for Genetic Resources and Biotechnology (NACGRAB), National Cereals Research Institute (NCRI) and Institute of Agricultural Research and Training, Moor Plantation, Ibadan, Nigeriawere the study sites.

A total number of 200 questionnaires were distributed out of which 137 questionnaires were returned by staffs of the three institutes. The data collected pertained to:

i. General information from individual respondents on their social and economiccharacteristics
ii. Type of meat consumed
iii. Frequency of consumption
iv. Average amount spent on meat consumption

SPSS 21 was used in analyzing the data collected. Frequency tables and descriptive statistics were employed.

RESULTS AND DISCUSSION

Table 1: Demographic Characteristics of Staffs of Research Institutes in Ibadan South west

S/No	Characteristics		Frequency	Percentage%
1.	Gender	Male	79	58
		Female	58	42
2.	Age (yrs)	18-30	42	31
		31-40	54	39
		41-60	28	20
		Above 60	11	8
3.	Marital status	Single	43	31
		Married	92	67
		Divorced	1	1
		Others	1	1
4.	Religion	Christianity	118	86
		Islam	18	13
		Others	1	1
5.	Education	No education	1	1
		Primary	3	2
		SSCE	7	5
		ND	22	16
		HND/Bachelor	65	47
		Masters	22	16
		Ph.D	5	4
6.	Monthly income	Below 18,000	3	2
		18,000-50,000	36	26
		50,000-100,000	47	34
		100,000-150,000	28	20
		Above 100,000	14	10
7.	Household income	Below 50,000	19	14
		50,000-100,000	33	24
		Above 100,000	38	28

SSCE: Senior School Certificate Examination ND: National Diploma HND: Higher National Diploma
Ph.D: Doctor of Philosophy

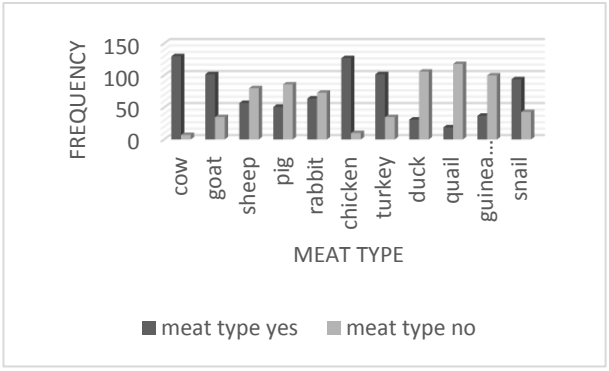

Figure 1. Consumption of different meat types

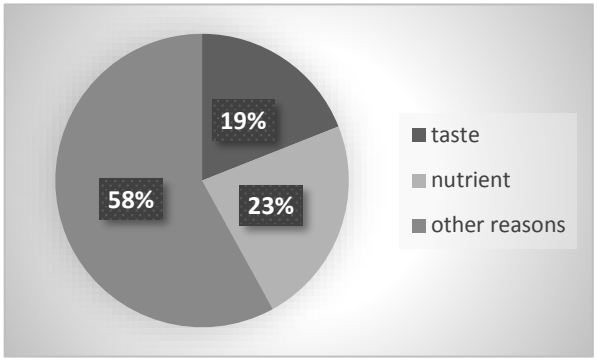

Figure 2. Factors that Affect Meat Consumption of respondents

Figure 3: Meat Consumption Formsby respondents

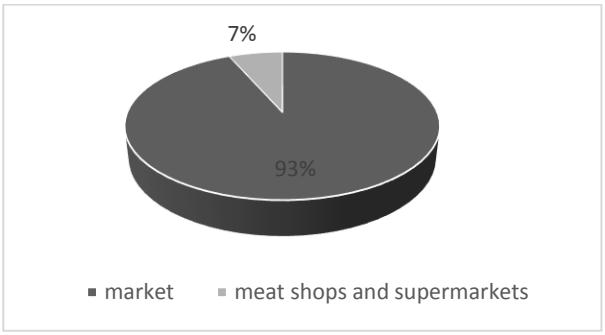

Figure 4: Meat market location of respondents.

The personal profile of the respondents is shown in Table 1. In this study,67% of the respondents were married, 31%were single 31% while 0.7% were divorced. 86%of the respondents were Christians, 13% were Muslims and 0.7% indicated that they belong to other religions. This is in tandem with Ogunwole and Adedeji, (2014) who reported more Christians in their study on consumers' preference and perception of the different types of meat among staff and students of the University of Ibadan, Nigeria.

Report based on the age of the respondents, shows that 42% belong to the age bracket of 18-30 years, 39% belong to 41-50 years, 20% to 50-60 years and 8% are above 60years of age. It alsorevealed that 0.7% had no primary education, 2.2% had primary education and 88% had at least secondary education.
Based on monthly income earned, 28% of the respondents had an average monthlyincome of less than N50, 001, while 54% have a monthly income of less than N150,001 and 10% have an average monthly income of over N150,000.

In Figure 1, the consumption of the different types of meat by respondents was shown graphically as 95% of total respondents indicated they consume cow meat, while the remaining 5% do not consume cow meat. This result agrees with earlier reports (Ikpi, 1990; FAO, 2006; Akinwumi *et al.* 2011; Emakoro and Adamasun, 2012) that cow meat was the most consumed meat in Nigeria and may be due to the cheaper cost and its availability. Other meat types commonly consumed by respondents are chicken, goat, turkey, snail, rabbit, sheep, and pig. The least consumed meat is quail meat which may be attributed to it inadequate supply as reported by Faith *et al.* (2017).
Top among the factors as provided by the respondents that determined their choice of meat were taste (19%), nutrient (23%) as shown in Figure 2. Other factors include availability, income, religious beliefs and personal preferences. This was consistent with the report of Tsegay (2012) that the high degree of variation in meat consumption could be due to availability, cost, sensory value, income level, religion and socio-cultural factors.

Figure 3 gives an overview of forms in which the respondents consume meat. 68% of the respondents consume boiled meat and the least consumed form were roasted (17%) and grilled meat (10%). This may be attributed to cost of grilled and roasted meat, as well as the recent warnings on the consumptions of roasted or grilled products which has been implicated in the diagnosis of cancer (Jägerstad and Skog, 2005) as the surveyed respondents were informed members of the society.

Figure 4 shows that 93% buy their meat from local markets with 7% buying from meat shops and supermarket. The choice of this market is as a result of their proximity to the residences of the respondents and or their office locations.

CONCLUSION

1. Cow meat is a common meat type by public servants of research institutes in Ibadan South-West.
2. Taste, nutrients, availability and cost of meat are some factors which affect the choice of meat consumed.

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Adoption of Improved Technologies on Pig Production among Farmers in Ifako-Ijaye, Lagos State

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Abstract: The adoption of improve technologies on pig production among farmers in Ifako-Ijaye, Lagos state was assessed in this study. A well-structured interview schedule was used to obtain information from the respondents. Data were collected on socio-economic characteristics of respondents and extent of adoption of improved technologies among the respondents. A score was assigned for the adoption of each of the practices as: Non-adoption=0, Partial adoption = 1 and Complete adoption = 2. The total score for a respondent was obtained by summing up the score obtained on each practice. Depending upon the extent of adoption of improved technologies the respondents were recognized as Low adopters (up to 33%), Partial adopters (34-66%) and High adopters (67-100%). Data was subjected to descriptive statistics. Result shows that most of the respondents were within the age range of 38-42 years (20.0%) and older than 47 years (20.0%) years, they were female and were married. Most of the respondents had formal education. Result also revealed that most (56.2%) of the respondents highly adopted improve technology on feeding practices while most of the respondents partially adopted improve technology on housing (65.4%), breeding (95.4%) and health care (75.4%). However, most of the respondents were low adopters of improved technology on animal identification (66.1%). Conclusively, overall adoption of improved technologies of pig production by respondents was partial.

Keywords: Adoption, production, respondents socio-economic, technology

INTRODUCTION

Over the years, pig farming has emerged as an effective enterprise. Pigs are monogastric simple stomach animal with a high survival rate that have the ability to utilize a host of agro-industrial by-products and crop residues, with little or no processing and at minimal cost (Tewe and Adesehinwa, 1995). Pig population in Nigeria in the recent years has shown a noticeable increase from nearly two million pigs in 1984 and rose to seven million in 1997. In 2002 it declined to five million one hundred thousand (FAO, 2003).

In many developing countries including Nigeria, lack of appropriate technological and scientific knowledge application limits agricultural and economic progress. A farmer is a rational decision maker who normally strives for a better standard of living and seeks ways of adopting new technologies to accomplish his goal (Nell *et al*., 1998). If agricultural technologies developed for farmers in developing countries are not transferred in appropriate manner and adopted accordingly, all the efforts by the researchers who developed such technologies would be in vain (Rahman 2007). There is therefore a need to identify factors that contribute positively to the adoption of pig production technologies as well as those that represent main constraint for the diffusion/ adoption process (Nell *et al* 1998). This study therefore sought to assess the adoption of improved technologies on pig production among farmers in Ifako-Ijaye, Lagos state.

MATERIALS AND METHODS

The study was conducted in Ifako-Ijaiye, a city and Local Government Area (LGA) in Lagos state, Nigeria. It has a land area of 43 square kilometres (17sqml). Ifako-Iijaiye LGA was purposively selected because of the predominance of pig farmers in the area. The list of pig farmers was generated from which 130 pig farmers as respondents were randomly selected. A well-structured interview schedule was used to obtain information from the respondents. Data were collected on socio-economic characteristics of respondents and extent of adoption of improved technologies among the respondents which were collected on seven selected practices, namely: housing, breeding, feeding, health care, record keeping, identification and general care and management.

A score was assigned for the adoption of each of the practices as: Non-adoption=0, Partial adoption = 1 and Complete adoption = 2. The total score for a respondent was obtained by summing up the score obtained on each practice. The minimum score an individual could get was 0 and maximum score was 10. The adoption level of

the respondents was measured by making use of adoption index developed by Karthikeyan (1994). Adoption index = (Respondents' total score / Total possible score) X 100. Depending upon the extent of adoption of improved technologies the respondents were recognized as follows: Low adopters (up to 33%), Partial adopters (34-66%) and High adopters (67-100%). Data was subjected to descriptive statistics using SPSS (V.22)

RESULTS AND DISCUSSION

Table 1 shows the results of socio-economic characteristics of the respondents. Result shows that most of the respondents were within the age range of 38-42 (20.0%) and >47 (20.0%) years. The mean age of the respondents was 38.6 years. The result of this study indicates that majority of the respondents are still in their economically active ages (Popoola *et al*., 2017). Result shows that majority of the respondents were female (50.8%), while 49.2% of them were male. This implies that more females were involved in pig production than their male counterparts. This shows that women are also involved in agricultural and other income generating activities in addition to their traditional, reproductive, household and community management roles (Odebode and Popoola, 2016). Majority of the respondents were married (76.9%), this is expected that since majority of the respondents were within the age bracket of 38-42 years. Most of the respondents had formal education (78.4%) at the level of tertiary and secondary education which implies that most of them can read and write. Thus, this will enhance better communication as well as adoption of innovation. The result revealed that most of the respondents were Christians (71.5%), few of the respondents were Muslims (25.4%), and (3.1%) of the respondent were traditionalist. The result of the respondents in terms of their religious affiliation is as a result of religious taboo on pig consumption such that Islamic religion prohibits the consumption of pork which will affect the involvement of Muslims in production and raising of pigs. Household size is an important variable that determines the total household food requirement and thus, affect per capita food consumption and household food security. The result shows that majority the respondents had a household size of between 5-10 members (52.3%), the mean household size of the respondents was 6 members. The result of the study shows that most of the respondents had been involved in pig production for 3-7 years (33.8%). The years of experience of respondents in pig production is important in determining the scale of production and their productivity levels (Popoola *et al*., 2017). This study presents the various primary occupations engaged in by the respondents. Result shows that most of the respondents were traders (45.4%), while other occupations like farming (36.2%), civil service (9. %) and artisans (9.2%) were practiced by the respondents. This implies that the main source of livelihood for most of the respondents was trading it also implied that respondents are not only involved in one income generating activities, but rather in different ones as means of increasing their income so as to improve their livelihood. The result reveals that majority of the respondents earned less than 18,000 (46.2%). The remarkable difference in income realized is due to differences in the primary occupation of the responds (Popoola *et al*., 2017). The mean income of the respondents was N 21.3

Table 1: Socio-Economic Characteristics of Respondents

Variables	Frequency (N = 130)	Percentage (%)	Mean	Variables	Frequency (N = 130)	Percentage (%)	Mean
Age (Years)				**Educational Level**			
<18	2	1.5		No Formal Education	11	8.5	
18-22	6	4.6		Primary	17	13.1	
23-27	12	9.2		Secondary	57	43.8	
28-32	22	16.9	38.6	Tertiary	45	34.6	
33-37	19	14.6		**Religion**			
38-42	16	12.3		Islam	33	25.4	
43-47	17	13.1		Christianity	93	71.5	
>47	36	27.7		Traditional	4	3.1	
Sex				**Household Size (Person)**			
Male	64	49.2		<5	27	20.8	

Female	66	50.8		5-10	68	52.3	6
Marital Status				11-15	31	23.8	
Single	22	16.9		>15	4	3.1	
Married	100	76.9		**Income (N)**			
Divorced	2	1.5		<18000	60	46.2	
Widow	6	4.6		18000-22000	37	28.5	
Years of Experience (Years)				23000-27000	14	10.7	21349.00
<3	39	30.0		28000-32000	9	6.9	
3-7	44	33.8		33000-37000	8	6.2	
8-12	29	22.3	11.4	>37000	2	1.5	
13-17	14	10.8		**Occupation**			
18-22	1	0.8		Farming	47	36.2	
>22	3	2.3		Trading	59	45.4	
				Civil Service	12	9.2	
				Artisan	12	9.2	

This result shows that majority of the respondents adopted improved technology on feeding practices at higher level (56.2%) in their farms. The mean adoption score for feeding practices was found to be 78.3. Most of the respondents partially adopted improved technology on housing (65.4%), breeding (95.4%), and health care (75.4%). The mean adoption score for housing, breeding and health care were 61.2, 65.2 and 61, respectively. However, most of the respondents were low adopters of improved technology in respect of animal identification. The mean adoption score for animal identification was 31.7. The result of this study reveals that generally, overall adoption of improved technologies of pig production by respondents was partial. This implies that although the adoption of improved technologies on pig production was partial, there is potential drift towards high adoption level by the respondents. This result disagreed with report of Rahman (2007) who reported that most of the respondents adopted improved technology on breeding and health care practices on pig production at higher level. The overall partial adoption of the improved technology as obtained in this result agreed with the report of Rahman (2007).

Table 2: Adoption of Improved Technology of Respondents

Technology	Level of Adoption	Score Index (%)	Frequency	Percentage	Mean
Housing	Low Adopters	0- 33	44	33.8	
	Partial Adopters	34-66	95	65.4	61.2
	High Adopters	67-100	1	0.8	
Breeding	Low Adopters	0- 33	4	3.1	
	Partial Adopters	34-66	124	95.4	65.2
	High Adopters	67-100	2	1.6	
Feeding	Low Adopters	0- 33	3	2.3	
	Partial Adopters	34-66	54	41.6	78.3
	High Adopters	67-100	73	56.2	
Identification	Low Adopters	0- 33	102	66.1	
	Partial Adopters	34-66	23	30.0	31.7
	High Adopters	67-100	5	3.8	
Management	Low Adopters	0- 33	60	46.2	
	Partial Adopters	34-66	51	39.2	55.4
	High Adopters	67-100	19	14.6	
Health Care	Low Adopters	0- 33	31	23.8	
	Partial Adopters	34-66	98	75.4	61.0
	High Adopters	67-100	1	0.8	

CONCLUSION

Based on the results of this study, it was concluded that most (56.2%) of the respondents highly adopted improve technology on feeding practices while most of the respondents partially adopted improve technology on housing (65.4%), breeding (95.4%) and health care (75.4%). However, most of the respondents were low adopters of improved technology on animal identification (66.1%). Generally, overall adoption of improved technologies of pig production by respondents was partial.

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Performance and profitability analysis of broilers chickens fed graded levels of baobab *(adansonia digitata)* pulp meal at the finisher phase

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Abstract: The experiment was conducted to evaluate the performance of broiler chickens fed graded levels of baobab (*Adansonia digitata*) pulp meal (BPM) at the finisher phase. Three hundred broiler (Anak) chickens were allotted to five treatments replicated thrice with 20 birds per replicate in a completely randomized design (CRD). The inclusion levels of the BPM in the diets were 0, 5, 10, 15 and 20% for treatment 1 (Control), 2, 3, 4 and 5, respectively. The experiments lasted for four weeks. Data collected were subjected to analysis of variance and significant differences among treatment means were compared using the Dunnet Test. Results showed a significantly lower feed intake (103.37-104.69g) ($P<0.05$) in birds fed 10, 15 and 20 % baobab pulp meal (BPM). Higher ($P<0.05$) daily weight gains of (47.21-47.55g) were recorded in birds fed 0%, 5% and 10% BPM. Birds fed 0%, 5% and 10% BPM were more efficient in feed utilization (2.17-2.22). It can be concluded that Baobab pulp can be included in finishing diets up to 20% but the optimum levels of inclusion was 5%.

Keywords: Baobab, Broiler, Economic, Finisher, Performance and Pulp

INTRODUCTION

The prices of animal products are beyond the reach of the average Nigerian owing to the increase in the production and maintenance cost of farm animals. This has necessitated the renewed interest in g the incorporation of neglected or underutilized energy feedstuff in broiler feed. Several workers have emphasized the need for the use of unconventional feedstuff as an alternative feed ingredient, as well as the use of human and industrial waste as livestock feed ingredients (Durunna *et al*., 1990; Fanimo *et al*., 2007). Not much has been done in evaluating the potential feed value of some multipurpose tree products such as baobab *(Adansonia digitata).* Medugu *et al.* (2011) reported that the tremendous decrease in poultry production is as a result of high cost of protein and energy feedstuffs especially cereal grains (maize) which form the bulk of energy in poultry feeds. The high cost of convetional protein and energy feedstuffs is as result of of the competition between human and animals for the available feed resources coupled with constant drought. The objectives of the study is to determine effect of feeding baobab (*Adansonia digitata*) pulp on the performance and the cost of production of broiler chickens.

MATERIALS AND METHODS

Source of Baobab Fruit: Baobab fruit used for this experiment were harvested at mature stage which was indicated by the hard brown colour of the ectoderm from the trees using locally made equipment around Mamudo, Danchuwa, Alaraba and Mele in Potiskum Local Government area of Yobe State, Nigeria.

Processing: Dried baobab fruits were processed by cracking open the hard shell of the baobab fruits using a small hammer to remove the inner contents (epicarp), and pounded using a mortar and pestle while the seed and pulp were separated using a sieve. The pulp was slightly milled and separated from the unwanted coarse material using a fine mesh.

Experimental Site: The feeding trialwas conducted at the Teaching and Research farm (Poultry unit) of the Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University Zaria. Zaria is located within the Northern Guinea Savannah of Nigeria with an average annual rainfall, relative humidity and temperature of

1,100 mm, 75% and 24.4^{O} C respectively, on Latitude 11^{o} 12'N and Longitude 7^{o} 33'E at an altitude of 610m above sea level (Ovimap, 2014).

Experimental design and management: Three hundred (300) broiler chicks (Anak) were purchased from Zarm Farm. The birds were vaccinated against Newcastle disease (intra ocularly) on the day of arrival and brooded together for three days using kerosene stoves and electricity bulbs as sources of heat and light. They were fed a common diet during this period. The birds were subsequently weighed and allotted to five dietary treatments. The birds were housed in a deep litter system in a completely randomized design. The treatments were replicated three times with twenty chicks per replicate. The feeding trial lasted for eight weeks. Feed and water were provided *adlibitum.*

Experimental diets: The composition and calculated analysis of the experimental diets are presented in Tables 1. The test ingredient was included in the broiler finisher diets at 0, 5, 10, 15 and 20% representing treatments 1 (control), 2, 3, 4 and 5, respectivelyThe diets were isonitrogenous (20% CP) and isocaloric (2950 Kcal/Kg) and met the recommended crude protein and metabolisable energy requirements as stated by NRC (1994). The diet was fed for four (4) weeks.

Parameters determined in the experiment

- **Performance:** The birds' performance such as feed intake, weight gain, feed conversion ratio were measured weekly while mortality was recorded as it occurred and the cost of experimental diets were calculated based on the prevailing market price at the time of the experiment.
- **Profitability of Production:** The profitability of broiler production was estimated using budget analysis and profitability ratios (Adeoti and Olawumi, 2013). The budget analysis involves the deduction of the total variable cost (Naira) from the total revenue of live birds (in Naira) to obtain the gross margin for each bird. The total variable costs of production are the cost of day old chicks, labour, feed, veterinary service, medication and other miscellaneous expenses. That is Gross margin is equal to Gross revenue minus Total variable cost. It was calculated by the given formula as follows:

$$GM = \sum_{i..1}^{n} PiYi - Ci$$

Where: GM = Gross margin
Pi = Price per Kg of meat
Yi = Total live weight in kilogram of meat
Ci = Total variable cost incurred on bird
I…n = Total number of birds.

The profitability ratios include the benefit cost ratio (BCR), the profitability index (PI) and the rate of return on investment (ROI). Calculated as follows

Benefit cost ratio (BCR) = $\frac{TR}{TC}$

Profitability index (P1) = $\frac{NP}{TR} = \frac{GM}{TR}$

Rate of return on investment (ROI) = $\frac{NPX\ 100}{TC} = \frac{GMX\ 100}{TC}$

Where: TR = Total revenue (value of the total live weight of a broiler), TC = Total cost of production of a broiler, NP = Net profit of a broiler production

Data Analysis: All data collected were subjected to analysis of variance (ANOVA) using the General Linear Model Procedure of SAS 9.2 (2002). Significant differences among treatment means were compared using Dunett multiple ranged in the SAS Package.

The model for this design was as follows:

$X_{ij} = \mu + t_i + e_{ij}$

Where: Xij = any observation made in the experiment, μ = the population mean, t_i = Effect due to treatment added or treatment effect, Eij = Experimental error.

RESULTS AND DISCUSSION

Table 1: Composition and calculated analysis of the experimental diet (finisher).

Ingredient (%)	**Inclusion levels of baobab pulp meal (% BPM)**				
	0	**5**	**10**	**15**	**20**
Maize	55.50	50.50	45.45	39.15	33.95
Baobab Pulp Meal	0.00	5.00	10.00	15.00	20.00
G/nut cake	15.15	15.25	16.00	16.80	17.00
Soybeans meal	15.00	15.00	15.00	15.00	15.00
Maize offal	10.00	10.00	10.00	10.00	10.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	0.30	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.30	0.20	0.00	0.00	0.00
*Pre-mix	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated					
ME (Kcal/Kg	2952.55	2956.25	2955.76	2955.67	2960.14
Crude protein	20.28	20.23	20.14	20.24	20.16
Crude fibre	3.55	3.79	4.07	4.35	4.59
Ether extract	4.07	4.27	4.50	4.73	4.93
Calcium	1.10	1.12	1.14	1.16	1.18
Av. Phosphorus	0.63	0.63	0.63	0.63	0.63
Lysine	1.11	1.12	1.17	1.18	1.24
Methionine	0.51	0.53	0.56	0.58	0.60
Cost (₦/Kg)	89.70	79.56	76.49	75.40	74.62

*Bio-mix finisher supplied/kg: Vit.A = 2125IU, Vit.D3 = 375IU, Vit.E = 2.50mg, Vit.K_3 = 0.375mg, Vit.B_1 = 0.400mg, Vit.B_2 = 1.00mg, Niacin = 5.00mg, Panthothenic Acid = 1.25mg, Vit.B_6 = 0.375mg, Vit.B_{12} = 0.003mg, Folic Acid = 0.125mg, Biotin H2 = 0.188mg, Choline 0.225mg chloride = 43.75mg, Cobalt = 0.05mg, Copper = 0.75mg, iodine = 0.25mg, Iron = 5.00mg, Manganese = 10.00mg, Zinc = 7.50mg, Selenium = 0.05mg, Anti-oxidant= 0.313mg, BPSM = Baobab pulp-seed meal, G = Ground, Av. = Available

Table 2: performance of broiler chickens (finisher) fed graded levels of baobab pulp meal.

Parameter	**Inclusion levels of baobab pulp meal (% BPM)**					
	0	**5**	**10**	**15**	**20**	**SEM**
Live weight (g)	749.20	749.21	749.24	749.18	750.00	4.70
F /I/Day (g)	103.37^{b}	104.64^{b}	104.69^{b}	107.88^{a}	109.80^{a}	1.92
Final Weight (g)	2080.50^{a}	2076.40^{a}	2071.00^{a}	1959.40^{b}	1928.50^{b}	38.46
W/G/Day (g)	47.55^{a}	47.40^{a}	47.21^{a}	43.22^{b}	42.09^{b}	2.72
FCR	2.17^{a}	2.22^{a}	2.22^{a}	2.55^{b}	2.62^{b}	0.07
Feed Cost (₦)	89.70	78.56	76.49	73.40	71.62	
T/Feed Cost (₦)	257.36	230.14	224.11	221.63	220.24	
C/Red. (₦)	0.00	27.05	33.25	35.40	37.12	
Cost/Gain (₦/g)	0.19	0.17	0.18	0.18	0.19	
Mortality (%)	1.27^{a}	0.63^{c}	0.95^{b}	1.25^{a}	1.27^{a}	0.02

[abcd] = Means within row with different superscript differ significantly ($P<0.05$).

F/I = Feed intake; FCR = Feed conversion ratio; T = Total; C = Cost; W = Weight; G = Gain

Table 3: Economic analysis of broiler chickens fed graded level of baobab pulp meal

Parameter	Inclusion levels of baobab pulp meal (% BPM)					
	0	**5**	**10**	**15**	**20**	**SEM**
L/W (g)	2052.40[a]	2076.40[a]	2071.00[a]	1959.40[b]	1928.50[b]	40.66
T/F/C (₦)	381.21[a]	347.07[b]	339.03[c]	336.40[c]	337.40[c]	3.38
T/P/C (₦)	679.54[a]	645.40[b]	637.42[c]	634.73[c]	635.73[c]	3.38
TR (₦)	1,231.40	1,245.80	1,200.50	1,175.60	1,157.10	76.78
GM (₦)	551.90[b]	600.41[a]	563.16[b]	540.91[bc]	521.37[c]	23.53
BCR	1.82[c]	1.93[a]	1.88[b]	1.85[b]	1.82[c]	0.04
PI	0.45[b]	0.48[a]	0.47[a]	0.45[b]	0.45[b]	0.01
ROI (%)	81.51[c]	93.01[a]	88.31[b]	85.14[b]	81.97[c]	3.61

[abc], = Means within row with different superscript differ significantly (P<0.05).L/W = Live weight; T/F/C = Total feed cost; TR = Total revenue; GM = Gross magin; BCR = Benefit cost ratio; PI = Profit index; ROI = Rate of return on investment.

The effects of feeding graded levels of baobab (*Adansonia digitata*) pulp on finisher birds are shown in Table 2. The average daily feed intake ranged from 103.37 – 109.80g. Significantly (P<0.05) higher values of 107.88g and 109.80g daily feed intake were recorded in birds fed 15% and 20% BPM while no significant (P>0.05) differences were observed in birds fed 0%, 5% and 10% BPM in daily feed intake. The increase in feed intake observed was due to sweetness of the pulp. Pulp is very sweet depending on the species and geographical location and the pulp sweetness is provided by fructose, sucrose and maltose contents of the pulp. According to Murray *et al.* (2001), sugars in the baobab pulp account for about 35.60% of the total carbohydrate content, which explained the noticeable sweet taste of the pulp and definitely increased feed intake of the birds.

The values recorded in this study for final weight and daily weight gain ranged from 1928.50 – 2080.50g and 42.09 – 47.55g, respectively. Significantly (P<0.05) higher values 2080.50g, 2076.40g and 2071.00g final weight were recorded in birds fed 0%, 5% and 10% respectively while significantly (P<0.05) lower values 1959.40g and 1928.50g final weight were recorded in birds fed 15% and 20% BPM, respectively. The differences observed across the treatment groups 1, 2 and 3 in daily weight gain were not significant (P>0.05). The result of this study agree with the finding of Bolu and Olutunde (2009) who reported that proportionate increase in weight gain when birds are fed with increasing levels of baobab fruit pulp. But finding disagree with the work of Adeosun *et al.* (2013) who reported significant (P<0.05) decrease in final, total and daily weight gain when baobab pulp fed to layers beyond 10.5% and also Sola-Ojo *et al.* (2013) who reported insignificant (P>0.05) effects of diets was observed in the final weight, total weight gain and average daily gain of broilers fed dietary levels of Baobab pulp. Feed conversion ratio (FCR) recorded ranged from 2.17 – 2.62 (Table 2). Significantly (P<0.0) higher values 2.55 and 2.62 were recorded in birds fed 15% and 20% BPM while significantly (P<0.05) lower values 2.17, 2.22 and 2.12 were recorded in birds fed 0%, 5% and 10% BPM. This implies that feed utilization efficiency was better at 0% BPM, 5% BPM and 10% BPM, inclusion level, while poor utilization of feed was observed at 20% BPM and 15%BPM inclusion.

The insignificant (P>0.05) difference observed between birds fed 0% BPM , 5% and 10% BPM is a testimony of the efficacy of BPM to replace conventional feed stuff in broiler diets up to 10% BPM as FCR is a good indicator of how well livestock utilize feed intake for weight gain. This agrees with the work of Egbewande *et al.* (2012) who reported non-significant (P>0.05) differences among layers fed diets containing baobab pulp, amaranthus leaves and tiger nut seed which significantly (P<0.05) influenced the birds positively.

The feed cost per kilogram of feed, total feed cost, cost reduction and cost per Kilogram gain ranged from ₦71.62 - ₦89.70, ₦220.24 - ₦257.36, ₦0.00 – ₦37.12 and ₦173.42 – ₦193.29 respectively. Higher cost of feed (₦89.70), total feed cost (₦257.36), and zero cost reduction and cost per kilogram gain (₦193.29) were recorded

in birds fed 0% BPM lower values were recorded in test diet (BPM) The cost of feed was proportionally related to the BPM inclusion level, this showed that the cost of producing one kilogram of feed reduced as the inclusion level of BPM increase. This is also in line with the main objectives of usage of unconventional feed stuffs as reported by some workers (Bawa *et al.*, 2003 and Abeke *et al.*, 2008). This result also agreed with the value reported by Nworgu *et al.* (1999) (₦81.27 – ₦93.91) and Nworgu (2002) ((₦69.90 – ₦97.82), but lower than the values reported by Jegede (2006) ((₦137.48 – ₦157.62). The variation could be due to test ingredients used, cost of feed stuff and season of the year the experiment was carried out. The mortality recorded in this study ranged from 0.63 – 1.27%.

The profitability index indicates that for every one naira earned as revenue, 45 kobo, 48 kobo 47 kobo, 45 kobo and 45 kobo were returned as profits in the present study. The total feed cost for this study ranged from 52.07-56.10% of the total cost of production and this was lower than 75 - 80% reported by the previous workers (Nworgu *et al.*, 1999 and opera, 1999). The reduction in the total feed cost recorded in this study was as a result of the drop in the prices of maize and baobab pulp used in feed formulation. The cost of day-old chicks constituted 19.13-20.48% of the total cost of production which is lower than 24-25% of the total cost of production (Adeoti and Olawumi, 2013). The difference might be due to differences in the source of day-old chicks and time of the purchase and the cost of medication was 2.10-2.25% of the total cost which was lower than 4% of the total cost of production (Khan *et al*., 2004). The benefit cost ratio ranged from 1.82 to 1.93 which is higher than 1.34 reported by Mohsin *et al*. (2008) for broiler production and the profitability index ranged from 0.45-0.48 which was within the range of 0.48-0.52 reported by Nworgu(2007).The rate of return on investment (81.57-93.01%) fell within the range reported by Ngworgu (2007) who reported a range of 76.2-106.04%. No significant (P>0.05) differences were observed in all mention parameters among the treatment groups except for birds fed 0% BPM and 10% BPM which was significantly (P>0.05) lower than the other treatment groups. Higher total revenue gross margin, benefit cost ratio, profit index and rate of return on investment was found in birds fed 5% BPM and lower in bird fed 20% BPM but insignificant (P>0.05) differences were observed, this implies that profitability was higher at most level of BPM inclusion compared to 0% BPM.

CONCLUSION

It can be concluded that Baobab pulp can be included in broiler chickens diets up to 20% but the optimum levels of inclusion was 5%, It has the reduced feed cost of broiler chickens thereby increasing profitability and protein supply to the greater populace.

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Effect of Storage Condition on Chemical Properties of Japanese Quail and Chicken Eggs

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Abstract: The study was conducted to determine the effect of storage condition on protein and lipid oxidation in chicken and Japanese quail's eggs. A total of 192 freshly laid chicken and quail table eggs (96 per species) were obtained and stored at two different temperatures; ambient temperature (27.9^0C – 30.1^0C) and refrigerator (4^0C). Data were obtained on protein oxidation and lipid oxidation by measuring the carbonyl value and the thiobarbituric acid reactive substance (TBARS) value respectively in the eggs of the two species. The chicken eggs had a significantly higher TBARS value. The carbonyl content of theeggs also increased with length of storage period but values were not significantly different in the two species. Storage conditions had effect on the rate of deterioration in the two species with eggs in the refrigerator having significantly lower ($p<0.05$) content of the carbonyl and TBARS value than those in room temperature. In either storage conditions, quail eggs had significantly lower ($p<0.05$) values of lipid and protein oxidation than the chicken eggs and hence better oxidative stability and shelf life.

Keywords: Carbonyl content, Storage condition, Storage period, TBARS.

DESCRIPTION OF THE PROBLEM

Eggs are important source of high quality lipid and proteins, vitamins and mineral (1). Eggs are readily susceptible to spoilage, which can be influenced by storage conditions. Changes in yolk and albumen occur during storage of eggs, initiating hydrolytic process of protein degradation and lipid degradation (2). Few studies have examined the impact of storage conditions on the physical properties of quail eggs (3) and chicken eggs (4). However, there is a dearth of information on the changes in oxidative stability of chicken eggs and quail eggs in response to storage conditions. Moreover, there is the need to further substantiate the claim that quail eggs are superior to chicken eggs in terms of quality and shelf life. Therefore, the present study has been undertaken to determine the effects of storage condition and storage period on some chemical characteristics of chicken and Japanese quail eggs.

MATERIALS AND METHODS

One hundred and ninety-two freshly laid tableeggs (96 per specie) of both chicken and Japanese quail eggs were collected from a reputable commercial farm in Ilorin, Kwara state and immediately taken to the laboratory for analysis.

Eggs of each species were marked and divided into two equal groups; one part was stored in refrigerator at 4^oc while the other part was stored in ambient temperature (average temperature of 27.9^oC to 30.0^oC) at a relative humidity of 70%. Temperature was set at 4^oC at regular power supply. Eggs in each group were further divided into eight parts of six eggs/ replicate. Measurements of egg qualities were taken periodically from day 0 at seven days interval for a total duration of 49 days. The Thiobarbituric acid TBARS values were determined for the Malonaldehyde (MDA) formed in fresh eggs and those that were refrigerated and was measured according to the TBA method described by (5) using third derivative spectrophotometry. Egg protein carbonyl content were measured according to the method described by (6). The reaction between 2,4-dinitrophenyl hydrazine (DNPH) with Protein Carbonyl to form hydrazone. Carbonyl contents were determined from the absorbance at 370 nm using a molar absorption coefficient of 22,000 M-1 cm-1 (6). The results were expressed as μmole of protein carbonyl content per gram of protein (μmole PC/g protein).

Statistical Analysis: Data collected were subjected to analysis of variance using a 2 x 2 x 8 factorial model in a completely randomized design (CRD) using the general linear procedure of SAS (2012). Significant differences between means were separated using the Duncan Multiple Range Test.

RESULTS AND DISCUSSION

Table 1: Effects of Species, Storage Condition and Period on the TBARS and Carbonyl Content of Chicken and Quail Eggs

Factor		TBARS (µmol/100g)	CARBONYL (µmolcarbonyl/mg protein)
Species	Chicken	9.7935^{a}	5.63e-05
	Quail	5.8494^{b}	5.74e-05
	SEM	0.16	0.00001
	P value	0.0001	0.54
Storage condition	Ambient	9.7828^{a}	6.337e-5^{a}
	Refrigerator	5.8601^{b}	5.036e-5^{b}
	SEM	0.16	1.2e-6
	P value	0.0001	0.0001
Period (Days)	0	0.15^{f}	2.74e-5^{d}
	7	1.197^{f}	3.04e-5^{d}
	14	4.10^{e}	5.18e-5^{c}
	21	4.21^{e}	6.36e-5^{b}
	28	7.5245^{d}	6.40e-5^{b}
	35	11.8281^{c}	6.97e-5^{ab}
	42	14.8049^{b}	7.04^{ab}
	49	18.7677^{a}	7.76e-5^{a}
	SEM	0.1	0.0001
	P value	0.0001	0.0001
Species x condition		**	Ns
Species x period (days)		***	***
Period (days) x condition		***	***
Condition xspecies x period (days)		**	***

a-f Meansin the same section and the same column having different superscript differs significantly.

Table 2: Details of Interaction between Storage condition and Storage period on TBARS and Carbonyl content on Chicken and Japanese quail Eggs

Day	Species	Storage condition (Temperature)	TBARS (u mol/100g)	Carbonyl (m mol carbonyl/mg) protein
0	Chicken	Refrigerator	0.15^{l}± 0	2.97e-05^{hkij} ± 6.65e-06
		Ambient	0.15^{l} ± 0	2.97e-05^{hkij} ± 6.65e-06
	Quail	Refrigerator	0.15^{l}± 0	2.51e-05^{k} ± 2.04e-06
		Ambient	0.15^{l} ± 0	2.51e-05^{k} ± 2.04e-06
7	Chicken	Refrigerator	0.85^{lk} ± 0.44	2.95e-05^{kij} ± 1.70e-07
		Ambient	1.68^{lk} ± 0.33	3.87e-05^{hkgijf} ± 9.47e-06
	Quail	Refrigerator	0.66^{lk} ± 0.23	2.46e-05^{k} ± 5.60e-07
		Ambient	1.57^{lk} ± 0.26	2.86e-05^{kj} ± 5.60e-07
14	Chicken	Refrigerator	2.06^{lkj} ± 0.5	3.76e-05^{hkgij} ± 5.03e-06
		Ambient	11.15^{gf} ± 1.19	7.47e-05^{bdac} ± 2.15e-06
	Quail	Refrigerator	0.93^{lk} ± 0.07	3.66e-05^{hkgij} ± 5.14e-06
		Ambient	2.25^{lkj} ± 0.15	5.84e-05^{ebdgcf} ± 8.78e06
21	Chicken	Refrigerator	5.5^{hj} ± 0.5	5.35e-05^{ehdgijf} ± 9.71e06
		Ambient	15.26^{dce} ± 0.99	7.79e-05^{bdac} ± 1.22e-06
	Quail	Refrigerator	3.05^{ilkj} ± 0.84	4.58e-05^{ehkgijf} ± 5.44e06

		Ambient	6.29 ^{h} ± 0.68	7.88e-05^{bdac} ± 6.00e-08
	Chicken	Refrigerator	6.36^{ih} ± 0.3	8.06e-05^{bdac} ± 7.50e-07
28		Ambient	15.26^{dce} ± 0.99	2.51e-05^{k} ± 2.04e-06
	Quail	Refrigerator	3.98^{ikj} ± 0.21	6.81e-05^{ebdac} ± 2.96e-06
		Ambient	6.36 ^{h} ± 0.3	8.06e-05^{bdac} ± 7.50e-07
	Chicken	Refrigerator	10.74^{gf} ± 1.07	5.71e-05^{bdac} ± 1.16e-05
35		Ambient	18.44^{c} ± 1.24	8.10e-05^{bdac} ± 9.76e-06
	Quail	Refrigerator	5.91^{ih} ± 1.21	5.66e-05^{ehdgicf} ± 1.36e05
		Ambient	12.23^{fe} ± 0.69	8.42e-05^{bac} ± 3.86e-06
	Chicken	Refrigerator	15.7^{dce} ± 1.78	5.77e-05^{edgcf} ± 7.96e-06
		Ambient	22.5 ^{b} ± 2.47	7.58e-05^{bdac} ± 5.75e-06
42	Quail	Refrigerator	7.67^{gh} ± 0.4	6.22e-05^{ebdgf} ± 9.00e-06
		Ambient	13.35^{dfe} ± 1.34	8.59e-05^{ba} ± 1.31e-05
	Chicken	Refrigerator	17.67 ^{c} ± 1.94	7.53e-05^{bdac} ± 2.52e-05
		Ambient	28.33 ^{a} ± 0.15	7.73e-05^{bdac} ± 1.53e-05
49	Quail	Refrigerator	12.39^{fe} ± 3.28	6.57e-05^{ebdac} ± 1.25e-05
		Ambient	16.67 ^{dc} ±1.75	9.22e-05^{a} ± 8.29e-06

$^{a-l}$*Means in the same columnhaving different superscript differs significantly*

Table 1 shows the TBARS values and carbonyl content of chicken and quail eggs subjected to different storage conditions and storage period with the details of interactions in Table 2. Chicken eggs had a significantly higher ($p<0.05$) TBARS value (9.7935) than quail eggs (5.8494). Eggs stored at ambient temperature had a significantly higher ($p<0.05$) TBARS value (9.7828) than those stored in the refrigerator (5.8601) regardless of species and length of storage. TBARS value of eggs showed no significant ($p>0.05$) increase between day zero and day seven. However, there was significant ($p<0.05$) increase in the values from day seven onward regardless of specie and storage condition. This result agrees with (7) who stated that the TBARS values of eggs increased when eggs were stored for 30-90 days at 4°C. The author, explained lipid oxidation becoming more intensive due to a larger occurrence of unsaturated fatty acids, which are susceptible to oxidation.

Lipid oxidation increased in proportion to increase of MDA concentration in analyzed sample. Food appropriate for consumption should present lipid oxidation values below 3mg MDA/kg with an upper limit of 7-8mg mda/kg (8). These results were in accordance with results published by (9), who also pointed out that MDA increased in proportion to egg storage period. Intensity of lipid peroxidation in egg yolks indicate how fresh the egg is. Thus, the higher the MDA values, the more intense the rate of oxidation. Chicken eggs deteriorated faster than that of Japanese quail eggs in this experiment. This result support the work of (10) who showed that antioxidant activity of Japanese quail eggs is slightly higher ($p<0.05$) when compared with hen eggs. This could be caused by the fact that quail eggs have a slightly higher proportion of proteins, minerals and vitamin A, which may cause higher antioxidant activity as indicated by (11).

The carbonyl content of chicken eggs werenot significantly different ($p>0.05$) from that of quail egg. Eggs stored at ambient temperature however had significantly ($p<0.05$) higher carbonyl content (6.337e-5µmolcarbonyl/mg) than those stored in the refrigerator (5.036e-5 µmolcarbonyl/mg). Carbonyl content in both species also increased as storage period progressed though the values were not significantly different as from the 35th day of storage. The higher the carbonyl value, the higher the rate of deterioration in the eggs. The values for the carbonyl were however lower than that obtained by (12) who reported 87.42µmolcarbonyl/mg protein and 122.3µmolcarbonyl/mg protein for eggs in ambient temperature and refrigerator, respectively. However, this could be as a result of temperature differences, species differences and storage period.

CONCLUSION

From this study, it is shown that lipid and protein oxidation increased in both species as storage period lengthens. Irrespective of specie, rate of deterioration was lower in the refrigerator than in ambient temperature. Also, regardless of storage condition and period, chicken eggs deteriorated faster than Japanese quail eggs. It was therefore concluded that Japanese quail eggs had better shelf-life than chicken eggs.

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Fetal Losses Among Pregnant Cows Slaughtered in Bauchi Central Abattoir and the Effects on Cattle Population in the State

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Abstract: A study was carried out to investigate the number of fetal losses due to the number of pregnant cows slaughtered in Bauchi central abattoir, Nigeria. The abattoir was visited monthly for one year using the check list to determine the number of cows slaughtered with pregnancy according to breeds. Slaughtered animals were monitored during the early and late rainy season, early and late dry season, respectively. Data collected were analyzed using simple percentages. The results showed that cows slaughtered during the early to late rainy season were mostly white Fulani (62) in the month of August followed by July (51), October (40), June (27), May (23) and September (17), respectively. Majority of Sokoto Gudali breeds were slaughtered in July (29) and June (25). The Red Bororo and the crosses had insignificant slaughtered figures. During the early to late dry season white Fulani breed recorded a higher number January (69), February (57), November (47), October (33), (31) and (23) for December and March respectively. Sokoto Gudali slaughtered figures were almost similar to that in early to late rainy season. The highest slaughter of Red Bororo was in January (18). Percentage fetal losses during the early to late rains were 23.74 and 22.35% in the months of July and August. The figures for early to late dry season were 23.90 and 22.93% (for November and December, respectively). It was concluded that increase in fetal losses will drastically reduce the cattle population in the state thereby leading to a decline in animal protein intake in Bauchi State.

Key words: Abattoir, Breed, Cows, Fetal Losses, Slaughter

INTRODUCTION

Over 50% of the national meat supply is contributed by cattle while the remaining 40-50% comes from other classes of livestock, (i.e. 35% from sheep and goats ,10% from poultry and the rest from pigs, donkeys, horses, camels and bush meat (FAO, 2003). There are about 14 million cattle in Nigeria (RIM, 2016) and 90% of the larger population of the cattle is concentrated in the northern region of the country, which is more favourable for large ruminants' husbandry (Osinowo, 2002). Bauchi state has a cattle population of 1.8 million (M.A.N.R., 2016). These animals are mostly owned by the Fulani pastoralists. The livestock sector in Nigeria has generally been characterized by low supply of meat and other animal products which has led to a wide spread rise in prices in most products (Duru *et al.*, 2015). Several factors such as inadequate nutrition, prevalence of disease, failure to harmonize crop and animal farming in agricultural practice and inadequate knowledge of sound herd management have been suggested to be responsible for low supply of meat and other animal products (Fetuga, 1997). The effects of these have led to the low level of animal protein intake by Nigerians. Lufadeju *et al.* (1997) reported that 90% of protein source consumed by Nigerians are vegetable source which shows that animals protein is below the minimum recommended level for daily maintenance of health. Meat from ruminant animals contributes substantially to the total protein intake. The habit of slaughtering pregnant animals is seen as a great wastage that needs urgent attention to curtail (Duru *et al.*, 2015).Such unhealthy practices were carried due to poor economy (finance)on the part of most farmers, inadequate law preventing the slaughter of in-animals, inadequate knowledge by majority of farmers to identify the pregnant animals at the early stage , poor ante mortem inspection by meat inspectors, ignorance on the part of the butchers , livestock owners and middlemen to know the economic and social implications of slaughtering in-animals. It is important to ensure ante-mortem inspection of animals, to certify animals, not pregnant before slaughter so as to reduce wastage. If fetal wastage is allowed to continue uncontrollably it will have great implication on the population of cattle and therefore herd size in Nigeria (Oyekunle*et al.*,1992). This will in turn reduce the access of an average Nigerian to proteins of

animal origin such as beef and milk. The objective of this study is to identify the different breeds of cows slaughtered; the number slaughtered with pregnancy hence fetal wastage at the Bauchi central abattoir.

MATERIALS AND METHODS

Bauchi central abattoir is located about 5km off Bauchi- Gombe road. The local government is the capital city of Bauchi state and is one of the twenty local governments of the state. It is the largest in terms of land mass. It is bordered to the south by Tafawa Balewa Local Government, to the West by Toro, North by Ganjuwa and to the East by Alkaleri Local Government. It is located between latitudes $9^{0}3^{1}$ and $12^{0}3^{1}$ North and longitudes $8^{0}50^{1}$ and 11^{0} east (Wikipedia 2017). The research was conducted by visiting the abattoir once every month in the rainy seasons (May to October 2016) and dry season (November to April; 2016/2017). Data collected using the check-list were analyzed using simple percentages and means.

RESULTS AND DISCUSSIONS

Table 1: Breeds of cows slaughtered during the early and late rainy season.

	May	June	July	August	September	October
White Fulani	23	27	51	62	17	40
Sokoto Gudali	18	25	29	15	6	17
Red Bororo	7	6	5	3	3	3
Crosses	0	1	0	0	0	0
Total	**48**	**59**	**85**	**80**	**26**	**60**

Table 2: Breeds of cows slaughtered during the early and late dry season

	May	June	July	August	September	October
White Fulani	47	31	69	57	23	33
SokotoGudali	12	20	21	31	13	11
Red Bororo	18	6	10	11	5	9
Crosses	2	0	3	0	0	0
Total	**79**	**57**	**103**	**99**	**41**	**52**

Table 3: Mean slaughter, fetal losses and percentages of the fetuses of cows during the early and late rainy seasons

	Average Monthly Slaughtered	No of fetal losses	Means	Percentages
May	56.84	48	1.55	13.41
June	63.80	59	2.63	16.48
Juy	78.06	85	2.74	23.74
August	68.77	80	2.58	22.35
September	37.27	26	0.87	7.26
October	67.16	60	1.94	16.76

Table 4: Mean slaughter, fetal losses and percentages of the fetuses of cows during the early and late dry seasons

	Average Monthly Slaughtered	No of fetal losses	Means	Percentages
May	74.23	103	3.43	23.90
June	76.20	99	3.41	22.97
July	87.45	41	1.32	9.51
August	79.45	52	1.73	12.06
September	61.32	79	2.63	18.33
October	59.15	57	1.84	13.20

The results of slaughtered cows during the early to late rainy season (Table 1) showed that October(60) and August (62) had the highest number of slaughter and the breed mostly slaughtered were the white Fulani and SokotoGudali indicating that the two breeds were more abundant in the area than other breeds such as the Red Bororo.The report agreed with the findings of Taiwo *et al.* (2012) where white Fulani recorded the highest (37.6%) number of slaughtered cattle in Lafenwa abattoir followed by SokotoGudali and Red Bororo 27% each. January and February had the highest number of slaughtered animals (103 and 99 animals, respectively) during the early to late dry season slaughters (Table 2). This is attributed to the period when herdsmen and nomads are yet to move southwards because pastures and cropresidues are still available. Also, July and August months had the highest mean average monthly slaughter of cattle (78.06 and 68.77, respectively) and number of fetal losses (23.74 and 22.35%, respectively) (Table 3). This is higher than 8.72% of pregnant cows slaughtered from January to April in Zango abattoir of Sabon Gari Local Government (Duru *et al.*, 2015). The mean slaughter of cattle during the early to late dry season (Table 4) was higher 438.15 than that in the early to late rainy season 371.90 (Table 3). This indicates that majority of families had the purchasing power to buy more meat in the dry period than during the farming season. The high percentage fetal losses in the months of November 23.90 and December 22.90% is buttressed by the fact that the period coincided with Christmas celebrations which agreed with (Matthew, 1992).

CONCLUSION

The high fetal losses in Bauchi central abattoir in both seasons are very alarming because proper checks are not normally carried by the meat inspectors. Post mortem inspections are hardly done as most meat inspectors do report late. Ignorance on the economic loss to the farmer and the nation and the effect on large livestock population will invariably affect the much-needed animal protein intake recommended by FAO.

RECOMMENDATION AND ACKNOWLEDGEMENT

The economic dangers of slaughtering pregnant animals with no regards to the rapid increase in human population (cattle in particular) should be made public. We are grateful to the staff of the Central abattoir under the Ministry of Agriculture and Natural Resources Bauchi, Nigeria.

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Growth Performance and Economics of Production of Broiler Chicks Fed Graded Levels of Baobab *(Adansonia Digitata*) Pulp Meal at the Starter Phase

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Abstract: The experimentwas conducted to evaluate the performance of broiler chickens fed graded levels of baobab (Adansoniadigitata) pulp meal (BPM) at the starter phase. Three hundred broiler (Anak) chickens were allotted to five treatments replicated thrice with 20 birds per replicate in a completely randomized design (CRD). The inclusion levels of the BPM in the diets were 0, 5, 10, 15 and 20% for treatment 1 (Control), 2, 3, 4 and 5 respectively. The experiments lasted for four weeks. Data collected were subjected to analysis of variance and significant differences among treatment means were compared using the Dunnet Test. Results showed a significantly higher feed intake (47.29 - 47.64g) ($P<0.05$) in birds fed 10, 15 and 20 % baobab pulp meal (BPM). Higher ($P<0.05$) daily weight gains of 24.36g - 24.66g were recorded in birds fed 0%, 5% and 10% BPM. Birds fed 0%, 5% and 10% BPM were more efficient in feed utilization. It can be concluded that Baobab pulp can be included in broiler chickens diets up to 20% but the optimum level of inclusion was 5%.

Keywords: Baobab pulp, Performance, Economics of production, Broiler chicks, Starter phase

Introduction

Animal protein is crucial for normal physical and mental development of human being, as deficit has serious adverse effects on the economic development of the country in terms of reduction in human productivity, incidence of high infant mortality, malnutrition and related diseases. Broiler industry represents the fastest and most economical means of bridging the animal protein shortage gap. In addition, it contributes to the Gross domestic products (GDP), it provides gainful employment and income to sizeable proportion of the populace. This will go a long way to alleviate poverty and improve the welfare of the population (Adebayo and Adeola, 2005). The broiler industry in Nigeria is characterized by high production cost which is the major constraint resulting in low profit margins. Most often in an attempt for producers to break even, the broiler products become so expensive that they are always unaffordable to majority of the citizenry. It is therefore necessary to look for cheaper and simple ways of getting animal protein required for normal body growth and function (Ayanwale *et al.,* 2006). The prices of animal products are therefore beyond the reach of the average Nigerian owing to the increase in the production and maintenance cost of farm animals. This has necessitated the renewal of interest in exploring the feasibility of incorporating neglected or underutilized energy feedstuff. Several workers have emphasized the need of utilizing unconventional feedstuff as an alternative feed ingredients as well as human and industrial waste (Durunna*et al*., 1990; Fanimo*et al*., 2007). Not much has been done in evaluating the potential feed value of some multipurpose tree products such as baobab *(Adansoniadigitata).*Medugu*et al.* (2011) reported that the tremendous decrease in poultry production is as a result of high cost of protein and energy feedstuffs especially cereal grains (maize) which form the bulk of energy in poultry feeds and are in short supply as a result of industrial and human needs. This has resulted in competition between human and animals for the available feed resources coupled with constant drought. Hence, the high cost of poultry feed has continued to be the major problem in developing countries. These necessitated the present study, in order to replace the expensive ingredients in livestock feeds especially for the monogastric animals. The objectives of the study is

to; determine effect of feeding baobab (*Adansoniadigitata*) pulp on the performance of broiler chickens and The cost effectiveness of including baobab (*Adansoniadigitata*) pulp in broiler chicken diets.

MATERIALS AND METHODS

Source of Baobab Fruit

Baobab fruits used for this experiment were harvested at mature stage which was indicated by the hard brown colour of the ectoderm from the trees using locally made equipment around Mamudo, Danchuwa, Alaraba and Mele in Potiskum Local Government area of Yobe State, Nigeria.

Processing

Dried baobab fruits were processed by cracking open the hard shell off the baobab fruits using a small hammer to remove the inner contents (epicarp), and pounded using a mortar and pestle while the seed and pulp were separated using a sieve. The pulp were slightly milled and separated from the unwanted coarse material using a fine mesh.

Experimental Site

The study was conducted at the Teaching and Research farm (Poultry unit) of the Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University Zaria. Zaria is located within the Northern Guinea Savannah of Nigeria with an average annual rainfall, relative humidity and temperature of 1,100 mm, 75% and 24.4^{O} C respectively, on Latitude 11^{o} 12'N and Longitude 7^{o} 33'E at an altitude of 610m above sea level (Ovimap, 2014).

Experimental design and management

Three hundred (300) broiler chicks (Anak) were purchased from Zarm Farm. The birds were vaccinated against Newcastle disease (intra ocularly) on the day of arrival and brooded together for three days using kerosene stoves and electricity bulbs as sources of heat and light. They were fed a common diet during this period. The birds were subsequently weighed and allotted to five dietary treatments. The birds were housed in a deep litter system in a completely randomized design. The treatments were replicated three times with twenty chicks per replicate. The feeding trial lasted for four weeks. Birds were vaccinated against Newcastle and Gumboro diseases. Feed and water were provided *adlibitum*..

Experimental diets

The composition and calculated analysis of the experimental diets are presented in Tables 1. The test ingredient was included at 0, 5, 10, 15 and 20% representing 1 (control), 2, 3, 4 and 5 respectively for broiler starter (23% CP; 2900 Kcal/Kg). The diets were isonitrogenous and isocaloric and met the recommended crude protein and metabolisable energy requirements as stated by NRC (1994)

Parameters determined in the experiment

Performance

The birds performance such as feed intake, weight gain, feed conversion ratio were measured weekly while mortality was recorded as it occurred and the cost of experimental diets were calculated based on the prevailing market price at the time of the experiment.

Economic Analysis

A simple analysis was conducted to assess the cost effectiveness of the experimental diets. Only the cost of feed was used in the calculations with the assumption that all other operating costs remained constant. Cost of the feeds was calculated based on the market prices of ingredients as at the time of the experiment.

Data analysis

All data collected were subjected to analysis of variance (ANOVA) using the General Linear Model Procedure of SAS 9.2 (2002). Significant differences among treatment means were compared using Dunett multiple ranged in the SAS Package.

Results and Discussion

The effects of feeding graded levels of baobab (*Adansoniadigitata*) pulp meal are shown in Table 2.The average daily feed intake ranged from 46.08 – 47.64g. Significantly (P<0.05) lower values 46.08g and 46.34g daily feed intake were recorded in birds fed 0% and 5% BPM while significantly (P<0.05) higher values 47.29g, 47.59g and 47.64g were recorded in birds fed 10%, 15% and 20% BPM respectively. The average daily feed intake increased linearly across the treatment groups as BPM increased in the diets. This observation is in line with the findings of Bola and Olatunde (2009) who reported a proportionate increase in feed intake when birds were fed increasing levels of baobab fruit pulp and also Ilori*et al.* (2013) who reported that baobab pulp meal only had a higher relative average feed intake than for whole fruit meal and suggested that pulp meal only is more acceptable to the animals than the whole fruit meal. According to Fairchid*et al.* (2005), birds have sensor for sweet, salt and bitterness, it may therefore be natural for the birds to consume more feed if it has a sweet taste or less feed if it has a bitter taste. The average final weight and daily weight gain ranged from 726.36 - 757.91g and 23.54 – 24.66g respectively. Significantly (P<0.05) higher values 749.61g, 755.85g and 757.91g final weight were recorded in birds fed 0%, 5% and 10% BPM while significantly (P<0.05) lower values 732.83 and 726.36g final weight were recorded in birds fed 15% and 20% BPM respectively and average daily weight gain follows similar trend as final weight. This agrees with the work of Rafiu*et al.* (2012) who reported the overall performances for final weight and daily weight gain were comparable across the treatment groups when broiler chicken was fed BPSM. This study also confirms the findings of Adeosun*et al.* (2013) who reported significant effects on final weight and body weight gain when baobab fruit pulp meal was included as a supplement (source of natural ascorbic acid) in laying hens but contrary to the suggestion that laying hens can tolerate only 3.5% level of inclusion and any further increase to 10.5% baobab pulp meal lead to decrease in almost all the mention parameters (Adeosun*et al.*, 2013). The major differences could be as results of differences in source of test material, management practice and breed used in the two studies which affects the performance of the birds. Feed Conversion ratio (FCR) ranged from 1.89 – 2.03. Significantly (P<0.05) higher values of 2.01 and 2.03 were recorded in birds fed 15% and 20% BPM and significantly (P<0.05) lower values 1.90, 1.89 and 1.90 were recorded in birds fed 0%, 5%, 10% BPM. This indicates that birds fed 0% –10% BPM are more efficient than those fed 15% BPM and beyond. This implies that feed utilization efficiency was better at 0% BPM, 5% BPM and 10% BPM, inclusion level, while poor utilization feed was observed at 20% BPM and 15%BPM inclusion.

CONCLUSION

The inclusion of BPM in broiler chicken diets significantly (P<0.05) increased feed intake and weight gain by 3.88% and 1.62% respectively while feed cost and mortality were decreased by 20.37% and 50.15% respectively in the starter phase. It can be concluded that Baobab pulp can be included in broiler chickens diets up to 20% but the optimum level of inclusion was 5%.

Table 1: Composition and calculated analysis of the experimental diet (starter)

	Inclusion levels of baobab pulp meal (% BPM)				
Ingredient (%)	**0**	**5**	**10**	**15**	**20**
Maize	57.00	51.65	46.35	41.85	35.40
BPM	0.00	5.00	10.00	15.00	20.00
G/nut cake	20.00	20.45	20.95	20.45	21.90
Soya bean meal	18.65	18.65	18.65	18.65	18.65
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	0.30	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.20

Lysine	0.30	0.20	0.00	0.00	0.00
*Pre-mix	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated					
ME (Kcal/Kg	2907.80	2908.98	2909.29	2910.58	2912.15
Crude protein	23.26	23.17	23.00	23.01	23.01
Crude fibre	3.83	4.09	4.35	4.61	4.87
Ether extract	4.07	4.28	4.50	4.71	4.92
Calcium	1.22	1.24	1.26	1.29	1.31
Av. Phosphorus	0.81	0.81	0.82	0.83	0.84
Lysine	1.24	1.27	1.22	1.33	1.44
Methionine	0.54	0.57	0.59	0.61	0.63
Cost (₦/Kg)	92.16	90.12	87.48	86.13	84.74

*Bio-mix: starter, unit/kg: Vit.A = 2500IU, Vit.D_3 = 500IU, Vit.E = 5.75mg, Vit.K_3 = 0.50mg, Vit.B_1 = 0.45mg, Vit.B_2 = 1.375mg, Niacin = 6.875mg, Panthothenic Acid = 1.875mg, Vit.B_6 = 0.75mg, Vit.B_{12} = 0.038mg, Folic Acid = 0.188mg, Biotin H2 = 0.015mg, Choline = 0.25mg, chloride = 750mg, Cobalt = 0.05mg, Copper = 0.75mg, iodine = 0.25mg, Iron = 5.00mg, Manganese = 10.00mg, Zinc = 7.50mg, Selenium = 0.05mg, Anti-oxidant = 0.313mg, BPSM = Baobab pulp-seed meal, G = Ground, Av = Available

Table 3: Performance of broiler chickens (starter) fed graded levels of baobab pulp meal

	Inclusion levels of baobab pulp meal (% BPM)					
Parameter	**0**	**5**	**10**	**15**	**20**	**SEM**
Live weight (g)	67.57	67.57	67.42	65.57	67.42	0.17
F/intake/Day (g)	46.08^{b}	46.34^{b}	47.29^{a}	47.59^{a}	47.94^{a}	0.51
Final Weight (g)	745.61^{a}	755.85^{a}	757.91^{a}	732.83^{b}	726.36^{b}	7.83
Wt/G/Day (g)	24.22^{a}	24.58^{a}	24.66^{a}	23.76^{b}	23.54^{b}	0.28
Feed conversion	1.90^{a}	1.89^{a}	1.92^{a}	2.01^{b}	2.03^{b}	0.03
Feed Cost (₦)	102.00	90.12	87.48	86.13	84.74	
T/Feed Cost (₦)	122.60	116.93	114.97	114.77	113.04	
C/Red. (₦)	0.00	5.67	6.96	8.30	9.56	
Cost/Gain (₦/g)	0.18	0.17	0.17	0.17	0.18	
Mortality (%)	3.33^{a}	1.67^{b}	1.66^{b}	1.67^{b}	1.61^{b}	0.06

^{abc} = Means within row with different superscript differ significantly ($P<0.05$).

G = Gain; Red = Reduction and C = Cost

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MICRO-LIVESTOCK PRODUCTION

Effect of Graded Levels of Dried Ginger (*Zingiber officinale*) Root Meal on the Performance and Carcass Parameters of Grower Rabbit

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Abstract: Twenty-eight grower's rabbits of mixed sexes and breeds were used for the experiment to determine the effect of dried ginger root meal (GRM) on the performance and carcass parameters. The rabbits were randomly assigned to four experimental treatments by weight (average weight of 557.09g). Each treatment was made up of seven replicates. The feeding trial lasted for eight weeks. The GRM was incorporated into the animals' diet at graded levels of 0%, 15%, 25% and 35% for T1, T2, T3, and T4 respectively. Rabbits were housed in individual cages; water and feed were administered by a known quantity. Data collected includes; water intake, feed intake, initial body weight gain, final body weight gain, weight gain, eviscerated weight and singe weight. Data collected were subjected to analysis of variance (ANOVA) and significant differences were separated using DMRT. The results showed that significant ($P>0.05$) difference were not observe with respect to weekly feed intake from week one to week six, weekly water intake in week 1, 3, and 4 and in the initial body weight, the final body weight, weight gain, eviscerated weight and singe weight. Mean weekly feed intake were significantly ($p<0.05$) different in week 7 and 8. Similarly, mean water intake differed significantly ($p<0.05$) in week 2, 5, 6, 7 and 8. It can be concluded from this study that GRM influenced feed and water intake without significant effect on the body weights and carcass parameters of the rabbits.

Keywords: Ginger, Root meal, Performance, Carcass and Rabbit

DESCRIPTION OF PROBLEM

Livestock Production is the most significant among all classes of agricultural production that serves as means of livelihood for humans and that serves as sources of protein provision (1). Animal protein is essential in human nutrition, due to its balanced amino acid profile and ease of utilization (2). Rabbits have been reported to have enormous potentials in alleviating low or scarce animal protein supply in developing economies (3). Effort aimed at increasing animal protein supply must necessarily address the competition between man and livestock for feed sources which has resulted in the shortage of conventional feedstuff such as maize, soybeans and groundnut cake for compounding livestock feeds (4). Ginger root meal can be used as alternative source of feed stuff in livestock production. Ginger has no negative effects on the growth performance of rabbits (5). Higher feed intake was observed among rabbits fed with higher levels of ginger root powder as inclusion (6). Ginger (*Zingiber officinale*) may act as a pro-nutrient because of the vast active ingredients it contains (7). It thus, presents a potential alternative to antimicrobial growth promoters (AGP). As a growth promoter, ginger was reported to promote feed intake and feed conversion (8) and body weight gain (9) in broilers. Birds fed ginger produced higher carcass weights compared to untreated birds (10).

MATERIALS AND METHODS

This study was conducted in the rabbitary unit of the Federal University of Agriculture Livestock Teaching and Research farm, Makurdi, Benue state, Nigeria. The experiment lasted for a period of eight weeks.28 mixed sex and breed grower rabbits were subjected to the same management condition. Management of the rabbits was intensive. Prophylactic treatments against ecto and endo parasites were administered. Water and feed were provided at *ad-libitum.* Weekly water and feed intake, body weight gain were recorded as it occurred throughout the period of study and the eviscerated and singe weight were collected at the end of the study. The rabbits were kept under strict hygienic conditions. The animals were randomly selected, weighed to get their initial body

weight and then assigned into four treatments (T1, T2, T3 and T4) with seven replicate each per treatment in a Completely Randomized Design (CRD).

Dried ginger root was purchased from a local market (North bank Market) within Makurdi, Benue state and milled into powder, which was incorporated into the formulated diet at different levels of inclusion (T1=0%, T2=15%, T3=25%, T4=35%) for the rabbits as presented in table 1. Weekly feed and water intake was recorded by subtracting feed and water left over from the quantity fed and volume of water given during the week and dividing it by the numbers of days in a week. Weight gain was determined at the end of the study by subtracting the initial body weight from the final body weight. Eviscerated weight was recorded after removal of the visceral organs and singe weight after the Rabbits carcasses were passed over fire for fur removal. All data obtained were subjected to the analysis of variance (ANOVA) using a statistical package for Social Sciences (SPSS® version 21, 2011) and their means were separated using Duncan Multiple Range Test.

RESULTS AND DISCUSSION

Table 1: Ingredients composition and calculated analysis of experimental diets

Ingredient	**Treatment**			
	T1 (0%)	**T2 (15%)**	**T3 (25%)**	**T4 (35%)**
Maize	39.70	24.86	15.90	7.80
Maize Offal	14.40	14.95	13.00	10.00
SBM	19.70	21.30	22.60	24.00
Ginger	0.00	15.00	25.00	35.00
Rice Bran	0.80	0.75	1.00	1.40
Rice Offal	22.40	20.14	19.5	18.8
Bone ash	2.50	2.50	2.50	2.50
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated Analysis				
CP	15.05	15.01	15.00	15.01
CF	12.03	11.87	11.91	11.87
Fats	3.84	3.99	4.15	4.32
Energy	2501.58	2505.00	2500.91	2503.01
Phosphorus	1.23	1.68	1.98	2.28
Calcium	0.97	1.28	1.48	1.68

T= Treatment, %= Percentage, SBM= Soy Bean Meal, CF=Crude Fibre, CP= Crude Protein.

Mineral Vitamin premix contents; vit A, 10,000,000 i.u; vit D3, 2,000,000 i.u; vit E, 20,000 mg; vit K3, 2,000 mg; B1, 3000 mg; B2, 5000mg; niacin, 45,000 mg; calcium pantothenate, 10,000 mg; vitamin B6, 4,000 mg; B12, 20 mg; choline chloride , 300,000 mg; folic acid, 1,000 mg; biotin, 50 mg; manganese, 300,000 mg; iron, 120,000 mg; zinc, 80,000 mg; copper, 8,500 mg; iodine, 1,500 mg; cobalt, 300 mg; selenium, 120 mg; antioxidants, 120,000 mg.

Table 2: Effect of Ginger Root Meal on the weekly feed intake of Rabbits (Mean±SEM)

Weeks (g)	**Treatments**				
	T1 (0%)	**T2 (15%)**	**T3 (25%)**	**T4 (35%)**	**LS**
1	343.24±27.62	321.50±29.75	335.47±32.72	364.10±27.62	NS
2	311.86±25.03	344.33±26.95	361.60±29.65	394.57±25.03	NS
3	374.72±40.86	380.00±44.00	374.40±48.40	461.15±40.86	NS
4	396.40±45.16	464.33±48.64	406.04±53.50	420.40±45.16	NS

5	406.88±40.60	466.67±43.72	442.38±48.09	507.59±40.60	NS
6	460.27±49.25	479.67±53.04	568.42±58.34	569.10±49.25	NS
7	420.27±47.77^{b}	547.67±51.45^{ab}	557.03±56.59^{ab}	602.55±47.77^{a}	*
8	429.16±49.27^{b}	527.33±53.06^{ab}	589.57±58.36^{a}	601.02±49.27^{a}	*

ab = means in the same row with different superscript are significantly different (p>0.05)
SEM= Standard Error of the Mean, NS= No Significant Difference (p>0.05), LS=Level of Significance, %= Percentage, T= Treatment.

Table 3: The Effect of Ginger Root Meal on the Weekly Water Intake of Rabbits (Mean±SEM)

Weeks	Treatment				
(g)	T1 (0%)	T2 (15%)	T3 (25%)	T4 (35%)	LS
1	82.38±16.88	103.17±18.18	141.37±19.99	120.25±16.88	NS
2	133.50±26.35^{b}	156.25±28.37^{ab}	230.24±31.21^{a}	224.84±26.35^{a}	*
3	172.74±29.21	210.67±31.46	262.27±34.60	256.09±29.21	NS
4	180.93±33.98	229.13±36.59	265.60±40.25	241.43±33.98	NS
5	165.05±31.66^{b}	260.08±34.09^{ab}	293.43±33.98^{a}	312.98±31.66^{a}	*
6	202.99±37.48^{b}	188.03±40.36^{b}	255.94±44.40^{ab}	330.59±37.48^{a}	*
7	217.24±22.38^{b}	241.58±24.10^{b}	242.89±26.51^{b}	326.58±22.38^{a}	*
8	275.66±32.55^{b}	298.33±35.05^{ab}	350.66±38.56^{ab}	398.87±32.55^{a}	*

ab = means in the same row with different superscript are significantly different (p>0.05)
SEM= Standard Error of the Mean, NS= No Significant Difference (p>0.05), LS= Level of Significance, %= Percentage, T= Treatment.

Table 4: Effect of Ginger Root Meal on the body Weight and Carcass parameters of Rabbit. (Mean ± SEM)

Parameters	Treatments				
	T1 (0%)	T2 (15%)	T3 (25%)	T4 (35%)	LS
IBW	574.70±35.20	535.67±41.67	573.00±51.90	545.00±41.67	NS
FBW	1284.40±45.00	1286.17±71.78	1281.60±96.30	1357.17±71.78	NS
TBWG	709.70±51.30	750.50±64.55	708.60±83.30	812.17±64.55	NS
EW	888.60±54.75	904.75±54.75	857.83±60.24	908.92±54.75	NS
SW	804.08±54.81	821.52±54.81	763.50±60.30	819.17±54.81	NS

SEM= Standard Error of the Mean, NS= No Significant Difference (p>0.05), LS= Level of Significance, IBW=Initial Body Weight, FBW=Final Body Weight, WG= Weight Gain, EW= Eviscerated Weight, SW=Singe Weight, T= Treatment, %= Percentage.

The effect of dried ginger root meal on the feed intake of rabbit is presented in table 2. The result showed that there were no significant (p<0.05) difference among the treatment means up to week 6. Treatment means of weekly feed intake differed significantly (p>0.05) in week 7 and 8. Feed consumption in T4 was higher significantly in week 7 and 8 than T1, though numerically higher, T4 was comparable to feed intake in T2 and T3. Feed intake in this study, showed relative increment as ginger levels increases and as the animal age. (11) Had noted that feed intake increases with the age of the animal. The finding of this study thus corroborated previous reports of (5 and 12). This could be due to the fact that ginger tends to enhance palatability and stimulate appetite (13).

The effect of ginger root meal on water intake is presented in table 3. Significant (p>0.05) variation were observed in week 2, 5, 6, 7 and 8. Animals on diet containing ginger diet consume more water, though T4 (35% ginger root meal) had higher mean water intake. Numerically, water intake of rabbits on ginger throughout the experimental period was higher than the control. The finding of this study agrees with the report of (5). These workers observed that inclusion of ginger meal in diet will stimulate increase in water consumption of rabbit. It was observed that water intake tends to increase with the age of the rabbits.

Table 4 presents the effect of dried ginger root meal on the body weights and some carcass parameters of grower rabbits. The result showed no significant ($p<0.05$) variation in the mean values of the parameters measured. The treatment means values did not show any specific numerical trend. The findings of this study agree with the earlier reports of (5 and 10). This variation with earlier report could be attributed to the breed, age, species and environmental condition of the animal used.

CONCLUSION

It can be concluded from this experiment that the inclusion of ginger root meal at varying levels in the diet of the rabbits did not affect the body weight and carcass parameters measured. Water and feed intake were however increased compared to the control.

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Performance and Economy of Weaner Rabbits Fed Diets with different levels of Rubber Seed Cake supplemented with *Pueraria phaseoloides*

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Abstract: A total of 48 cross bred weaned rabbits were used to access the effect of replacing soya bean meal (SBM) with rubber seed cake (RSC) supplemented with *Puerariaphaseoloides* ina nine week feeding trial. Four dietary treatments (1, 2, 3 and 4) were formulated and were allotted in 3 replicates per treatment grouping with 4 rabbits each in a completely randomized design. Treatment diets 1, 2, 3 and 4 were formulated to contain 0, 25, 50 and 75% RSC in place of SBM and each diet was supplemented with 200g of *Pueraria phaseoloides* forage per day. Data collected on growth performance, carcass quality, and hematology and serum biochemistry were subjected to Analysis of variance (ANOVA) at $P<0.05$. The results showed that the highest average live weight of 2.15kg was obtained in diet 2 and lowest in diet 1 and 4. Daily and Total feed intake of rabbits were higher in diet 1, but the highest daily weight gain was obtained in diet 3. Cost of production was least (N1592.35) in rabbits fed diet 4 and highest (N1664.35) in the control. Net profit realized was highest (N 907.65) in rabbits fed diet containing 75% RSC and lowest (N835.65) in rabbits fed the control diet. It is therefore concluded that up to 75% replacement of Soya bean meal (SBM) with rubber seed cake (RSC) as protein source in the diet supplemented with *Puerariaphaseoloides* improved growth performance of rabbits and also gave better economic returns.

Key words: Economy, Performance, P*ueraria phaseoloides*, Rabbit, Rubber seed cake.

DESCRIPTION OF PROBLEM

The persistent shortage of conventional feedstuffs for livestock feeding as a result of competition between man and livestock for these feed ingredients has made the prices of livestock feeds to be on the high side and thereby culminating into high cost of livestock production. This has therefore forced animal nutritionists to intensify research efforts into the feeding value of potentially useful, attractive, cheaper and readily available protein and energy sources of unconventional feed stuffs such as palm kernel cake, groundnut meal, pigeon pea meal, mango seed (kernel) meal, rubber seed meal amongst others that can be used for feeding livestock especially poultry, pigs and rabbits with encouraging results [1, 2]. One of these is rubber seed cake (RSC) obtained from rubber tree seed (*Hevea brasilliensis*). It has been reported [3.], that rubber seeds have the potential to be used as source of plant or vegetable protein for livestock. Rubber seeds are abundant in southern Nigeria where rubber is produced for domestic and export purposes and the seeds are usually discarded. Recent reports [4] had shown that about 75,000 metric tons of the seeds could be produced annually in the country.

Pueraria phaseoloides otherwise known as *Puero* or *Kudzu* is a valuable fodder plant that had given excellent results in the wet tropics. Since rabbits are pseudo ruminants, they are efficient at converting forage and vegetative matters into meat. There is the need to evaluate the potentials of rubber seed cake supplemented with *Pueraria phaseoloides* for cheaper and better-quality rabbit meat production hence, this research work. The aim of the study was to assess the performance and economy of production of weaner rabbits fed diets with different levels of rubber seed cake as replacements for soybean meal supplemented with *Pueraria phaseoloides.*

MATERIALS AND METHODS

This experiment was carried out at the Rabbitary Unit (livestock section) of the Teaching and Research Farm, Faculty of Agriculture, Ambrose Alli University Ekpoma, Nigeria for a period of nine weeks. The rubber seed cake was collected from the Rubber Seed Processing Unit of the Rubber Research Institute of Nigeria (RRIN),

Iyanomo, Benin City, Nigeria, while other feed ingredients were purchased in the open market in Ekpoma. *Pueraria phaseoloides* forage commonly known as African kudzu was cut on a daily basis around the vicinity of the study area. A total of forty-eight (48) cross bred weaner rabbits were used for the study. Twelve rabbits each were assigned to each of the four treatment diets which were replicated three times in a completely randomized design (CRD). Four (4) rabbits each were housed separately in a cell or units of the hutch of 45 x 30 x 40cm in size. Routine medication using vitamin and de-wormer were administered through water to ease stress and worm infestations from source, while antibiotics and vaccinations were administered subcutaneously. Other routine management practices were carried out during the feeding trial.

Experimental diets and Feeding: A total of four treatment diets were formulated. Diet 1 served as the control which contained 0% level of rubber seed cake (RSC). Diets 2, 3 and 4 contained RSC at inclusion levels of 25, 50 and 75 %, respectively in place of SBM. The diets were formulated to contain levels of protein and energy as reflected in Table 1. A total of 200g each of *Pueraria phaseoloides* forage were offered to rabbits in each of the treatment replicates at 12 noon daily during the experimental period. The rabbits had free access to the experimental diets and water *ad-libitum* throughout the feeding trial.

Table 1: Gross composition of the experimental diets (% DM)

Replacement levels of RSC (%)	**0**	**25**	**50**	**75**
Diets	**1**	**2**	**3**	**4**
Maize	45.0	45.0	45.0	45.0
Soya bean meal	16.0	12.0	8.00	4.00
Rubber seed cake	0.00	4.00	8.00	12.0
Fish meal	2.50	3.00	3.50	4.00
Palm kernel cake	13.0	13.0	13.0	13.0
Rice offal	18.0	17.5	17.0	16.5
Bone meal	3.00	3.00	3.00	3.00
Oyster shell	1.50	1.50	1.50	1.50
Premix	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50
Total	100	100	100	100
Calculated analysis:				
ME (Kcal/kg)	2530	2530	2531	2531
Crude protein (%)	16.74	16.67	16.60	16.54

ME = Metabolizable energy; RSC = Rubber seed cake.

Chemical analysis: The proximate composition and gross energy of rubber seed cake were determined according to standard procedures [5, 6].

Data Collection: Data were collected and calculated on the following parameters: body weights, feed intake, weight gain, feed conversion ratio, protein efficiency, cost of feed/kg, cost of feed consumed per rabbit, cost of feed per kg weight gain, cost of production and net gain. Body weights at the beginning and end of the experiment constitutes the initial and final body weights respectively while the weight gain is the increment or difference in rabbits' weights during the time that the study lasted. Feed conversion ratio or feed: gain ratio is the ration of the feed intake to body weight gain of the animal. Protein efficiency is a measure of the daily weight gain divided by the daily protein intake. The costs of feed/kg were used to calculate other cost parameters.

Statistical Analysis: Data obtained were subjected to a one-way analysis of variance (ANOVA) using the general linear procedure [7] and means were separated using DMRT of the software.

RESULTS AND DISCUSION

Performance Characteristics of Rabbits: The performance characteristics of rabbits as influenced by the dietary treatments are as shown in Table 2 below. Rubber seed cake used was found to contained 90.37% dry matter, 39.23% crude protein, 7.87% crude fibre, 6.57% ash, 9.27% ether extract, 27.43% nitrogen free extract and 2.82 kcal metabolizable energy per gram while *Pueraria phaseoloides* contained 80.26% dry matter, 22.0% crude protein, 46.06% crude fibre, 3.60% ash, 2.11% ether extract, 6.50% nitrogen free extract and 2.75 kcal metabolizable energy per gram. The initial body weights of the rabbits used for the study ranged between 0.93kg and 1.24 kg. The daily Feed Intake-FI (97.98 – 104.25g/day) varied significantly ($p < 0.05$). The daily FI for weaner rabbits fed diets 1, 2 and 3 were similar just as those fed diets 2. 3 and 4 were also similar. Rabbits on control diet without RSC had significantly ($p < 0.05$) higher FI than those on diet 4 with 12% RSC. The total FI (5.50 – 5.97kg/rabbit), daily body weight gain (16.67 – 17.48g/day), final body weight gain (1.80 – 2.15kg/rabbit) and protein efficiency ratio (1.01 – 1.05) varied significantly. The daily weight gain for rabbits on diets 1 and 4 were similar and significantly lower than what obtained for those fed diets with 4 and 8% RSC (diets 2 and 3).

The higher daily and total feed intake in Diet 1 (control) could be an indication that rabbits still prefer SBM to RSC in the concentrate feeds and this could have resulted in the higher total and daily weight gained recorded from the control. Rabbits on diet 2 (4%RSC) had the highest final body weight (2.15kg) that was similar to those on diet 3(8%RSC), but significantly higher than what obtained for those fed diet without RSC (Control diet) and diet 4. The RCR for rabbits fed diets without RSC was significantly higher than what obtained for those fed RSC-based diets.

The PER was similar for rabbits fed diets 1, 2 and 4 while those of rabbits fed diet 3 was significantly ($p < 0.05$) higher. The PER for rabbits on diets 2 and 3 (25 and 50% replacement levels respectively) were also similar. The significantly higher live weight and protein efficiency ratio of rabbits fed various levels of RSC inclusion diets indicates that in rabbit nutrition, SBM may not be superior to RSC as the protein source. This is similar to the observation of [8] Babatunde *et al*. (1990) who observed that RSC effectively replaced SBM efficiently as protein source up to 30% level in the diets of swine. Also, the significant effect on performance characteristics at the various levels of RSC inclusions in the diets of the rabbits could have been enhanced by the supplementary puero (*Pueraria phaseoloides*) forage in the diets. It was also observed [9] that when diets of rabbits consists of a mixed forage and concentrate regime, higher weight gain is obtained than when diets that consist of concentrate or forage alone. In the same vein, it was also observed [10] a significantly (P<0.05) higher weight gain in rabbit fed 50% level of inclusion of *Syndrella nodifolora* forage in concentrate diets.

Table 2: Performance characteristics of rabbits fed the experimental diets

Diets	**1**	**2**	**3**	**4**	**SEM±**
RSC Inclusion levels (%)	**0**	**4**	**8**	**12**	
Replacement levels (%)	**0**	**25**	**50**	**75**	
Parameters:					
Initial body weight (kg)	0.93	1.24	1.19	1.06	0.01
Daily feed intake (g)	104.25^{a}	99.76^{ab}	101.25^{ab}	97.98^{b}	1.70
Total feed intake (kg)	5.97^{a}	5.59^{b}	5.74^{ab}	5.50^{b}	0.09
Daily weight gain (g)	17.02^{b}	17.41^{a}	17.48^{a}	16.67^{b}	0.76
Final body weight (kg)	2.00^{b}	2.15^{a}	2.10^{ab}	1.80^{c}	0.05
Feed conversion ratio	6.13^{a}	5.73^{b}	5.79^{b}	5.89^{b}	0.57
Protein efficiency ratio	1.02^{b}	1.04^{ab}	1.05^{a}	1.01^{b}	0.003

$^{a-c}$Meansalong the same row with different superscripts differ significantly (p <0.05) SEM = standard error of mean; RSC = Rubber seed cake.

Economy of replacing SBM with RSC in rabbit diets: The economy of rabbit fed with the experimental diets in Naira (N) is as shown in Table 3. The cost of feed (N67.43 – N74.43/kg), cost of feed consumed (N372.35 – N444.35), cost of feed intake per kg body weight gain (N50.06 – N79.69), cost of production (N1592.35 –

N1664.35) decreased as the levels of RSC increased in the diets while the net profit increased with the inclusion of RSC up to 75% replacement value for soybean meal in rabbit's diet. Replacement of Soya bean meal (SBM) up to 75% with rubber seed cake (RSC) as protein source in the diet of rabbits supplemented with *Pueraria phaseloides* improved the general performance and economy of production as it elicited the least feed conversion ratio, least cost of feed intake per kg body weight gain and the least cost of production with the highest net profit.

The cost of feed was reduced by between 2.5% in diet 2 (25% RSC inclusion) and 8.7% in diet 4 (75% RSC inclusion). Similarly, production costs were reduced by 2.45 % per rabbit in diet 1 and 4.23% per rabbit in Diet 4. This observation lends support to the findings [11] that the inclusion of 30% level of unpeeled cassava waste meal in the diets of rabbits led to reduction in the cost of feed, cost of feed/kg weight gain, cost of production and improvement in the profit margin. These may look small in the micro scale, but where commercial production is the target it could make a lot of difference. As pointed out in some reports [12], the cheaper cost and the non- competition with man for rubber seed cake and the abundance of rubber seeds in Southern Nigeria makes RSC a potential solution to the high cost of rabbit meat production in Nigeria.

Table 3: Economy of rabbit fed with the experimental diets in Naira (N)

Diets	**1**	**2**	**3**	**4**
RSC Inclusion levels (%)	**0**	**4**	**8**	**12**
Replacement levels (%)	**0**	**25**	**50**	**75**
Parameters:				
Cost of weaner rabbits (N)	1,100.00	1,100.00	1,100.00	1,100.00
Cost of feed (N/100 kg)	7,443.00	7,219.00	6,995.00	6,770.00
Decrease in cost of feed (%)	0.00	3.01	6.01	9.04
Cost of feed (N/kg)	74.43	72.19	69.95	67.70
Cost of feed consumed (N)	444.35	403.54	401.51	372.35
Cost of feed intake/kg weight gain (N)	79.67	65.65	63.66	50.06
Other Expenses (N)	120.00	120.00	120.00	120.00
Cost of Production (N)	1,664.35	1,623.54	1,621.51	1,592.35
Decrease in cost of production (%)	0.00	2.45	2.57	4.23
Value of Matured Rabbit (N/animal)	2,500.00	2,500.00	2,500.00	2,500.00
Net Profit (N)	835.65	876.46	878.45	907.65
Increase in net profit (%)	0.00	4.88	5.12	8.61

CONCLUSIONS

Rabbits on diets with rubber seed cake performed better and economical than those on control diet without rubber seed cake. Replacement of Soya bean meal (SBM) up to 75% with rubber seed cake (RSC) as protein source in the diet of rabbits supplemented with *Pueraria phaseloides* improved the general performance and economy of production as it elicited the least feed conversion ratio, least cost of feed intake per kg body weight gain and the least cost of production with the highest net profit.

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Evaluation of Performance Characteristics of Rabbits Fed Pawpaw Seed Meal (PSM) Based Diet

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Abstract: In ten-week trial, sixty mixed breeds of weaner rabbits aged 5 - 6 weeks were allotted to five treatments in a completely randomized design to examine the performance characteristics of rabbits fed pawpaw seed meal (PSM). Five concentrate diets were compounded with the inclusion of pawpaw seed meal (PSM) at 0, 10, 20, 30 and 40% graded levels (Table 1). The proximate components of the diets contain inclusion of PSM were similar and comparable to the control diet in this study. There were no significant differences (P>0.05) among the means of feed intake, initial and final weight of rabbits across the experimental treatment. The rabbits fed diets 0%PSM (6.52g) and 30%PSM (6.82g) had significantly higher (p<0.05) daily weight gains as compared to 10%PSM (5.82g) and 40%PSM (4.85g) diets whereas rabbits fed 20%PSM (4.59) had the best feed conversion ratio compared to 10%PSM (5.92), 0%PSM (6.55), 30%PSM (6.71) and 40%PSM (7.75). It was concluded that inclusion of pawpaw seed meal up to 30% in the diet of rabbits could lead to improved performance characteristics.

Keywords: characteristics, evaluation, pawpaw seed meal, performance, rabbits

DESCRIPTION OF PROBLEM

Rabbit has the ability to convert feedstuffs such as forages, most agricultural by-products, kitchen wastes that human being cannot consume directly into highly nutritious meat. Though rabbits have been found to perform best when fed on concentrates, (Farinu, 1994), the ever increasing costs of grains has created a need to augment both the energy and protein requirements with forage in order to reduce the quantity of the more expensive feed ingredients. For any livestock enterprise to be profitable and sustainable, it has become necessary to find alternative cheap feedstuff which can adequately replace the more expensive and highly competitive ones (Akpodiete *et al*., 1999). An example of such alternative feedstuff is pawpaw seed which is a waste from consumption of pawpaw fruit. Bolu *et al*., (2009) reported that pawpaw seed contains 97.27% DM, 30.08% CP, 34.80% EE, 1.67% CF and 7.11% Ash. Thus, pawpaw seed is a cheap and available protein source for livestock animals. However, limited information is available on the utilization pawpaw seed in the diets of rabbits. Hence, this study examines the performance characteristics of rabbits fed pawpaw seed meal (PSM).

MATERIALS AND METHOD

The experiment was carried out at the Rabbit Unit of the Oke Ogun Polytechnic Teaching and Research Farm Saki, Oyo State. Nigeria. The study lasted for ten weeks. Pawpaw seeds were sourced, dried, ground and stored for subsequent use. Five concentrate mash diets were compounded with the inclusion of pawpaw seed meal (PSM) at 0, 10, 20, 30 and 40% graded levels (Table 1). Sixty mixed breeds of rabbits (4-6 weeks) were randomly allotted to five treatments in a completely randomized design. The rabbits were housed individually in iron net cages netted with wire mesh measuring 23 x 18 x 15 inch in dimension. The rabbits were provided with the moist mash experimental diets and clean water *ad-libitum* daily. The animals were subjected to a 7-day adaptation period before the commencement of the experiment. Data were obtained on the feed intake, daily weight gain, feed conversion ratio and nutrient digestibility coefficients of rabbits. Also, animals were subjected to a 7-day digestion trial where sample of faeces collected were bulked, thoroughly mixed, ground and sub-sampled for chemical analysis. The proximate analysis of experimental diets and faecal samples was done while the nitrogen content of the urine samples was also determined (AOAC, 2000). Data obtained were subjected to analysis of

variance procedure of General Linear Model was used to test treatment effect and the Duncan's New Multiple Range Test options of SAS (2008) was used to test significant differences among means.

RESULTS AND DISCUSSION

The proximate components of the diets contain inclusion of PSM were similar and comparable to the control diet in this study. The crude protein content of diets in this study was higher than 15-18% reported for newly weaned rabbits (Fielding, 1991). The metabolizable energy of all the experimental diets in this study was higher than 2588.63 – 2995.59kcal/kg obtained by Mufwa *et al*., (2011) for growing rabbits. There were no significant differences (P>0.05) among the means of feed intake, initial and final weight of rabbits across the experimental treatment. The rabbits fed diets 0%PSM and 30%PSM had significantly higher (P>0.05) daily weight gains as compared to 10%PSM and 40%PSM diets whereas rabbits fed 20%PSM had the best feed conversion ratio compared to other diets. The daily feed intake values obtained in this study lower than Moringa inclusion diet of 60.10 - 63.40g/day reported for rabbits (Federick, 2010) and concentrate feed intake of 61.08 – 133.9g/day reported for rabbits (Okorie, 2003). The daily weight gain recorded in this study was lower than 6.78 – 8.64g/day reported by (Odeyinka *et al,* 2008). The feed conversion ratio values obtained in this study were higher than 2.63- 3.00 reported by Okorie, (2003) but was comparable to 5.11 – 7.66 by Mmereole *et a*l. (2011).

Table 1: Gross composition of the experimental diets

Ingredients	0%PSM	10%PSM	20%PSM	30%PSM	40%PSM
Maize	34.11	34.11	34.11	34.11	34.11
Wheat offal	41.75	41.75	41.75	41.75	41.75
Groundnut cake	10.52	9.42	8.42	7.35	6.31
Pawpaw seed	-	1.10	2.10	3.17	4.21
Bone meal	4.00	4.00	4.00	4.00	4.00
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100

Table 2: The proximate composition of the experimental diets

Parameters (%)	0%PSM	10%PSM	20%PSM	30%PSM	40%PSM
Dry Matter	90.77	90.19	90.15	90.11	90.27
Crude Protein	22.49	22.88	22.69	22.78	22.97
Crude Fibre	3.73	3.76	3.79	3.79	3.68
Ether Extract	3.56	3.61	3.67	3.67	3.59
Ash	6.74	6.52	6.48	6.48	6.43
NFE	53.78	53.45	53.51	53.39	53.45

Table 3: Performance characteristics of rabbits fed PSM

Parameters	0%PSM	10%PSM	20%PSM	30%PSM	40%PSM	0%PSM
Feed intake (g/day)	36.08	34.83	32.78	39.13	33.18	2.06
Initial weight (g)	874.00	890.00	822.00	962.00	778.00	53.12
Final Weight (g)	1176.00	1160.00	986.00	1278.00	990.00	53.24
Weight gain (g)	302.0^{a}	270.0^{ab}	164.0b	316.0^{a}	212.0^{ab}	19.95
Daily Weight gain (g)	6.52^{a}	5.82^{ab}	3.50^{b}	6.82^{a}	4.58^{ab}	0.433
FCR	6.55^{b}	5.92^{b}	4.59^{a}	6.71^{b}	7.75^{ab}	1.25

CONCLUSION

It could be concluded that inclusion of pawpaw seed meal in the diet of rabbits up to 30% could lead to improved performance characteristics.

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Effects of Mango Fruit Reject Pulp-Maize Offal Mix (MFRP-MO) on the Growth Performance of Japanese Quails

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Abstract: The experiment was conducted to investigate the effects of mango fruit reject pulp-maize offal mix (MFRP-MO) on the growth performance of Japanese quails. MFRP-MO was prepared by mixing mango fruit pulp with maize offal in the ratio, 1:1. It was thereafter included into growing quail diets at 0, 5, 10, 15 and 20% respectively. Seventy-five (75) quail chicks aged 17 days were randomly allocated to the five dietary treatments replicated three times, with each replicate having five quail chicks in a completely randomized design and fed for 28 days. Except for daily protein intake, which was significantly different ($p<0.05$) without pattern, other growth performance parameters such as daily feed intake (17.16 – 18.18g), daily weight gain (3.01 – 3.17g) and feed conversion ratio (5.41 – 5.97) were not significantly different ($p>0.05$). It was concluded that composite MFRP-MO is a potential feedstuff for quail birds and by extension poultry. It was suggested that higher levels of inclusion of MFRM in their diets should be investigated.

Keywords: Japanese quails**,** Growth, Mango Fruit Reject pulp, Performance, maize offal,

DESCRIPTION OF PROBLEM

The Japanese quail (*Coturnixcoturnix japonica*) is a micro livestock of great potentials and is being considered as one of the livestock that can fit into the project of bridging the protein deficiency gap in developing countries of the world with extra advantages [1]. However, as a monogastric species, it is not immune from the feed-food competition; requiring human foodstuff for animal feedstuffs, should the feedstuffs be conventional alone [2]. Cereal by-products, which have been intensively investigated for non-conventional energy sources are known with common challenges of low nutrient density, high fibre content and anti-nutritional factors, limiting their utilization [3]. Fruit by-products, and or rejects are on the other hand reported to have high nutrient density and are abundantly free [4], but presented with difficulty of costly processing technology [5]. Half-ripe mango fruit rejects have been successfully utilized in poultry diets [2] However, over-ripe fruit is not easily sundried but could be dried using a suitable carrier such as maize offal [5]. Huge quantity of this overripe rejected fruits is available but unused; thereby posing environmental problems. Successful processing of the material will solve both feed and environmental problems, when it is converted to animal feedstuff (2).
This research therefore determined the effects of MFRP-MO mix on the growth performance of Japanese quail (*Coturnixcoturnix japonica*).

MATERIALS AND METHODS

Experimental Site: The study was conducted at the Poultry Experiment Station of the livestock Unit, Federal University of Agriculture Makurdi. The area is warm with a minimum temperature range of 21.71+ 3.43˚C and a maximum temperature range of 32.98+ 2.43˚C [6].

The Preparation of Mango Fruit Reject Pulp-Maize Offal Mix: Over-ripe composite mango fruits rejects were obtained at no cost from mango markets around Makurdi town during its season, which is between April and May. The pulp was extracted manually by removing the peel, and brushing the pulp into a container and discarding the seed. Extracted mango fruit pulp was thereafter mixed thoroughly and evenly mixed with maize offal at the ratio of 1:1, weight by weight. The mixture was sun dried till the moisture was less than 10% and store in polyethylene sacks to the time it was used. Before the mango fruit reject pulp-maize offal mix was

incorporated into the Japanese quail diet, it was first milled using feed milling machine to obtain mango fruit reject pulp-maize offal meal (MFRP-MO).

MFRP-MO was included in diets such that maize was displaced at 0, 5, 10, 15, and 20% respectively to obtain diets T1 (0%), T2 (5%), T3 (10%), T4 (15%), and T5 (20%), as presented in Table 1.

Management of Experimental Birds and Procedure: A total of seventy-five (75) Japanese quail birds were obtained from CHI hatchery farm Ibadan for the study.

On arrival, the birds were weighed and allocated randomly to five (5) treatments with each treatment having three (3) replicates; with each replicate containing five (5) Japanese quail birdsin aCompletely Randomize Design (CRD). Feed and water were served *ad libitum* throughout the experimental period which lasted for 28 days.

Table 1: Percentage composition of the experimental quail diets

Ingredients	**Experimental Diets**				
	0% MFRP-MO	**5% MFRP-MO**	**10% MFRP-MO**	**15% MFRP-MO**	**20% MFRP-MO**
Maize	42.00	37.00	32.00	27.00	22.00
MFRM-MO	0	5.00	10.00	15.00	20.00
SBM	40.00	40.00	40.00	40.00	40.00
BDG	9.55	9.55	9.55	9.55	9.55
Blood meal	4.40	4.40	4.40	4.40	4.40
Bone ash	3.00	3.00	3.00	3.00	3.00
Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.25	0.25	0.25	0.25	0.25
Common salt	0.25	0.25	0.25	0.25	0.25
Premix*	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated Nutrients					
Energy (kcal/kg)	2723.72	2652.11	2591.21	2482.23	2385.10
Crude protein	26.62	26.48	26.21	26.01	25.91
Crude fibre	5.41	5.55	5.65	5.81	5.91
Ether extract	3.68	3.45	3.26	3.05	2.86
Calcium	0.15	0.15	0.15	0.15	0.15
Phosphorous	0.31	0.75	0.75	0.73	0.72

Key: SBM = Soybean meal, BDG=Brewer dried grain, MFRP-MO = Mango fruit reject pulp maize offal mix, VPM = vitamin premix

Vitamin/Mineral premix*= Animal care vitamin/mineral premix included at 0.25 %, translating to 24000 iu vitamin A, 6000 iu vitamin B, 60mg vitamin E, 5 mg vitamin K3, 2 mg Folic acid, 80 mg niacin, 4 mg vitamin B1, 10 mg Vitamin B2, 7 mg vitamin B6, 0.04 mg Vitamin B12, 0.16 mg biotin and 250 mg antioxidant per kg diet. The minerals values per kg diet were: cobalt 0.5 mg, copper 16 mg, selenium 0.5 mg, iodine 24 mg, iron 80 mg, manganese 140 mg, zinc 120 mg and chloride 400 mg

DATA COLLECTION AND ANALYSIS

Initial live weight of the 17-day old Japanese quails was taken by weighing birds before exposing them tomeasured experimental diets. Thereafter, weekly live Weight and feed leftover were recorded, while the final live weight was recorded on the 28th day of the feeding trial, when it was terminated. Weekly feed intake was determined as the difference between amount of feed served at the start of the week and feed leftover at the end of the same week, for all the weeks. Total feed intake was calculated as the sum of the weekly feed intakes, for the four weeks, while daily feed intake was determined by dividing total feed intake against the number of days (28) that the feeding trial lasted. Total weight gain was calculated by difference (final weight- initial weight) and daily weight gain was calculated as total gain over 28; being the number of days the experiment lasted. Feed conversion ratio was determined as the ratio of feed to weight gain.

All data were subjected to analysis of variance using SPSS [7], which was pre-configured to automatically separate significant means, using its Duncan multiple range test.

RESULTS AND DISCUSSION

Table 2: Effects of Mango Fruit Reject Pulp-Maize Offal Mix Meal on the Growth Performance of Japanese Quails *(Coturnixcoturnix japonica)*

	Experimental Diets					
Mean Parameters	**0% MFRP-MO**	**5% MFRP-MO**	**10% MFRP-MO**	**15% MFRP-MO**	**20% MFRP-MO**	**SEM**
Initial weight (g)	49.5o	50.00	49.00	50.33	50.00	0.74
Final weight (g)	135.00	135.00	133.33	139.66	138.66	2.58
Total weight gain (g)	85.50	85.00	84.33	89.00	88.67	2.35
Daily weight gain (g)	3.05	3.03	3.01	3.17	3.16	0.34
Daily feed intake (g)	18.18	17.78	17.16	17.25	17.43	0.24
FCR	5.97	5.87	5.71	5.41	5.41	0.18
DPI (g)	3.65^{a}	3.50^{ab}	3.38^{c}	3.46^{bc}	3.44^{bc}	0.04
FER	0.17	0.17	0.17	0.18	0.18	0.00
PER	0.043	0.042	0.039	0.038	0.039	0.00

^{abc}means with superscript differs significantly ($p<0.05$) SEM=Standard error of mean, MFRP-MO=mango fruit reject pulp-maize offal mix, FCR=feed conversion ratio FER=Feed efficiency ratio DPI=Daily protein intake PER=protein efficiency ratio

Result of the effects of mango fruit reject pulp -maize offal (MFRP-MO) mix inclusion on the growth performance of Japanese quails is presented in Table 2. There were no significant differences ($P>0.05$) among treatment groups on daily feed intake, daily weight gain, feed conversion ratio and final weight. Protein intake was however, significantly different($P<0.05$) across treatment groups without pattern.

Daily feed intake (17.43g- 18.18g) recorded was less than 18.01g to 27.46g as reported by Akinola and Sese [8] but within the range of 14g to 18g reported [9]. Guluwaand others [10] reported 23.67g to 27.01g feed intake per day. This is also higher than this report.

Variation in feed consumption from some past reports may be due to differences in experimental duration and quail strain. The daily weight gains of 2.51g to 2.84 reported by Sheidi [11] is less than the one in this finding. Feed utilization was equally optimized in the MFRP-MO mix based diets for tissue accretion, resulting to similar growth rate. A situation where variation in protein intake did not affect performance suggests that protein intake and quality was enough for optimal performance and exceeded; demonstrating high biological value across dietary treatments. Similarity across dietary treatments group for final weight, weight gain feed intake and feed conversion ratio alludes to the fact that MFRP-MO) mix based diets were comparable to maize base diets at those levels of inclusion. Moreover, Japanese quails are reported to be more tolerant to anti-nutritional factors; characteristic of agricultural by-products and harsh conditions than other poultry species [9]. This might be one reason why they could so utilize the test material.

The feed conversion ratio was but better than 6.40 – 7.05, reported by Sheidi [11], similar with other reports). This implies that higher level of MFRP-MO mix was efficiently utilized by the birds. This means MFRP-MO mix could partially replace maize in Japanese quail diet for efficient yield. Better feed conversion ratios have been reported [10]. This has nothing to do with diet. It is simply because this experiment did not start at the very early chick stage where growth rate and feed efficiency are usually very high.

CONCLUSION

Growth performance was supported by MFRP-MO based diets in a similar way maize did based on the levels examined, and 20% MFRP-MO mix is recommended in quail diets. It is suggested that higher levels should be investigated.

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MICRO-LIVESTOCK AND AQUACULTURE

Growth Performance and Organoleptic Indices of Weaner Rabbits Fed Two Dietary Protein Levels with or without Alligator Pepper *(Aframomum melegueta*)

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Abstract: *Aframomum melegueta*, a phytoadditive is widely used and utilized in the tropics due to its anti-oxidizing, anti-microbial, digestive properties and for treating gastrointestinal disorders. This study aimed at investigating *Aframomum melegueta as a* growth promoter in the diets of weaner rabbits. The growth performance and organoleptic indices of weaner rabbits (mixed breed and unsexed) fed two dietary protein levels (18 vs 16%) with or without *Aframomum melegueta* seed meal (APSM, 0, 0.1 and 0.2%) was evaluated. Six experimental diets were formulated such that diets A, B and C contained 18%CP and 0%, 0.1%, 0.2% APSM, respectively while diets D, E and F contained 16%CP with 0%, 0.1% and 0.2% APSM, respectively. Thirty-six weaner rabbits were allotted into the 6 groups of 3 replicates each. The experimental diets were fed to animals for 8 weeks. Daily Weight Gain (DWG), Daily Feed Intake (DFI), Feed Conversion Ratio (FCR) and sensory qualities of the rabbit meat were monitored. Data collected was analysed as appropriate for a 2x3 factorial arrangements in a completely randomized design. Findings showed that main effects of protein levels and alligator pepper did not elicit any significant differences (P>0.05) on DFI, DWG FCR and sensory attributes. Interaction effect of protein level x inclusion levels of APSM also did not reveal any significant variations except on apparent adhesion. In conclusion, the use of alligator pepper had no adverse effect on growth performance while 16% dietary protein level appeared better utilized compared to 18% in rabbit weaner diets.

Keywords: Alligator Pepper Seed Meal, Growth, Rabbit, Sensory Attributes

INTRODUCTION

Rabbit production is very essential in improving animal protein intake in the developing countries like Nigeria. Rabbit is a very prolific animal as determined by the number of kits born alive at kindling and birth to weaning survivability (Orunmuyi *et al.,* 2006). Rabbit is a monogastric herbivore, it does not compete directly with man for both cereal and legume grains. Rabbits are also favoured because of its high fecundity, low cost of investment, short gestation interval, as well as ability to utilize diverse forages (Taiwo *et al.,* 2004).

In the recent time, the use of herbal feed additives in animal feeds to improve their nutritive value, boost animal growth rate, and enhance feed conversion efficiency as well as lower mortality in livestock industry has been advocated for (Durrani *et al*., 2006; Andriyanto *et al*., 2016). *Aframomummelegueta*is widely used and cultivated in the tropical regions of West Africa and used in food brewing, veterinary and traditional medicine (Doherty *et al*., 2010), for treating gastrointestinal disorders (Alaje *et al*., 2014; Doherty *et al*., 2010). Among several authors (Afolabi and Eko, 2016) reported that inclusion of Alligator pepper seed meal in pullet chicks diet had no detrimental effect on their performance and it compared favourably with those on diet without pepper. This study therefore, aimed at evaluating the effect of alligator pepper *(Aframomum melegueta*) on growth performance of weaner rabbits fed two different protein levels.

MATERIALS AND METHODS

This study was carried out in the Rabbitary unit of the Teaching and Research Farm of Ladoke Akintola University of Technology, Ogbomosho, Oyo State, Nigeria. Dried seeds of Alligator pepper were purchased from local market in Ogbomosho. The seeds were removed from the epicarp and milled into a fine powder using a Gasa blender with model number QBL-20140 and stored in airtight bottles till required for analysis. Thirty-six (36) weaned rabbits of mixed sex and mixed breeds of Chinchilla, New Zealand white and California white with

average weight of 500-700g were used for the experiment. The rabbits were purchased from a reputable farm in Ibadan, Nigeria. The cages were disinfected and the rabbits were treated against endo and ecto parasites before stocking. The rabbits were divided into six groups and 3 replicates with 2 rabbits per replicate. The rabbits were housed in hutches having separate feeders and drinkers.
Experimental diet: Six diets were formulated such that diets A, B and C contained 18%CP supplemented with 0%, 0.1% and 0.2% alligator pepper, respectively. Diets D, E and F contained 16%CP supplemented with 0%, 0.1% and 0.2% alligator pepper, respectively.

Data collection: Initial body weights of the rabbits were taken on replicate basis at the start of the study and thereafter on two weeks' basis. Weekly feed intake was also recorded. The average weight gain, total feed intake and FCR were calculated from the data obtained during the experimental period. For the sensory attributes, 10 semi trained panelists were used to evaluate colour, flavor, juiciness, ease of fragmentation, apparent adhesion, residue after chewing and acceptability. All data collected were analysed as appropriate for a 2x3 factorial arrangement in a Completely Randomized Design (CRD) using procedure of SAS (2003). Significant means was separated by Duncan's multiple range test of the same statistical package.

Results and Discussion: The main effect of protein and alligator pepper on the performance of weaner rabbit (Table 1) elicited no significant effect. The values obtained for the protein levels in terms of DWG (9.6g and 9.4g), DFI (47.9 and 43.1g) and FCR (5.2 and 4.6) for 18 and 16% CP, respectively were not significantly ($p>0.05$) influenced by the level of protein in the diet. For the alligator pepper levels, values of all parameters measured (DWG, DFI and FCR) ranges from 8.8-10.3g, 38.3-50.3g and 3.6-5.6, respectively.

The interaction effect of protein and alligator pepper revealed no significant variations on the performance parameters (Table 2). Though there were no significant effects in the values obtained, but the rabbits on 16%CP diet without APSM had the best values for DWG, DFI and FCR while those on 16%CP diet with 0.2%APSM had the least and poorest values for DWG and FCR. Rabbits on 18%CP with 0.1%APSM had the highest DFI and poorest FCR. Aduku, (2004) recommended that 16%CP is adequate for growing rabbits in the tropics and this corroborates the result obtained in this study. Feed intake was not significantly influenced across the dietary treatment which affirmed the report of Afolabi and Eko, (2016) on pullet chicks. Nuhu, (2010) fed rabbits Moringa oleifera leaf meal and recorded values ranging from 11.71 - 15.10g/rabbit/day, which is relatively higher to the values obtained from this study. The variation could be as a result of diet differences, breed and management systems.

The main effect of protein and alligator pepper on sensory attributes of weaner rabbit revealed that all parameters measured were not significantly influenced as shown in Table 3. The values obtained for protein levels are 6.13 and 5.92 (colour), 6.13 and 6.13 (flavor), 6.13 and 5.50 (juiciness), 6.29 and 5.83 (ease of fragmentation), 5.54 and 4.92 (apparent adhesion), 4.29 and 4.46 (residue after chewing), 7.17 and 7.08 (acceptability) for 18%CP and 16%CP, respectively, while that of alligator pepper levels rages from 5.56 to 6.06, 6.0 to 6.19, 5.38 to 6.25, 5.69 to 6.31, 5.06 to 5.50, 4.19 to 4.63 and 7.00 to 7.25for colour, flavour, juiciness, ease of fragmentation, apparent adhesion, residue after chewing and acceptability, respectively.

The interaction effect of protein and alligator pepper on the sensory attributes of weaner rabbit (Table 4) did not reveal any significant variations. Rabbits on 18%CP without APSM had the highest values for juiciness, ease of fragmentation, apparent adhesion and acceptability (6.63, 6.88, 6.50, 7.50), those on 16%CP with 0.2% APSM had the least values for colour, flavor, juiciness and residue after chewing (5.38, 5.88, 5.13 and 4.00). Carcass meat from rabbits fed 16%CP without APSM recorded the highest values 6.25 and 4.88 for flavor and residue after chewing respectively and least values 5.50 and 4.50 for ease of fragmentation and apparent adhesion

respectively. The non-significant variations observed may be due to the fact that APSM level of inclusion was not high enough to elicit any major response in the rabbit.

CONCLUSION: Findings from this study showed that the use of alligator pepper had no protein sparing effect while 16% dietary protein level appeared better utilized compared to 18% in rabbit weaner diets.

Table 1: Main Effect of Protein and Alligator pepper levels on the performance of weaner rabbit

Parameters	Protein levels		SEM	P. Values	Alligator Pepper levels			S E M	P. Value
	18%	16%			0 %	0.1%	0.2%		
DWG	9.6	9.4	0.52	0.76	10.3	9.5	8.8	0.90	0.54
DFI	47.9	43.1	3.95	0.41	38.3	50.3	48.0	6.85	0.72
FCR	5.2	4.6	0.57	0.48	3.6	5.5	5.6	0.99	0.61

Table 2: Interaction Effect of Protein and Alligator pepper levels on the performance of weaner rabbit

Protein levels	18 %			16 %			SEM	P.Value
Alligator pepper	A	B	C	D	E	F		
DWG	9.8	9.8	9.3	10.8	9.2	8.3	0.90	0.54
DFI	41.3	55.2	47.3	35.3	45.4	48.7	6.85	0.72
FCR	4.3	5.9	5.3	2.9	5.0	5.9	0.99	0.61

Table 3: Main Effect of Protein and Alligator pepper levels on the sensory attributes of weaner rabbit carcass meat

Parameters	**Protein levels**		**P.Values**	**SEM**	**Alligator Pepper levels**			**P.Values**	**SEM**
	18%CP	16%CP			0 %	0.1%	0.2%		
Colour	6.13	5.92	0.68	0.35	5.56	6.44	6.06	0.37	0.43
Flavour	6.13	6.13	1.00	0.34	6. 19	6.19	6.00	0.94	0.42
Juiciness	6.13	5.50	0.22	0.35	6.25	5.81	5.38	0.37	0.43
Ease of fragmentation	6.29	5.83	0.24	0.27	6.19	5.69	6.31	0.38	0.33
Residue after chewing	4.29	4.46	0.81	0.48	4.63	4.31	4.19	0.87	0.59
Acceptability	7.17	7.08	0.80	0.23	7.25	7.00	7.13	0.82	0.28

Table 4: Interaction Effect of Protein and Alligator pepper levels on the sensory attributes of weaner rabbit carcas meat

	18% CP			**16% CP**				
PARAMETERS	**A**	**B**	**C**	**D**	**E**	**F**	**PValues**	**SEM**
Colour	5.50	6.13	6.75	5.63	6.75	5.38	0.25	0.61
Flavour	6.13	6.13	6.13	6.25	6.25	5.88	0.94	0.59
Juiciness	6.63	6.13	5.63	5.88	5.50	5.13	0.98	0.6
Ease of fragmentation	6.88	5.75	6.25	5.50	5.63	6.38	0.24	0.47
Residue after chewing	4.38	4.13	4.38	4.88	4.50	4.00	0.85	0.84
Acceptability	7.50	6.88	7.13	7.00	7.13	7.13	0.64	0.40

a, b: Treatment means on the same row with different superscripts differ significantly ($p<0.05$).

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MONOGASTRIC PRODUCTION/NUTRITION

GROWTH AND EARLY LAYING PERFORMANCE OF JAPANESE QUAIL CHICKS *(Coturnix coturnix japonica)* FED DIETS CONTAINING RAW AND PROCESSED PIGEON PEA SEED MEAL BASED DIETS WITH ENZYME (VEGPRO) SUPPLEMENTATION

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Abstract

A total of seven hundred and twenty (one – week old) Japanese quail chicks were randomly allocated to eight dietary treatments, replicated three times with 30 birds per replicate to investigate the growth performance of the quail chicks fed diets containing raw and processed pigeon pea seed meal (PPSM) supplemented with enzyme (Vegpro$^{(R)}$). Eight diets were formulated which contained 25 % crude protein and were designated as treatments: T1 (Control), T2 (Raw PPSM), T3 (Soaked PPSM for 24 hrs), T4 (Soaked PPSM for 48 hrs), T5 (Soaked PPSM for 72 hours), T6 (Fermented PPSM), T7 (Boiled PPSM) and T8 (Roasted PPSM). Milled pigeon pea seeds raw and processed were incorporated into the treatments at 30 % level. All the diets were supplemented with enzymes except the control. The experiment lasted for 28 days. The results showed that PPSM supplemented with enzyme significantly ($P<0.05$) influenced the performance parameters across all the treatments. Birds on the T1, T2, T3 and T7 diets had significantly ($P<0.05$) higher final body weight and daily weight gain compared to those in other groups. Feed intake was significantly (($P<0.05$) lower in birds fed T1 (11.73g) and T4 (12.03g). However, feed to gain ratio and feed cost per kg gain (₦), first egg weights and age at first egg (days) of birds were also significantly affected. Mortality was significantly ($P<0.05$) low across the treatments. It was therefore concluded that raw and processed PPSM diets with enzyme supplementation improved performance of Japanese quail chicks.

Keywords: Growth performance, Japanese quails, pigeon pea seeds, digestibility, nutrients.

INTRODUCTION

Among many challenges facing livestock sector, acute shortage and high cost of feed ingredients have been identified as a major obstacle to the expansion of the poultry industry in Nigeria and by extension in most developing countries of Africa [1]. The implication is increased total cost of production leading to consequent increase in cost of poultry products. Hence, low average animal protein intake of persons in most of these countries [2].

Due to increasing demand for conventional protein sources like soybean meal, groundnut cake, fish meal and others coupled with their exorbitant cost animal nutritionists has focused on the exploitation of other non-conventional protein sources in an attempt to improve livestock production. One of such non-conventional protein sources is pigeon pea. Pigeon pea (*Cajanus cajan*) is one of the widely grown legumes with a crude protein values of 20.6 – 27.7 % and is desirable due to its high nutrient profile [3]. However, the presence of anti nutritional factors (e.g. trypsin inhibitors, tannins, trypsin, etc) and their effects limit its use [4]. Most of these toxins are reduced to tolerable levels through various processing methods such as soaking and germination, fermentation, cooking, roasting, dehulling etc. [5].

During the past decades, enzyme supplementation of poultry diets has been increasingly investigated and has been found to exert significant beneficial effect Marquardt et al. [6]. Commercial brand of exogenous enzymes include Allzyme SSF, Vegpro, Maxigrain, Nutrasexyla, Rovabio and Roxazyme G2G. Vegpro is an enzyme complex and its major activities include protease, cellulase, pentosanase, (xylanase), Galactosidase and amylase which improves the digestibility, growth and economic efficiency of feed. However, the objective of this trial was to determine the effect of feeding diets containing raw and processed pigeon pea seeds meal supplemented with enzyme (vegpro) on the growth performance of Japanese quails chicks.

MATERIALS AND METHODS

This study was conducted at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, Ahmadu Bello University, Samaru Zaria, Kaduna State. The Pigeon pea seeds used for this study were purchased from Samaru Market in Sabon Gari Local Government Area of Kaduna State, Nigeria. Four processing methods of pigeon pea seeds were employed which included soaking (for 24, 48 and 72 hours), fermentation, boiling for 60 minutes and roasting for 30 minutes. A total of seven hundred and twenty (720) one – week old Japanese quail chicks purchased from National Veterinary Research Institute (NVRI) Vom, Jos were used for the study. Ninety birds were randomly assigned to each of the eight dietary treatments which had 30 chicks per replicate in a completely randomized design. The birds were raised in 75cm long × 75cm wide × 60cm high cages which were thoroughly cleaned and disinfected. Electric bulbs were installed in each pen to provide light and heat during the brooding period. Feed and water were provided *ad libitum* and necessary drugs were administered. Eight experimental diets were formulated which contain 25% crude proteins based on the standard requirement NRC [7]. The experimental diets is as shown in Table 1. Milled pigeon pea seeds processed by different methods as described above were incorporated into the dietary treatments at 30% of diet. Enzymes (Vegpro) were supplemented in the diets at the level of 100g/ton of feed. The experiment lasted for 4 weeks. Feed supplied and the left over were also weighed weekly to determine the weekly feed intake. Average final weight, feed intake, weight gain, feed to gain ratio and cost of feed /kg gains were calculated. Percentage mortality was also computed. The proximate composition of the test ingredient (raw pigeon pea seeds) and experimental diets were determined using the procedures of A.O.A.C. [8]. Data obtained were subjected to analysis of variance using the general linear model procedure of Statistical Analytic System SAS [9]. Significant differences among treatment means were separated using Tukey model.

RESULTS AND DISCUSSION

Growth Performance of Quail Chicks

The performance of the quail chicks fed diets containing differently processed pigeon pea seeds meal with enzyme supplementation is presented in Table 2. The result showed that there were significant ($P<0.05$) differences in all the parameters measured. Significantly ($P<0.05$) higher final weight and weight gain were observed in birds fed T1 (control), T2 (raw PPSM), T3 (soaked PPSM for 24 hours), and T7 (boiled PPSM) supplemented with enzyme compared to those on other treatments. This may be due to higher reduction of anti nutrients in pigeon pea seeds leading to better nutrient utilization in the diets. However, the improved weight and weight gain observed in birds fed diet T2 disagreed with the report of [5] who reported that raw or improperly heated legume seeds fed as the major source of protein in diet for monogastrics can depress growth and efficiency of feed utilization. The higher feed intake was observed in birds fed PPSM based diets supplemented with enzymes except those on diets T1 (11.73 g/bird/day) and T4 12.03 g/bird/day). This may be attributed to the improved taste of PPSM diets as a result of enzyme supplementation hence, the improved feed intake. [10] reported that smell and taste were critical traits in food selection. However, birds on diets T1 (2.94, ₦235.81) and T4 (3.18, ₦289.16) had lower and significantly ($P<0.05$) better feed to gain ratio and feed cost per kg gain compared to those in other treatment groups. This may indicate that feed wastage was minimized leading to better nutrients utilization and conversion to gains. [11] had earlier reported that better feed conversion ratio signified that more feed was retained in the animals and less waste to the environment. Age at first egg (days) was significantly ($P<0.05$) higher (34.67 days) in birds fed T5 (soaked PPSM for 72 hours) with enzyme compared to those in other treatments. However, birds in the control group (6.67g). had significantly ($P<0.05$) lower first egg weights compared to those on PPSM supplemented diets. [12] reported that the addition of enzyme like proteases enhanced the utilization of proteinaceous components of feeds. The result also showed that birds across the dietary treatments came to lay at early age. Mortality was significantly ($P<0.05$) low across all the treatments. It was also observed that the dietary treatments had no negative effect on the performance and health status of the birds.

CONCLUSION AND RECOMMENDATION

From the results of this study, it can be concluded that inclusion of raw and differently processed PPSM with enzyme supplementation in quail diets improved growth performance of quails. In addition, inclusion of raw pigeon pea seeds with enzyme supplementation in quail diets removes stress of processing and poses no threat to performance and health status of quail birds.

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Table 1: Composition of Quail Starter Diets Containing Differently Processed Pigeon Pea Seed Meal with Enzyme (Vegpro) Supplementation (2 - 6 weeks)

Treatments								
Ingredients	**1 Control**	**2 Raw PPSM + Vegpro**	**3 SoakPPM (24hrs) + Vegpro**	**4 Soaked PPSM (48hrs) + Vegpro**	**5 Soaked PPSM (48hrs) + Vegpro**	**6 Soaked + Fermentation+ Vegpro**	**7 Boiled PPSM (60 mins) + Vegpro**	**8 Roasted PPSM (30 mins) +vegpro**
Maize	47.97	30.29	30.29	30.29	30.29	30.29	30.29	30.29
SBM	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
PPSM	0.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
GNC	37.53	25.21	25.21	25.21	25.21	25.21	25.21	25.21
Bone	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Limestone	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Common Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Vit. Premix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25

Total (%)	100	100	100	100	100	100	100	100
Enzyme	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Determined Analysis								
M.E (Kcals/Kg)	2933	2976	2971	2965	2881	2927	2975	2955
Crude protein ((%)	25.12	25.88	26.13	26.68	24.87	24.68	25.06	24.50
Crude Fibre (%)	5.73	5.64	5.00	5.45	6.70	6.00	5.94	6.25
Ether Extract (%)	4.54	4.16	3.92	4.00	4.34	3.85	3.77	4.08
Feed cost/kg (₦)	80.20	90.69	90.69	90.69	90.69	90.69	97.36	97.36

*Biomix chick premix provided per kg of diet: Vit A. 10,000 I.U; Vit D_3 32,000 I.U; Vit E 23,000 mg; Vit K 2,000mg; Vit. B_1 1,800 mg; Vit. B_2 5,000mg; Pantothenic acid 7,500mg; Vit.B_{12} 150mg; Folic acid 750mg; Biotin 100mg; Choline chloride; 300,000mg; Cobalt 3,000mg; Iodine 1,000mg; Iron 20,000mg; Manganese 40,000mg; Selenium 200mg; Zinc 30,000mg; Antioxidant 1250mg.

SBM = Soybean meal, PPSM = Pigeon Pea Seed Meal, ME = Metabolizable Energy, GNC = Groundnut cake

Table 2: Effect of Diets containing Differently Processed Pigeon Pea Seed Meal with Enzyme Supplementation on Growth and Early Laying Performance of Quail Chicks (2 – 6 weeks)

Parameters	**TREATMENTS**								
	1 (Control)	**2 RPPSM + Vegpro**	**3 SPPSM (24hrs) + Vegpro**	**4 SPPSM (48hrs) + Vegpro**	**5 SPPSM (72hrs) + Vegpro**	**6 S+FPPSM + Vegpro**	**7 BPPSM (60mins)+ Vegpro**	**8 RPPSM (30mins) + Vegpro**	**SEM**
Initial Wt (g/b)	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	0.00
Final Wt (g/b)	134.83^{a}	130.67^{a}	129.43^{a}	128.43^{b}	127.80^{b}	127.37^{b}	130.33^{a}	127.47^{b}	3.16
TWG (g/b)	111.83^{a}	107.67^{a}	106.43^{a}	105.43^{b}	104.80^{b}	104.37^{b}	107.33^{a}	104.47^{b}	3.12
DWG (g/b/d)	3.99^{a}	3.85^{a}	3.80^{a}	3.77^{b}	3.74^{b}	3.72^{b}	3.83^{a}	3.73^{b}	0.10
TFC (g/b)	328.55^{b}	386.90^{a}	401.43^{a}	336.78^{b}	404.00^{a}	388.73^{a}	385.94^{a}	392.45^{a}	27.45
DFC (g/b/d)	11.73^{b}	13.82^{a}	14.33^{a}	12.03^{b}	14.43^{a}	13.88^{a}	13.78^{a}	14.01^{a}	0.97
FGR	2.94^{b}	3.59^{a}	3.77^{a}	3.18^{b}	3.86^{a}	3.72^{a}	3.60^{a}	3.75^{a}	0.26
Feed Cost/Kg gain	235.81^{b}	325.79^{a}	341.76^{a}	289.16^{ab}	350.19^{a}	336.97^{a}	350.53^{a}	368.80^{b}	24.93
AFE (days)	33.00^{b}	33.00^{b}	32.67^{b}	33.00^{b}	34.67^{a}	32.67^{b}	33.33^{b}	33.33^{a}	0.72
FEW(g)	6.67^{b}	8.33^{a}	8.33^{a}	7.60^{ab}	7.83^{ab}	7.83^{ab}	7.33^{ab}	6.93^{ab}	0.44
Mortality (%)	1.11^{ab}	2.22^{b}	2.22^{b}	2.22^{b}	0.00^{a}	2.22^{b}	1.11^{ab}	1.11^{ab}	0.42

ab = Mean within the same row with different superscripts are significantly different (P<0.05), SEM = Standard Error of Mean

FWG = Final weight gain, TWG = Total weight gain, DWG = Daily weight gain, TFC = Total feed consumed, DFC = Daily feed consumed, FGR = Feed to gain ratio, AFE = Age at First egg, FEW = First egg weigth.

Effects of sweet potato (*Ipomoea batata)* peel meal (sppm) replacement for maize on the growth performance and carcass characteristics of weaner rabbits (*Oryctalaguscurniculus)*

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Abstract: Eight weeks feeding trial was conducted with thirty-six (36) weaner rabbits to evaluate the performance of rabbits fed sweet potato peel meal (SPPM) as replacement for maize. The rabbits were randomly alloted into four treatment groups in a complete randomizes design. Each treatment was replicated three times with three rabbits per replicate. Four experimental diets were formulated with SPPM at varying levels of replacement. Diet 1 was maize based, which served as control and the test ingredients (Sweet potato peels) quantitatively replaced 5% (2.00kg), 10% (4.00kg) and 15% (6.00kg)of maize meal in diets 2, 3 and 4 respectively. Each of the diets was offered al-libitum to the rabbits. Parameters measured include, growth performance and carcasss characteristics. There were no significant (P>o.o5) differences observed among the growth performance parameters, Carcass yield and the by-products values obtained except the values of internal organs that were significantly affected by the test ingredients with liver and lungs having higher values (25.20 and 6.17g) at treatment three (3). The values of the By-products showed no significant (p>0.05) difference with the exception of pelt/skin and Hind leg. Diet 4 had highest value for pelt/skin and control diet had the highest value for Hind leg respectively. It was therefore recommended that sweet potato peel meal (SPPM) can be used to replace maize at 15% level of inclusion for growing rabbit diets for optimum performance in terms of feed intake, body weight gain and carcass yield without adverse effects.

Keywords: Growing, Rabbit, Growth Performance, Carcass, Replacement

DESCRIPTION OF PROBLEM

The problem of animal protein scarcity in Nigeria and other developing nations have attained a deplorable status which calls for urgent remedy to avert the imminent protein malnutrition (8). In Nigeria, low animal protein intake has remained a major nutritional problem, especially for the low income and non-wage earners (4). Average consumption of animal protein in Nigeria is estimated at 8g/head/day as against a minimum requirement of 35g/head/day recommended by the Food and Agricultural Organization of the United Nations (6). Researchers have shown that the low level of animal protein intake by Nigerians have generated concern as it affects both the physical and mental development of youths and labor force in general. One way of solving this problem is by focusing on production of animals with high rate of production and growth (3).Animal protein is obtained from various animals one of such animals is the rabbit which is rich in protein (20.8%) and low in fat (10.2%) than other meat species (10). The used of non-conventional feed is gaining ground in Nigeria and many others developing counties. The economization of feed cost using cheap and unconventional feed resources is an important aspect of commercial rabbit production (10). Sweet potato (*Ipomoea batata*) peel meal for animal feed will help in reducing the competition between man and animal for the less available grains and will harness the efficient and effective use of sweet potato peel waste. This study is therefore, designed to evaluate the effect of sweet potato (*Ipomoea batata*) peel meal (SPPM) replacement for maize on the growth performance and carcass characteristics of feeding weaned rabbits.

MATERIAL AND METHODS

The research work was carried out at the Rabbit Section of the Teaching and Research Farm of Ibrahim Badamasi Babangida, Lapai, Niger state. Lapai is very close to Minna which is the state capital and lies between latitude 9.31˚and 9.45˚, east of the equator (12).

Source of Rabbits and Test Ingredients and Processing: The thirty six weaned rabbits of mixed sexes and breeds were obtained from Sultan Veterinary Consult farm No 2, Kauru Street hayindogoSamaru Zaria, Kaduna state. The sweet potatoes peel were collected from the surrounding environment in Lapai metropoli in Lapai Local Government Area of Niger state, Nigeria. It was sundried and milled before it was used for formulation of diet to reduce the effect of ant-nutritional factors such as oxalates tannin, saponin and trypsin inhibitor according to (5).

Experimental Diets and Management of Rabbits: Thirty six weaned mixed breeds and sexes rabbits, age between 5-6weeks were randomly allotted to four treatment groups with nine rabbits per treatment. Each treatment had three replicates of three rabbits per replicate. Four experimental diets were formulated with crude protein set at 18% for each diet. Diet 1 which was designated as T1 serves as the control diet and contained high per cent of maize as the main feed ingredient with none test ingredient (sweet potato peel meal). While diets 2, 3 and 4 were designated as T2, T3, and T4 respectively with sweet potato peel meal inclusion at 5, 10 and 15% The cages were well clean disinfected with Dettol and equipped with drinkers and feeders. Prior to the experiment, the animals were fed the control diet and allowed the adjustment period of one week to enable the animals get used to their various cages and diets. The fresh clean water was provided ad-libitum and the diets were measured before giving throughout the research period. The experiment lasted for 8 weeks.

Table 1: Composition of experimental diets

Ingredients	**T_1**	**T_2**	**T_3**	**T_4**
	0%	**5%**	**10%**	**15%**
Maize	42.00	38.00	36.00	34.00
Sweet potatoes peel	0.00	4.00	6.00	8.00
Maize offal	25.00	25.00	25.00	25.00
Soybeans meal	2.00	2.00	2.00	2.00
Fish meal	1.20	1.20	1.20	1.20
Groundnut cake	10.00	10.00	10.00	10.00
Limestone	1.00	1.00	1.00	1.00
Bone meal	2.00	2.00	2.00	2.00
Salt	0.20	0.20	0.20	0.20
Premix	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10
Total	**100**	**100**	**100**	**100**

Experimental design: Completely randomized design (CRD) was used where each treatment was replicated three times with three rabbits per replicate in the ratio of 2:1 (2 females and 1 male).

Data collection

Performance parameters: Data were collected on growth performance parameters (Daily feed intake, Weekly weight gain, Feed conversion ratio) and carcass quality was carried out as described by (2).

Data analysis: The data generated were subjected to Analysis of Variance (ANOVA) using statistical package (SAS, 1998). The means were separated using Duncan Multiple Range Test (DMRT) as described by (5).

RESULTS AND DISCUSSION

Table 2: Proximate analysis of Experimental Diets

Parameters	Treatments			
	T_1	**T_2**	**T_3**	**T_4**
Moisture	6.88	6.30	6.64	6.81
Ether extract	12.90	13.68	13.40	12.64
ASH	11.91	14.50	14.75	14.87
Crude Fiber	3.20	3.86	3.94	4.05
Crude Protein	21.87	23.62	26.25	29.75
Nitrogen Free Extract	43.24	38.04	35.02	31.88

Table 3: growth performances of rabbit fed sweet potatoes peel meal at varying levels of inclusion

Parameters	Treatments					
	0%	5%	10%	15%		
(g)	T_1	T_2	T_3	T_4	SEM	LSD
Initial weight	667.78	744.44	700.00	761.11	19.9806	NS
Final weight	877.20	965.6	902.80	1085.60	47.361	NS
Total weight gain	209.45	221.11	202.78	324.45	31.0398	NS
Daily weight gain	98.12	3.95	3.62	5.79	23.4724	NS
Weeklyweight gain	29.94	31.60	28.96	46.35	4.4325	NS
Daily feed intake	194.76	196.00	196.13	195.94	0.69538	NS
Total feed intake	10906.40	10808.0	10983.10	10972.50	45.146	NS
Feed conversion ratio	12.63	11.327	12.53	10.35	0.59025	NS

Key NS= not significant difference SEM = Standard error of means

Table 4: Carcass characteristics of rabbit fed sweet potatoes peel meal at varying levels of inclusion

Parameters	Treatment					
	0%	**5%**	**10%**	**15%**		
	T_1	**T_2**	**T_3**	**T_4**	**SEM**	**LSD**
Live weight(g)	813.33	693.33	893.33	860.00	35.4943	NS
Slaughter weight (g)	776.67	676.67	856.67	836.67	34.2082	NS
Dressing weight(%LW)	635.40	560.00	413.0	631.4	48.844	NS
Neck weight (%LW)	18.47	17.53	15.90	18.47	1.16901	NS
Thoracic weight (%LW)	70.70	59.10	68.90	68.83	9.6651	NS
Lumber sacral (%LW)	142.87	120.20	149.03	145.23	5.4406	NS
Hind limb weight(%LW)	110.23	98.17	111.87	114.07	3.24072	NS
Fore limb weight (%LW)	64.37	54.23	66.08	65.80	1.44245	NS

NS= not significant (p>0.05) difference SEM= standard error of means

Table 5: Internal organs of rabbit fed sweet potatoes peel meal at varying levels of inclusion

Parameters	Treatments					
	0%	5%	10%	15%		
% live weight	T_1	T_2	T_3	T_4	SEM	LSD
Liver	22.03^{ab}	19.20^{b}	25.20^{a}	24.73^{ab}	1.03739	*
Kidney	7.23	7.20	7.70	7.43	0.29010	NS
Lungs	5.87^{ab}	4.33^{c}	6.17^{a}	5.20^{b}	0.24009	*
Intestine	128.20	120.67	147.53	123.07	5.6088	NS
Heart	2.06	2.23	2.33	2.07	0.10451	NS
Pancrease	0.83	0.77	0.83	1.33	0.15248	NS
Bile	0.50	0.40	0.37	0.50	0.06681	NS
Ceacum	60.40	55.97	51.33	54.67	2.11257	NS

Key a, b, c= means within the same role bearing different superscript differ significantly (p<0.05)
NS= not significant (P>0.05) difference *=significant (P<0.05) SEM= standard error of means.

Table 6: By-products of rabbits fed sweet peelmeal at varying level of inclusion

Parameters	Treatments					
	0%	5%	10%	15%		
% live weight	T_1	T_2	T_3	T_4	SEM	LSD
Blood weight	19.57	18.27	24.77	25.53	1.44245	NS
Pelt/skin	66.83[a]	41.87[b]	61.67[a]	70.03[a]	4.47659	*
Head weight	86.50	78.03	83.50	88.80	2.18322	NS
Tail weight	2.50	1.93	1.97	2.23	0.11772	NS
Fore leg	7.23	6.20	7.03	7.00	0.24319	NS
Hind leg	16.80[a]	12.70[b]	15.93[a]	16.63[a]	0.6518	*

a, b, c= means within the same row bearing different superscript differ significantly ($p<0.05$) NS= not significant difference ($P>0.05$)*=significant ($P<0.05$) SEM= standard error of means

DISCUSSIONS

Table 2 Shows the proximate analysis of experimental diets. The value of crude protein determined for the diet fall within the range of the nutrient requirement for weaned rabbit (2). (9) in their work with sorghum milling dust used in weaners rabbit diet reported % CF (5.29-8.18) is lower than 16.80-17.80%. The growth performance of weaner rabbit fed different level of SPPM is presented in table 3. There were no significant ($P>0.05$) differences in all growth performance parameters measured. However, there were numerical differences in the final weight with diet one having the least value. This indicates an effective utilization of the feed nutrients by the rabbit. Feed conversion ratio value shows that the control diet is not significantly ($p>0.05$) different from the test diets.The values of carcass traits of rabbit fed different level of SPPM as presented in Table 3. were also no significantly ($p>0.05$) different in all the parameters measured. Non significant ($p>0.05$) differences except liver and lungs that recorded significant difference. This probably could be attributed to the effects of the anti-nutritional factors presents in the test diet. Liver been a major detoxification organ and hence increase weight as a result of increased activity to detoxify the anti-nutritional factor (1, 2)., The results of by-products also showed a significant ($p<0.05$) difference in pelt/skin and hind legs weight which did not follow any known cause.

CONCLUSION

The result of the experiment indicate that sweet potatoes peel meal which is cheaply available in the country (Nigeria) can be used successfully up to 15% to replace maize in conventional rabbit feed without any adverse effect on the growth performance and carcass characteristics of growing rabbits.

RECOMMENDATIONS

Based on the result obtained, it is recommended that: Rabbits can be feed up to 15% sweet potato as a replacement for maize in rabbit diet

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Cost Benefit Analysis of forages used in Rabbit Feeding

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Abstract: The use of alternative feed resources with less competition in feeding of livestock is used to address the problem of rabbit production because these alternative feed resources such as forages contain adequate nutrients to meet the requirements of rabbits and also anti-nutrients which inhibit optimum performance. This research seeks to investigate the cost implications of Panicum maximum (Guinea grass) and Leucaena leucocephala (Leucaena) leaf meals in the diets of rabbits. Four diets: Control (Solely concentrates), C+GGLM (equal mixture of concentrates and Panicum maximum leaf meal), C+LLLM (equal mixture of Leucaena leucocephala leaf meal) and C+GGLM+LLLM (equal mixture of concentrates, Panicum maximum and Leucaena leucocephala leaf meals) were used to feed twenty mixed breed weaner rabbits with an average initial weight of 494.0-502.0g. The rabbits were divided into 4 groups of 5 replicates per group and each randomly assigned to the treatment groups in a CRB design. Results obtained showed that Feed cost and Feed cost per unit weight gain was affected by the dietary treatments showing that the inclusion of these forages in rabbit production yields little or no profit.

Keywords: *Leucaena leucocephala* leaf meal, Guinea grass leaf meal, Concentrate diet, Rabbits, Economic benefits.

INTRODUCTION

Rabbits play an important role in the supply of animal protein to the Nigerian populace (Ahamefule *et al*., 2006) which can survive on low concentrates and high forage diets. Forage use in feeding rabbits is a common practice amongst rabbit farmers but a given number of forages contain anti-nutrients. Anti-nutrients serve as a defence mechanism in plants that impair availability of nutrients. The major anti-nutrients mostly found in plant are toxic amino acids, saponins, cyanogenic glycosides, tannins, phytic acid, gossypol, oxalates, goitrogens, lectins, protease inhibitors, chlorogenic acid and amylase inhibitors. Adegbola *et al*.(1985) andBamikole and Ezenwa (1999) reported negative effects of weight loss when they fed forages solely to rabbits but the use of compounded concentrate diets alone has not given optimum results either *Panicum maximum* is the most productive grass in tropical areas which produces palatable fodder (Heuze and Tran, 2015). However,it is generally preferable to supplement it with sources of protein to improve animal performance, it also contain some anti-nutrients (FAO, 2009).*Leucaena leucocephala*: a palatable high nutritive legume which chemical composition is similar to alfafa has anti-nutrients (mimosine and tannin) as its limiting factor for livestock utilization (Onwuka *et al*., 1992; Norton, 2000; Ajit *et al*., 2010; Adekojo *et al*., 2014). These anti-nutrients inhibit protein biosynthesis in the living body and causes toxic symptoms, including growth retardation (Makkar *et al*., 1997; Norton, 2000; Schofield *et al*., 2001; Ajit *et al*., 2010). The astringent taste of tannin-rich feed reduces feed intake (Makkar, 2003) thereby leading to poor growth rate.

MATERIALS AND METHOD

Experimental Site:

The research was conducted at the Rabbits Unit of the Livestock Teaching and Research Farm of the Federal University of Agriculture Makurdi, Benue State, Nigeria.

Preparation of test ingredients

Pannicum maximum and *Leucaena leucocephala* leaf meals were prepared individually by air-drying the leaves on a concrete floor inside a well ventilated house to preserve their nutritive values as much as possible. The dried

leaves were then milled into *Pannicum maximum* leaf meal and *Leucaena leucocephala* leaf meal to be combined with concentrate to form the experimental diets.

Experimental design and procedure

A concentrate diet used was formulated to meet the nutrient requirement of the rabbit. Twenty (20) mixed breed, weaner rabbits of both sex were obtained from a reputable, disease free rabbit farm and used for a ten (10) week experiment. The rabbits were balanced for sex and five (5) rabbits allotted to four (4) treatments in a completely randomized design with each rabbit serving as a replicate. The rabbits were allowed to acclimatize to the new environment for a period of seven (7) days, after which, Live weight differences between treatment groups was minimized. Individual rabbits were given feed and fresh water *ad-libitum.* The treatment diets were as follow:

T1- Sole concentrates (C)

T2- equal mixture of concentrate/*Pannicum maximum* (C+G)

T3- equal mixture of concentrate/*Leucaena leucocephala* (C+L)

T4- equal mixture of concentrate/*Pannicum maximum*/*Leucaena leucocephala* (C+G+L)

Economics of Production

The cost per kilogramme feed and the cost of each diet were determined. The cost of feeding the rabbits on a particular diet for the period of the study was also calculated as the product of the cost per kilogramme of the diets and feed intake. Feed cost/kg weight gain was calculated by dividing the cost Naira/kilogramme of the diets by the total weight gained. The net profit was determined as the selling price of the table rabbit less the total production cost. Consideration was given to cost of medication, labour and depreciation of fixed assets (feeder, drinker and house).

Results and Discussion

The proximate composition of the test diets and cost benefit report of this feeding trial is presented in Table 1 and3 respectively. It showed that feed cost per kg of the dietary treatments was higher in T_1 (#109.50) and progressively reduced with the inclusion of leaf meals, this agrees with Ayoola and Akkinbami (2011) and Adekojo *et al.* (2014) that used non-conventional feedstuffs on rabbits and stated that as the inclusion of the test ingredients increased, cost of feed reduced. Abu and Ekpeyong (1993); Mathew and Akin (2011) observed a decrease in cost per kg diet and cost of feeding which agrees with the observation obtained in this study. This trial also agrees with the findings of Whyte and Wadak (2002) who reported an increase in the cost per unit weight gain with increased inclusion of sweet potatoe in rabbit diets but disagrees with the findings of Abu and Ekpenyong (1993) on cost per unit weight gain. This study contradicts the conclusions made by Ani and Adiegwu (2005), and Ani (2006) that the use of alternative feedstuffs tends to reduce the overall cost of production and improve profit, the poor growth rate could be attributed to anti-nutrients present in the test ingredients (Table 2) which adversely affected profit. The cost benefit ratio, if greater than one is an indication that profit was not met, therefore it concludes that rabbit can be raised at cheaper cost using *Leucaena leucocephala* and *Pannicum maximum* leaf meals but with little or no profit.

Conclusions and Applications

From this study, it can be concluded that the economic analysis revealed that with the inclusion of leaf meals in the rabbit's diets, little or no profit was achieved.Finally, it has been established in this study that *Panicum maximum* leaf meal adversely affects performance and cost benefits of rabbits.

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Table 1: Proximate Composition of Test Diets
(% DM Basis)

FRACTION	T1 (C)	T2 (C+G)	T3 (C+L)	T4 (C+G+L)
Dry matter	89.01	88.98	86.51	87.97
Ether extract	3.87	2.05	2.83	2.40
Crude protein	12.29	15.73	22.76	17.40
Crude fibre	11.71	16.17	14.52	17.88
Ash	9.43	12.35	15.34	12.46
NFE	51.71	42.68	31.06	37.83
ME*(Kcal/Kg)	2598.48	2264.84	2176.24	2183.09

NFE = Nitrogen Free Extract; ME = Metabolizable Energy

Table 2: Chemical Composition of the Test Ingredients (% Dry matter basis)

	DM	Ash	Protein	Fat	Fibre	NFE	ME(kcal/kg)	Tanin	Mimosine
L. leuoucephela	88.15	13.17	26.31	3.73	15.58	29.36	2320.86	0.14	3.38

P. maximum	89.07	14.34	9.82	1.70	30.76	32.45	1654.38	0.58

NFE = Nitrogen Free Extract; ME = Metabolizable Energy, DM = Dry Matter

L. leuoucephela = Leucaena leuoucephela

P. maximum = Pannicum maximum

Table 3: Effect of Feeding *Pannicum maximum* and *Leucaena leucocephala* forages to Rabbits on Economics of Production

Parameters	T1 (C)	T2 (C+G)	T3 (C+L)	T4 (C+G+L)
Feed cost (#/kg)	109.50	90.50	90.50	68.28
Average feed intake (kg)	3.54	2.46	3.04	2.48
Cost of weaner rabbit (#)	1500.00	1500.00	1500.00	1500.00
Total cost of production (#)	1759.50	1740.50	1740.50	1718.28
Average final weight (kg)	1.51	0.68	1.18	0.91
Cost/kg weight gain	387.81	1060.14	419.85	416.62
Feeding cost/Rabbit (#)	387.63	222.63	275.12	169.33
Revenue	2265.00	1020.00	1772.00	1365.00
Profit	515.30	-720.50	32.50	-456.72
Cost benefit ratio	0.78	1.71	0.98	1.26

Cost of a Kg rabbit was sold for #1,700.00k.

Effects of Graded Levels of Boiled Flamboyant Seed Meal (*Delonix regia*) Based Diet on Performance and Carcass Characteristics of Weaned Rabbits

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Abstract: This study was conducted to determine the growth performance and carcass characteristics of weaned rabbit fed graded levels of boiled flamboyant (*Delonix regia)* seed meal in a Completely Randomised Design (CRD). Thirty (30) weaned rabbits between 6 and 8 weeks old were allotted to 5 treatments with 3 replicates each (n=2). Diets were formulated to contain 0%, 2.5%, 5.0%, 7.5% and 10% boiled flamboyant (*Delonix regia)* seed meal respectively. The experiment lasted for eight (8) weeks. There were significant difference (0<0.05) in the weight gain, final weight and FCR of the weaned rabbits across the treatments with those in 10% and 7.5% having the least FCR and best utilized the feeds. There were significant differences (0<0.05) in the weight of the heart, kidney, bladder and lungs across the treatments. It can be concluded that use of *Delonix regia* in rabbit and other livestock production can be used to replace soya beans in a diet. Inclusion level of boiled *Delonix regia* seed meal at 10% gave promising results compared to the control (Maize and soya beans diet).

Keywords: boiled flamboyant seed meal, performance, carcass characteristics and weaned rabbit

INTRODUCTION

The intake of animal protein is low in developing countries than in developed countries. The Food and Agricultural Organization (FAO, 1991) observed that developed countries consume about 60 grams of animal's protein per capital per day while Nigerians with a population of 140 million consume only 15 grams per capital per day with the recommended minimum value of 20 grams per capital per day (FAO, 1991) and due to this low animal protein intake, Nigeria has been recorded to have the highest mortality rate. Therefore, to bridge this gap intensification of researches on animals like rabbits that have high reproductive efficiency and increasing the use of unconventional feedstuff for animal feeding are taken into consideration (Diaro *et al.*, 2005). Micro livestock such as rabbit, guinea pig, grass cutter, quail and pigeons have been suggested as a rapid means of obtaining animal protein Orerede *et al.*, (2000). Rabbit play an important role in the supply of animal protein to the Nigeria populace Amaefule *et al*., (2005). They are efficient converters of feed to meat and can utilize up to 30% crude fibre as against 10% by most poultry species Egbo *et al.*, (2001). Due to their usefulness to thrive on diverse plant materials, studies are therefore on the increase to reduce feed cost and to conserve grains for human feeding in developing countries (Alawa and Umunna 1993). It is therefore imperative to identify and explore legumes indigenous to the tropics among the thousand known species.

Flamboyant tree (*Delonix regia)* otherwise known as 'flames of the forest' is a tropical ever green shrub which belongs to the family of Fabacae (Russel *et al.*, 1997). *Delonix regia* is one of those under-utilized legumes which seeds are wasted every year since they are neither consumed by any animals nor utilized for medical purpose. This seed is known to contain about 20.36% crude protein. Like most legumes, *Delonix regia* seed contains anti-nutrient such as phytic acid, cyanide, trypsin inhibitors, oxalate and haemagglutinins which unless removed or reduced by processing are capable of exerting deleterious effect when ingested by animals. Heat treatment generally activate protein inhibitors, volatile and off-flavor and nutrient qualities may be improved particularly through the breakdown of certain heat stable anti-nutrient such as phytate and flatulence factor (Despende, 1984). This paper will focus mainly on the effect of different inclusion levels of boiled flamboyant (*Delonix regia)* seed meal on the growth performance and carcass characteristics of rabbits.

MATERIALS AND METHODS

This study was carried out at the Teaching and Research farm of Federal College of Animal Health and Production Technology Vom. A total number of 30 rabbits between 6 and 8 weeks old in a Completely Randomised design were allotted to 5 treatments with 3 replicates each (n=2). Five experimental diet were formulated with the control T1 containing (0%), T2 (2.5%), T3 (5.0%), T4 (7.5%) and T5 (10%) boiled flamboyant (*Delonix regia)* seed meal respectively. Feeds were provided in the various troughs daily and water were given ad-libitum. The parameters were measured weekly and the performance data taken include feed intake, initial, final weight, weight changes and body weight gain while the feed conversion ratio (FCR) was calculated weekly. Daily feed consumption was recorded as the difference between feed offered and the left over. Dry seed of *Delonix regia* was obtained from a Vom in Jos South Local Government of Plateau State. The seed was soaked for 8-12 hours after which were boiled for 45 minutes at 100^{o}C and later sun-dried for 72 hours. The sample was subjected to proximate analysis (As shown in Table 1) to determine nutritional component of the seed. The Proximate analysis of the boiled *Delonix regia* seed was carried out at the Biochemistry Department, National Veterinary Research Institute (NVRI), Vom, using the method of AOAC (2005). The Feed composition given to the weaned rabbit is shown in Table 2 to meet the NRC 1977 requirements.

Statistical analysis: Data from the experiment were subjected to statistical Analysis of variance (ANOVA) procedure of SAS 2008 and significant level of $\alpha_{0.05}$ was used. The treatment means were compared using Duncan multiple range test option of the same software.

RESULTS AND DISCUSSION

Table 1: Proximate Composition of Boiled *Delonix regia* Seed Meal

Nutrients (g/100g)	Composition
Moisture	5.25
Crude protein	20.36
Crude fibre	18.00
Ether Extract	2.80
NFE	50.44
Calcium	0.27
Phosphorus	0.07
Ash	3.15

NFE = Nitrogen free Extract

Table 2: Feed Composition of Weaned Rabbit fed boiled *Delonix regia*

Treatments	**A**	**B**	**C**	**D**	**E**
Ingredients	**Control (%)**	**2.5%**	**5.0%**	**7.5%**	**10%**
Maize	53.11	50.58	48.08	45.56	43.04
Maize offal	13.28	12.64	12.02	11.39	10.76
Groundnut cake	29.26	29.89	30.55	31.20	31.85
BDRSM	0.00	2.50	5.00	7.50	10.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Limestone	1.00	1.00	1.00	1.00	1.00
Salt	0.30	0.30	0.30	0.30	0.30
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.15	0.15	0.15	0.15	0.15
Methionine	0.15	0.15	0.15	0.15	0.15
Total	**100**	**100**	**100**	**100**	**100**

Calculated value					
CP	19.00	19.51	20.04	20.56	21.07
MEkcal/kg	2927.20	2909.84	2894.78	2878.53	2860.08

GNC- Groundnut cake; BDRSM- boiled *Delonix regia* seed meal

Table 3: Performance of Weaned Rabbits Fed Graded Levels of Boiled (*Delonix regia)* Seed Meal

Parameter	**(A) 0%**	**(B) 2.5%**	**(C) 5.0%**	**(D) 7.5%**	**(E) 10%**	**SEM**
Initial weight	440.00	444.00	442.00	444.00	445.00	0.27
Final weight (g)	1408.00^{b}	1120.00^{c}	792.00^{d}	1440.00^{ab}	1560.00^{a}	0.25
Weight gain	176.00^{b}	140.00^{c}	99.00^{d}	180.00^{ab}	195.32^{a}	
Total feed intake	1059.90^{ab}	1098.90^{a}	735.40^{c}	1016.00^{b}	1036.30^{b}	0.20
Feed cost/kg	119.58^{a}	116.15^{a}	112.81^{a}	109.34^{b}	105.33^{b}	0.22
FCR	6.02^{a}	7.85^{a}	7.43^{a}	5.64^{b}	5.31^{b}	

FCR= Feed Conversion Ratio

Table 4: Carcass characteristics of Grower Rabbit Fed Graded Levels of Boiled *Delonix regia* Seed Meal

Parameter	**Treatments**					
	A 0%	**B 2.5%**	**C5%**	**D7.5%**	**E10%**	**SEM**
Live weight (LW)g	166.00^{a}	110.00^{b}	74.00^{c}	106.00^{b}	170.00^{a}	12.400
Dressed wt, (g)	968.00^{a}	436.00^{c}	151.00^{d}	390.00^{c}	779.00^{b}	97.200
Forelimb %	72.00^{a}	39.00^{b}	13.00^{c}	37.00^{b}	70.00^{a}	7.440
Hind limb %	126.00^{a}	54.00^{b}	18.00^{c}	63.00^{b}	113.0^{a}	13.300
Skin %	129.00^{a}	78.00^{b}	46.00^{d}	59.00^{c}	63.00^{c}	9.660
Liver %	67.00^{a}	43.00^{b}	22.00^{c}	44.00^{b}	63.00^{a}	5.470
Lung %	13.00^{ab}	8.00^{b}	8.00^{b}	10.00^{ab}	15.00^{a}	1.110
Kidney %	7.00^{a}	5.00^{a}	3.00^{a}	6.00^{a}	7.00^{a}	0.687
Heart %	7.00^{a}	5.00 ^{a}	3.00 ^{a}	6.00 ^{a}	7.00 ^{a}	0.627
Intestine %	360.00 ^{a}	255.00^{c}	217.00^{d}	222.00^{d}	302.00^{b}	18.000
Head %	166.00 ^{a}	110.00^{b}	74.00^{c}	106.00^{b}	170.00 ^{a}	12.400

$^{a.\ b.c}$.means with different superscript on the same row differ significantly.

SEM = Standard Error Mean.

Data in Table 3 showed the effect of boiled *Delonix regia* seed meal on the growth characteristics such as final weight (g), total feed intake (g) and feed conversion ratio. The result showed significant increase (P<0.05) in feed consumption at 2.5% level of *Delonix regia* seed meal inclusion when compared with other groups. It was also noticed that at 10% inclusion level, there was better result regarding to weight gain. There was also significant difference (P<0.05) between the feed conversion ratio between treatments. Effect of graded level of *Delonix regia* seed meals on carcass data contained in different diet present in Table 4 showed that there was significant difference (P<0.05) in the dressing percentage of T1 (Control diet) as compared to other diet. It was observed that T1 has the highest dressing percentage while T3 has the least dressing percentage. The weight of the heart, kidney, bladder and lungs did not significantly (P<0.05) differ among treatments. The forelimb, hind limb and live weight were not significantly different from each other. The results obtained on weight gain at 10% inclusion corresponded with the investigation made by Fatife (2009) who also fed diets containing *Delonix regia* seed meal at 5% and 10% and reported that it has no adverse effect on body weight and carcass evaluation of the rabbits. However, at 5% inclusion level, two (2) mortality were recorded and stunted growth and this could be attributed to the strain and types of rabbits used for the experiment since the rabbits were obtained at different commercial farmers.

CONCLUSION

Based on the findings of the study, it can be concluded their *Delonix regia is* a good source of protein which can be used to replace soya bean in rabbits and other livestock diet thereby reducing cost of feed. Feeding of of boiled *Delonix regia* up to 10% can therefore be recommended for rabbits which also agrees with the findings of Fatife, (2009) in diet of grower rabbit without adverse effect on growth performance and carcass characteristics.

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Haematological Indices and Carcass Characteristics of Weaner Rabbits Fed Pawpaw Seed Meal (PSM)

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Abstract: The study evaluates the haematological indices and carcass characteristics of rabbits fed pawpaw seed meal. The rabbits 4-6 weeks old were allotted to five treatments (12 rabbits per treatment) in a completely randomized design. The experiment lasted for ten weeks. Five concentrate diets were compounded with the inclusion of pawpaw seed meal (PSM) at 0, 10, 20, 30 and 40% respectively. The rabbits fed diets 20%PSM and 30%PSM had significantly higher ($p<0.05$) values in PCV, RBC, WBC, Hb, lymphocyte and monocyte than other diets. Rabbits fed 40%PSM diet had significantly highest ($p<0.05$) in the dressing percentage, followed by 30%PSM and 10%PSM while 20%PSM and 0%PSM were the least. Carcass parameters such as skin, hind and fore limbs, loin, head, thorax and abdomen were highest in rabbits fed 20%PSM and 30%PSM diets compared to other diets. It was also indicated from the result of the study that rabbits fed 0%PSM and 10%PSM were significantly highest in the lung and kidney values than other diets. The heart weight was significantly highest ($p<0.05$) in diet 20%PSM (4.31), 0%PSM (3.71), 10%PSM (3.40), 30%PSM (3.25) and 40%PSM (3.25). It could be concluded that inclusion of PSM in the diets of rabbits had no deleterious effect on haematological indices and 20%PSM diet had the best carcass characteristics.

Keywords: Haematological Indices, Carcass, Characteristics, Pawpaw Seed, Rabbits

DESCRIPTION OF PROBLEM

Micro-livestock production has been identified as the possible means to bridge the protein shortage of the undernourished average African people (Njidda and Isidahomen, 2011). The advocacy for expanding micro-livestock production, particularly rabbit, stems from the potential of rabbit as animal with short generation interval, high prolificacy (Bassey *et al*., 2008), good mothering ability, easy management strategy, ability to utilize waste and other unconventional feed sources for maximum meat gain and the ability to thrive on forage (Fielding, 1991), with little concentrate. As a result of these attributes of rabbit over other livestock, researchers have put in more effort to improve on rabbit nutrition for better performance by searching for alternative feed sources such as agro-industrial wastes to supplement the costly conventional feed ingredients. Thus, pawpaw seed is readily available in the tropics because the fruits can be found all year round, after consumption of the fruits the seed are thrown away and regarded as waste products. Pawpaw seed contains 97.27% DM, 30.08% CP, 34.80% EE, 1.67% CF and 7.11% Ash (Bolu *et al*., 2009). Despite its nutritional values the potentials of pawpaw seed as cheap protein source in animal feed has not been fully exploited. Therefore, this study evaluates the haematological indices and carcass qualities of rabbits fed pawpaw seed meal (PSM)

MATERIALS AND METHODS

The experiment was carried out at the Rabbit Unit of The Oke Ogun Polytechnic Teaching and Research Farm Saki, Oyo State. Nigeria. The study lasted for ten weeks. Pawpaw seeds were sourced, dried, ground and stored for subsequent use. Five concentrate mash diets were compounded with the inclusion of pawpaw seed meal (PSM) at 0, 10, 20, 30 and 40% graded levels (Table 1). Sixty mixed breeds of rabbits (4-6 weeks) were randomly allotted to five treatments in a completely randomized design. The rabbits were housed individually in iron net cages netted with wire mesh measuring 23 x 18 x 15 inch in dimension. The rabbits were provided with the moist mash experimental diets and clean water *ad-libitum* daily. The haematological parameters were determined following standard procedures described by Davis and Lewis (1991). At the end of the experiment, five rabbits from each treatment were slaughtered through the cervical dislocation for carcass analysis using the method of

Odeyinka *et al*. (2007). Data obtained were subjected to analysis of variance procedure of General Linear Model and the Duncan's New Multiple Range Test options of SAS (2008) was used to test treatment effect and detect significant differences among means.

RESULTS AND DISCUSSION

Table 1: Gross composition of the experimental diets

Ingredients	0%PSM	10%PSM	20%PSM	30%PSM	40%PSM
Maize	34.11	34.11	34.11	34.11	34.11
Wheat offal	41.75	41.75	41.75	41.75	41.75
Groundnut cake	10.52	9.42	8.42	7.35	6.31
Pawpaw seed	-	1.10	2.10	3.17	4.21
Bone meal	4.00	4.00	4.00	4.00	4.00
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100

Table 2: Haematological indices of rabbits fed the experimental diets

Parameter	0%PSM	10%PSM	20%PSM	30%PSM	40%PSM	SEM
PCV	34.00^{b}	35.00^{ab}	38.67^{a}	28.00^{c}	36.30^{b}	4.07
RBC	4.24^{c}	4.86^{b}	5.56^{a}	3.67^{d}	4.79^{d}	0.67
WBC	6.80^{c}	9.06^{b}	10.70^{a}	10.67^{a}	8.99^{b}	3.34
Hb	8.70^{b}	9.67^{b}	11.50^{a}	7.70^{c}	8.90^{b}	1.88
LYMPH	69.00^{a}	45.67^{b}	69.08^{a}	65.67^{a}	46.33^{b}	11.41
MONO	0.08^{b}	1.05^{a}	1.00^{a}	1.33^{a}	1.28^{a}	0.59
EOSIN	3.67^{a}	1.36^{b}	0.99^{b}	4.00^{a}	1.33^{b}	1.67
NEU	23.00^{d}	52.00^{b}	32.00^{cd}	36.33^{c}	58.00^{a}	12.26

Table 3: Carcass characteristics of rabbits fed PSM

Parameter	0%PSM	10%PSM	20%PSM	30%PSM	40%PSM	SEM
Dress (%)	62.92^{c}	77.52^{b}	63.91^{c}	72.69^{b}	83.03^{a}	4.49
Carcass (g)	850.00^{c}	1200.00^{a}	1000.00^{b}	1180.00^{a}	1040.00^{b}	56.65
Skin (g)	150.00^{c}	190.00^{b}	220.00^{a}	200.00^{a}	170.00^{b}	11.56
Hind limb	230.00^{b}	225.00^{b}	240.00^{a}	260.00^{a}	180.00^{c}	12.40
Fore limb	150.00^{b}	170.00^{a}	180.00^{a}	180.00^{a}	170.00^{a}	9.06
Loin	365.00^{c}	400.00^{b}	460.00^{a}	440.00^{a}	400.00^{b}	17.25
Head	170.00^{b}	170.00^{b}	190.00^{a}	200.00^{a}	150.00^{c}	8.84
Thorax	190.00^{c}	180.00^{c}	230.00^{a}	200.00^{b}	220.00^{a}	11.00
Abdomen	205.00^{b}	205.00^{b}	280.00^{a}	230.00^{ab}	190.00^{b}	12.00
Liver	60.00^{a}	32.50^{d}	55.00^{b}	37.50^{c}	40.00^{c}	5.96
Heart	3.71^{ab}	3.40^{ab}	4.31^{a}	3.25^{b}	3.25^{b}	0.23
Lung	9.74^{a}	9.92^{a}	7.58^{b}	7.56^{b}	6.16^{c}	0.57
Kidney	9.58^{a}	8.54^{ab}	8.31^{b}	8.49^{ab}	7.69^{b}	0.22

There were significant differences ($p<0.05$) among the means of all haematological parameters in this study (Table 2). The rabbits fed diets 20%PSM and 30%PSM had significantly higher ($p<0.05$) values in PCV, RBC, WBC, Hb, lymphocyte and monocyte than other diets. The PCV observed in this study was within the range value of 31 to 38% reported by Shah *et al*. (2007), and Njidda and Isidahomen (2011) on rabbits fed sesame seed meal. The values reported for these blood parameters were within the normal physiological range for rabbits (Amata, 2010). Adejumo (2004) reported that haematological traits, especially PCV and Hb were positively

correlated with the nutritional status of animal. Hence, the values for PCV and Hb in this study suggest that the various experimental diets had no toxicity effect on the health status of the experimental animals. The values of WBC increased with increasing level of PSM particularly at 20%PSM and above. The implication therefore is that inclusion of PSM at higher levels in rabbit diet showed no indication of allergic condition, presence of parasites or invasion of pathogen or foreign substance in the circulatory system of the animal (Ahamefule *et al*., 2008). There was significant difference ($p<0.05$) in the carcass characteristics of the rabbits fed experimental diets (Table 3). Rabbits fed 40%PSM diet had significantly highest ($p<0.05$) in the dressing percentage, followed by 30%PSM and 10%PSM while 20%PSM and 0%PSM were the least. Carcass parameters such as skin, hind and fore limbs, loin, head, thorax and abdomen were highest in rabbits fed 20%PSM and 30%PSM diets compared to other diets. It was also indicated from the result of the study that rabbits fed 0%PSM and 10%PSM were significantly highest in the lung and kidney than other diets. The 20%PSM had significantly highest value for the heart in relation to other diets. The dressing percentage and carcass weight in this study were higher than the values reported by Ogunsipe and Agbede (2012) for rabbits fed millet offal-based diet. Furthermore, the values recorded for hind and fore limbs and loin here were also higher than that reported for rabbits fed bread waste and *Moringa oleifera* diet (Ayandiran and Odeyinka, 2016). The values obtained for liver, kidney and heart in this study were higher than values of Odeyinka *et al*. (2007) but similar to that reported by Frederick, (2010).

CONCLUSION

It could be concluded that inclusion of PSM in the diets of rabbits had no deleterious effect on haematological indices and 20%PSM diet had the best carcass characteristics.

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Changes in Plasma Electrolytes and Cholesterol of Turmeric root (*curcuma longa*) Meal fed to Growing Rabbits (*Oryctolagus cuniculus*)

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Abstract: The experiment was conducted to determine the effects of turmeric root (*curcuma longa*) meal (turmeric) on the plasma electrolytes and cholesterol of rabbits. A total of twenty-four weaned rabbits were purchased and used for this study that last for 12 weeks. Four diets were formulated to contain different levels of turmeric root meal. Treatment I(0% turmeric root meal) the control, treatment II, 5% turmeric root meal, treatment III , 10% turmeric root meal, treatment IV ,15% turmeric root meal. The twenty-four rabbits were divided into four treatments and each group further replicated into 3 groups with 2 animals per replicate. The animals were housed in a cage in a completely randomized design. The results show that there was significant increase in the serum level of potassium, sodium and chlorine. The result shows that there was a non-significant difference in the level of bicarbonates There was no significant difference in the cholesterol level of the rabbit. The study revealed that the use of turmeric root (*curcuma longa*) meal (turmeric) will not have adverse influence on the plasma electrolytes and cholesterol of rabbits.

Keywords: Rabbit, turmeric, serum electrolyte and cholesterol level

INTRODUCTION

In Nigeria, there is a protein deficiency gap especially when it involves high animal protein (Iheukwumere and Okoli, 2002). The quantity and cost have continued to remain a major challenge to the livestock industry. Rabbit has been reported to utilize fibrous feed efficiency (Leng,2006) hence, they can be raised on cheap and readily available forages (Linga and Lukefahr, 2000). Generally, the purpose of using alternative feedstuffs in livestock diet is to reduce cost while improving the carcass characteristics and meat quality (Obeidat*et al*., 2009).

Feed additives have become essential components of feeds especially for monogastric animals. Until late 1980's, various antibiotics were heavily used worldwide as growth promoting feed additives.

Turmeric root is a tropical root herb of *zingiberaceae* family and it is an essential component of curry powder used in most Nigerian Kitchens. It is also widely used in indigenous medicine in Asia as an anti-microbial endogenous stimulant, anti-flatulent and anti-inflammatory agents. The main active substance on turmeric extract is identified as *curcumin*, which is a strong anti-oxidant (Torres *et al.*, 1998). One other anti-oxidant peptide is tumerin which also has been isolated from turmeric extract. Several in-vitro studies have however revealed that turmeric extracts have antimicrobial effects. Thestudy determined the serum electrolytes and cholesterol of rabbits fed turmeric as feed additive.

MATERIALS AND METHODS

Experimental Location and Duration: The experiment was conducted at the rabbit unit of the University of Port-Harcourt Research and Demonstration Farm Choba, Port-Harcourt, Rivers State and lasted for a period of 12 weeks.

Experimental Animals, Housing and Management: A total number of twenty-four (24) rabbits were sourced from the rabbitry unit of the University of Port Harcourt Research and Demonstration Farm Choba and used for

this experiment. Before the commencement of the experiment, one-week Pre-experimental procedures was observed to get the rabbits acclimatized with the experimental procedures. The test animals in each treatment were identified on individual basis using labelled tags and the initial weight of the animals were recorded. The rabbits were subjected to the same management condition with a well wired merged cage a house for easy observation, feeding and cleaning of their cages. Feeders and drinkers were cleaned daily before fresh feed and clean water were added.

Experimental Procedure and Diet: The rabbits were randomly selected and divided into four (4) treatment groups (T_1, T_2, T_3, T_4) of 12 animals each and further replicated into 3 groups. The groups were assigned to four treatment diets in a completely randomized design experiment. The dietary treatment consists of four levels of Turmeric (*Curcuma longa*) meal. The treatment T_1 (control) had 0g turmeric meal and treatments (T_2, T_3, T_4) had 0g, 50g, 70g and 100g in the formulated feed respectively was given to the animal.
Fresh turmeric rhizomes were harvested from the crop and soil department of the University of Port-Harcourt, Nigeria. The turmeric root was washed thoroughly and boiled for 45 minutes to soften the root and to also kill any bacteria/germ present in the soil which can enter into the powder.
The turmeric root/rhizomes were sliced into small pieces to increase its surface area before drying. It was dried for about 10-15 days to attain an ideal moisture content of 5-10%. Finally, the sliced rhizomes were grinded with the aid of a simple grinder to produce the uniform and smooth turmeric powder.

Sample collection and determination of serum electrolytes and cholesterol: The blood samples were collected from the heart of the dissected animal using syringes and needles. The collected blood samples were put into well labeled sterile plain bottles. The blood samples were centrifuged using the centrifuge machine and serum was collected into well labelled plain bottles, while the blood cells were discarded. The serum was taken to the laboratory for kidney function tests. Serum sodium potassium, Chlorine and cholesterol levels were determined using the Flame photometry method (410 flame photometer, Chiron Diagnostics) The blood samples wereanalysed by methodsexpounded by [Bush, 1975] Serum bicarbonate was determined using the standard assay kit following back titration, diacetylmonoxime, and alkaline picrate methods, respectively

Statistical Analysis: All data collected weresubjected to analysis of variance using the linear models statistical package for social sciences (SPSS) software. Significant difference between means was separated using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The results show that there was significant increase in the serum level of potassium, sodium andchlorine. Potassium is an intracellular ion and it plays a vital role in muscle contraction (mostly cardiac muscle), it also helps in the transfer of phosphate from ATP to pyruvic acid and also plays a role in many other basic cellular enzymatic reactions. Similarly, potassium, an abundant intracellular ion, and plays a vital role in muscle contraction. Chlorine is also important in fluid and electrolyte balance and it is the principal ion in extracellular fluid. The electrolyte derangement resulting from the increase serumlevel of sodium, potassium and chlorine seen in this study thus provides evidence that the use of turmeric root (*curcuma longa*) meal could not present a risk for cramping and muscle weaknessin rabbit. The result shows that there was a non-significant difference in the level of bicarbonates and this was in line with the report of Akhige *et al.* (2012) who reported a non significant difference in the serum level of bicarbonates rat treated with aleo- vera. Bicarbonates is a chemical that acts as a buffer and keeps the pH of blood from becoming too acidic or too basic. There was no significant difference in the cholesterol level of the rabbit.

Table 1: Feed Composition and Calculated Analysis of each Treatment.

Ingredients	**T_I**	**T_2**	**T_3**	**T_4**
Yellow Maize	28.15	28.15	28.15	28.15
Wheat Bran	25.00	25.00	25.00	25.00
GNC	15.00	15.00	15.00	15.00
PKC	28.00	27.50	27.30	27.10
Vit/Min Premix	0.25	0.25	0.25	0.25
Dl Methionine	0.10	0.10	0.10	0.10
Salt	0.40	0.40	0.40	0.40
Lysine	0.10	0.10	0.10	0.10
Turmeric	__	0.50	0.70	0.90
Bone Meal	3.00	3.00	3.00	3.00
Total	**100**	**100**	**100**	**100**
Calculated Analysis				
Crude Protein	20.96	21.085	21.05	21.165
Met. Energy(kcal/kg)	2630.14	2662.80	2670.2	2672.5
Crude Fat (%)	5.70	5.82	5.750	5.90
Calcium (%)	0.36	0.362	0.376	0.380
Potassium (%)	0.605	0.632	0.635	0.639

Table 2: Effect of Turmeric on Electrolytes and Cholesterol

Parameters	**T_1**	**T_2**	**T_3**	**T_4**
Sodium	140 ± 3.00^a	144 ± 6.00^b	146 ± 3.5^b	148 ± 2.00^c
Potassium	5.05 ± 0.05^a	6.64 ± 0.55^b	8.65 ± 0.05^b	9.05 ± 0.05^c
Chlorine	79 ± 1.00^a	91.5 ± 12.5^b	92.5 ± 15.5^b	108.5 ± 2.5^c
Bicarbonate	132±1.00	130.5±12.5	131±15.5	129±2.5
Cholesterol	2.9±0.1	3.0±0.4	2.8±0.15	3.0±0.25

CONCLUSION AND APPLICATION

The study revealed that the use of turmeric root (*curcuma longa*) meal (turmeric) will not have adverse influence on the plasma electrolytes and cholesterol of rabbits.

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Effect of Diferrent Feeds on the Growth Performance of *Archachatina Marginata*

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Abstract: An 8week completely randomized design [CRD] feeding trial was conducted at the site of Teaching and Research farm of Agricultural Technology Department, Federal polytechnic, Ado-Ekiti, Ekiti State, Nigeria.The growth performance of snails (Archachatina marginata) fed with five different feed materials were monitored in this studyso as to know which feed improve or promote the growth of the snails. Forty Juvenile snails were used for this study and were subjected to ten diet treatments of four snails each. Snails fed Treatment 1 (Chicken mash as the control), Treatment 2(Water melon peel), Treatment 3 (Palm fruit), T4 (Cocoyam leaves) and T5 (Sweet potatoes leaves), were housed in a trench cage. The Animals were obtained from a reputable market in Ekiti State and acclimatized for two weeks and fed for eight weeks. Data was collected on weekly basis by measuring growth parameters (shell length increase, shell circumference, and weight gain). The result of the data collected showedthat Moisture content and crude protein in Water melon peel (38.12%and 14.17%) had the highest value; followed by Sweet potatoes leaves (28.17% and 7.96%); Palm fruit(28.01% and7.64%); Cocoyam leaves(23.74% and 7.66%)and chicken mash (18.76% and 13.12%). Considering the weight gained,Chicken mash had the highest weight (41.75 ± 19.16^{b}); followed by Water melon peel(30.13 ± 2.71^{b}g); Palm fruit (27.88 ± 2.80^{b}g); Cocoyam leaves(18.38 ± 7.38^{b}g) and sweet potatoesleave (14.75 ± 0.40^{b}g).Thus snail fed with Chicken mash and Water melonperformed better than Cocoyam and Sweet potatoes leaves which could be exploited as a cheap feed resource for small holder snail production in the humid tropics.

Keywords: Snails, Water Melon Peel, Sweet Potato Leaves, Cocoyam Leaves, Palm Fruit, Growth

DESCRIPTION OF PROBLEM

Archachatina marginata are micro livestock and non-convectional wildlife protein sources. The survival, growth, development and reproduction of snails like that of other species depend highly on housing and quality of feed consumed. In the past, snail production was given little or no attention because of limited awareness of its nutritional and medicinal potentials. It is a vital animal species of good protein source of high biological value, generates high income, and has high market demand {Ngenwi, 2010}.

Snails contain almost all the amino acids needed by the body and most of its by-products are used for cosmetics. Their high protein, low fat and cholesterol content make them a nutritional favourite. Snail farming could be combined with other businesses and reared at the backyard {Ahmadu, 2012}. The feeds are cheap and could be locally sourced {Nwogor, 2015}.

Snails are accepted Nationwide and in all cultures in Nigeria. Snail meat is regarded as a delicacy. It is very palatable, nutritious, rich in protein and iron as well as calcium and phosphorus. It is a major source of essential amino acids (lysine, leucine, isoleucine, arginine, tryptophan, and phenylalanine (Kalio and Etela 2010).

In addition, accelerated deforestation has rendered local gathering of snails from the wild a very difficult task because of rapidly declining snail populations. The consequence is that local communities are not able to satisfy demand for both subsistence and commerce. Although alternative strategies are being sought to boost production, they are also plagued with some difficulties.

For example, knowledge on feed sources is limited to a few {Okpeze, 2007}, the nutrient compositions of these sources have not been evaluated, and the effects of different feed sources on growth and reproduction performances are still not well-known. The therapeutic uses of snails had been on the increase as more scientific researchers are carried out. Some which are worth monitoring both the meat and fluid could be active Ingredients for drugs formulation.

The snail meat could be used in treatment of ulcer, asthma and poor eye-sight. Regular eating of snail meat could also prevent heart problems, kidney related diseases and they are therefore highly recommended for the treatment of diabetes. A recent study has also shown the granular substance in edible snail meat cause agglutination of certain bacteria which could be of value in fighting a variety of ailments including whooping cough (Cobbinah *et al*, 2008).
Snail meats is high in protein (88.37%) and iron (45-50mg/kg), low in fat and contain almost all the amino acids needed by humans. According to Onadeko, *et al.* (2011), the African giant land snails are herbivores, they eat a wide range of plant materials, fruits and vegetables. They may sometimes eat sand, very small stones, bones from carcasses, compound feeds and even broken cement blocks as calcium source for hardening of shell.
African giant land snail could live in captivity for 3-7years with good maintenance whereas native snails could live up to 15years (CEDVS 2012). Snails are vegetarians and accept many types of food. It feed on leafy vegetables that man safely consumes like pumpkins, potatoes and amaranthus among others but waterleaf is suspected to induce diarrhoea in snails.

Also, they feed on grains waste such as maize chaff, crayfish dust, succulent vegetables including fruits of water melon, pawpaw, cassava and cocoyam leaves. Other foods eaten by snails among others include flowers, yam, and carcasses like dead birds, ants and termites. (Fasakin, 2007). Snails are fed with various food items in captivity ranging from compounded feed to plant materials (roughages).
The plant material varies from annual to perennial plants. Similarly, non-compounded materials like poultry dropping, pineapple peel, *Centrosemaesp., Mucinasp.* were also consumed by snails (Eruvbetine, 2012). One major obstacle to efficient snail production in intensive and semi-intensive management system is high cost of feed materials. In livestock farming feed cost is responsible for 60-70 % of the total cost of production (Omole *et al.* 2013).

Various researches have been carried out on feed requirements and growth performance of snail species under captive rearing (Ejidike, 2007). This study assessed the effects of different feeds materials; such as Chicken mash (control), Water melon peel, Palm fruits, Sweet potatoes leaves and Cocoyam leaves on survival rate, weight gain, shell length increase and circumference of African giant land snail (*Archachatina marginata*) under intensive management.

MATERIALS AND METHODS
An 8week completely randomized design [CRD] feeding trial was conducted at the site of Teaching and Research farm of Agricultural Technology Department, Federal polytechnic, Ado-Ekiti, Ekiti State, Nigeria. Forty Juvenile snails were used for this study and were subjected to ten diet treatments of four snails each. Snails fed Treatment 1 (Chicken mash as the control), Treatment 2(Water melon peel), Treatment 3 (Palm fruit), T4 (Cocoyam leaves) and T5 (Sweet potatoes leaves), were housed in a trench cage.
The Animals were obtained from a reputable market in Ekiti State and acclimatized for two weeks and fed for eight weeks with these diets. Data was collected on weekly basis by measuring growth parameters (shell length increase, shell circumference, and weight gain).

Experimental Procedure: Digital measuring scale was used to measure the initial weight of the snail in grams. Each group of the snails was fed with 5% of their body weight. They were fed early in the morning around 7a.m and 6p.m in the evening while left over feeds were removed before the next feeding. The feeders were emptied and washed on daily basis before new feeds were introduced.
Water was also sprinkled on the soil and snails on daily basis to maintain adequate temperature in the pen and also to prevent hibernation. At the end of every three weeks, the soil was removed and replaced to prevent any pathogenic manifestation in the cage.

Data Collection: The snails were weighed at the onset of the experiment and subsequently on a weekly basis. The parameters measured were growth (weight gain response), shell length and shell circumference. The weight

was determined by using digital sensitive weighing balance while the length and circumference was measured using tape rule and vennier calliper respectively.

Statistical analysis: All data were analysed usingStatistical Packagefor the Social Sciences (SPSS, 2014).

RESULTS AND DISCUSSIONS

Table 1showed the proximate composition of the experimental diets. TheMoisture content and crude protein in Water melon peel (38.12%and 14.17%) had the highest value followed by Sweet potatoes leaves (28.17% and 7.96%); Palm fruit (28.01% and 7.64%); Cocoyam leaves (23.74% and 7.66%) and chicken mash (18.76% and 13.12%).

Likewise, Crude Fibre of Cocoyam leaves (11.64%) were higher than other treatments while Ash of the Water melon peel (8.64%) was the highest. Also, CHO of cocoyam leaves (53.76%) were the highest while Water melon peel (35.28%) recorded the lowest carbohydrate in the feed.

Odunaiya, (2008) reported that fruits like pawpaw, cucumber, especially water melon are good and the best for feeding snail because of the essential minerals and vitamins in them. Agbogidi, *et al* (2011), noted thatsnails fed with fruits should contain high moisture content and some vitamins which would increase the weight of snails.

It was suggested that water melon peel would be more nutritious base on the very high crude protein content. According to Fasakin (2007), compounded feeds were rich in all the nutrients but were very expensive to obtain. Compounded feeds are indispensable for commercial snail producers.

Lameed (2006) reported that growing animal required higher nutrient food with crude protein metabolic energy for their body growth and development. The higher carbohydrate in snail meat fed with Chicken mash (44.96%) may be attributed to the high amount of mineral availability in the feed through the natural feed ingredients. Also, various plant parts have different effects on animal tissues (Ademolu*et al.* 2013).

Table 2 indicated the growth performance of *Archachatina marginata* fed with Chicken mash (control); water melon peel; sweet potatoes leave, cocoyam leaves and palm kernel fruit. The highest weight gain was recorded by snails fed with Chicken mash (41.75 ± 19.16^{b}); followed by Water melon peel (30.13 ± 2.71^{b}); Palm kernel fruit (27.88 ± 2.80^{b}) and Cocoyam leaves (18.38 ± 7.38^{b}) while Sweet potatoes leaves (14.75 ± 0.40^{b}) were the least.

Also, the shell length gain was similarly influenced by the experimental diets. Snails on Water melon peel (2.50 ± 1.06^{a}cm) had the highest shell gained while the least was from Sweet potato leaves (1.13 ± 0.35^{a} cm). There was no significant difference ($P>0.05$) in the growth data among the snail species fed with these five diets.

According to Wilson (2004) who agreed with this fact that snail fed with Water melon peel had the highest shell length gained but had little influence on the weight gained because it contained some nutrients, such as vitamin C and A, calcium, potassium which play some important roles for the development of shell.

Ebenso (2002) stated that African giant land snail (*Archachatina marginata)* increases in weight due to the quality of feeds given to them, which enhance the growth, reproduction and good health. Ugwu (2008) reported that the best result in rearing snails is obtained through the mixture of feeds such as (water melon peel, palm kernel fruit, sweet potatoes leaves and cocoyam leaves) which supplement minerals and vitamins.

Table 1 Proximate Composition of Water Melon peel and Palm Fruit.

Component (%)	Chicken mash	Water Melon Peel	Palm Kernel fruit	Sweet potato leaves	Cocoyam leaves
Moisture content	18.76	38.12	28.01	28.17	23.74
Crude protein	13.12	14.17	7.64	7.96	7.66
Crude fiber	11.41	3.96	3.64	11.14	11.64
Ash	3.57	8 .64	4.76	6.68	6.55
Fat	7.12	5.88	3.12	3.74	3.20
CHO	44.96	35.28	46.67	42.31	53.76

Table 2: Growth Performance of *Archachatina marginata* fed different feeds

Parameters	Chicken mash	Water Melon peel	Palm Kernel fruit	Sweet Potato leaves	Cocoyam leaves
Mean final length (cm)	13.88±0.35[a]	16.00± 0.76[a]	17.00±0.00[a]	13.75±0.75[a]	13.75±0.07[a]
Mean initial length (cm)	12.75±0.46[a]1	3.50± 0.93[a]	13.63± 0.52[a]	12.63±0.74[a]	12.63±005[a]
Length difference (cm)	1.13±0.64[a]	2.50± 1.06[a]	2.67±0.96[a]	1.13±0.35[a]	1.13±0.35[a]
Mean final Weight (g) 164.00±14.00[b]	198.63±19.43[b]	246.63± 10.86[b]	239.75±10.83[b]	171.63 ±	20.41[b]
Mean initial Weight (g) 149.25±13.60[b]	156.88±0.27[b]	216.50±11.99[b]	211.88±0.94[b]	153.25 ±	13.03[b]
Weight difference	41.75±19.16[b]	30.13± 2.71[b]	27.88± 2.80[b]	18.38±7.38[b]	14.75±0.40[b]
Mean final Circumference	1.36±0.09[c]	1.52± 0.39[c]	2.00 ±0.19[c]	1.43±0.17[c]	1.57±0.13[c]
Mean initial circumference	1.34±0.09[c]	1.46± 0.39[c]	1.72± 0.42[c]	1.40±0.17[c]	1.55±0.13[c]
Circumference difference	0.02±0.01[c]	2.50± 1.06[c]	2.67 ±0.96[c]	0.03±0.01[c]	0.02 ±0.00 [c]
Specific growth rate (%)	11.00	2.86	3.79	9.00	8.00
Protein efficiency ratio	8.2	2.8	2.5	7.5	8.0
Gain percentage (g) (%)	26.61	13.91	13.16	11.99	9.88
Average Daily gain	1.30	0.94	0.87	0.57	0.46
Survival rate	100	100	75	50	75

CONCLUSION

1. The rate of consumption of Chicken mash and Water melon peel showed that it was highly cherished by the snails. Snails fed with chicken mash feed are rich in all the nutrients.
2. It can thus be concluded that chicken mash, Water melon peel and cocoyam leaves contribute more significantly to the growth and performance of *Archachatina marginata* than sweet potato leaf and Palm kernel fruit.
3. The low weight gained by sweet potato leaf and Palm kernel fruit when compared to other treatments group may be as a result of some anti-nutrients present in the diets which made them unbearable for the snails.

RECOMMENDATION

Based on the above conclusion,snail's farmers are advised to use water melon peel and cocoyam leaves in feeding snails which can be seen at any place.Agricultural extension workers should regularly organize snail workshops, conferences and seminars for snail farmers.Snails rearing in schools, colleges and other institutions of higher learning should be encouraged to establish snailery as school demonstration farms to arouse student's interest as well as enable them acquire heliculture competencies for entrepreneurship, on graduation.

The government should organize exhibitions of these African giant land snails, attend agricultural shows, and trade fair to disseminate the skills required in snail husbandry for the public and patronage researchers on snail farming should be motivated and assisted financially to publish their works for wider publicity on snail rearing which is still very new in the country.

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Response of Crossbred Weaned Rabbits to Diets Containing Fermented – Roasted Ackee Apple Seed Meal

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Abstract: An experiment was conducted at the rabbitary unit of the Teaching and Research farm of Oyo State College of Agriculture and Technology, Igboora to assess the performance of weaned rabbits fed fermented – boiled ackee apple seed meal. The matured ripened ackee apple seeds were collected from trees grown in Igboora metropolis and were processed by fermentation for twenty – one (21) days and were later boiled for 40minutes to ensure detoxification of phytotoxins embedded in ackee apple (hypoglycin A and hypoglycin B) to levels an animal can tolerate. Twenty crossbred (New Zealand white x Chinchilla) weaned rabbits weighing an average weight of between 400g and 500g sed for the experiment and were allotted to five dietary levels of fermented boiled ackee apple seed meal at 0% (A), 5% (B), 10% (C), 15% (D) and 20% (E) respectively and was replicated twice with two rabbits per replicate. The experiment lasted for four weeks. The experiment was arranged in a completely randomized design by using analysis of variance. The result showed that there were significant differences in all the parameters (average final weight, average weight gain/rabbit, average feed intake/rabbit, feed conversion ratio and protein intake) measured for the growth response. The average final weight and average weight gain decreased with increasing level of fermented – boiled ackee apple seed meal. The best feed conversion ratio was obtained in diet 2. The results showed that rabbits can utilize fermented – boiled ackee apple seed meal up to 5% level of inclusion in diets without deleterious effects on the performance.

Keywords: Ackee apple, fermentation, boiled, performance, weaned rabbits

INTRODUCTION

Rabbit production is a veritable tool of alleviating animal protein deficiency in Nigeria as the world was faced with inflation and there was the problem of lack of feed to sustain its ever growing population. Rabbit posse's attributes that make them important over other livestock species. Rabbits are highly prolific and have a short gestation period (28 – 32days). They are good converters, easy to care for and they require low capital investment in rearing. In biological value, the meat is white, highly delicious and appetizing. There are no religious taboos against the consumption of rabbit meat in most countries (Biobaku, 1998). Ackee apple fruit is a tropical fruit belonging to the Sapindaceae family. It is native to tropical West Africa. In Yoruba it is known as isin. The objective of this study was to examine the effects of fermented – boiled ackee apple seed meal on the growth performance of weaned rabbits.

MATERIALS AND METHODS

The experiment was carried out at the rabbitary unit of Teaching and Research Farm of Oyo State College of Agriculture and Technology, Igboora. The experimental area lies in savannah forest zone on Latitude 7^0.43N and Longitude 3^0.28E in an elevation of 140m above the sea level (World Atlas, 2016). The average minimum temperature is above 21.5^0C and maximum average temperature is about 32. 50C.Twenty (20) crossbred (Newzealand x Chinchilla) weaned rabbits with an average weight of between 400g – 500g were purchased from reputable commercial rabbit farm. The rabbits were randomly assigned to five dietary treatments comprising (0%, 5%, 10% , 15% and 20%) of fermented – boiled ackee apple seed meal. Each treatment was replicated twice with four rabbits per replicate. The animals were acclimatized for seven days. The rabbits were dewormed with

albendazole and other routine management practices. The rabbits were grouped based on weight equalization and housed in pen equipped with individual feeding and drinking troughs. Water was supplied *ad libitum* and feed was offered twice daily 0800hr in the morning and 0400hr in the evening. The rabbits were individually weighed at the beginning of the experiment to obtain the initial weight and then subsequently weighed at weekly intervals. The design of the experiment was completely randomized design and the experiment lasted for eight weeks. Ackee apple seeds were obtained from ripened fruit harvested from trees grown in Igboora metropolis. The seeds were sundried to ease crushing and grinding using hammer mill before subjecting the meal to fermentation. Fermentation was carried out by first soaking the grind ackee apple seed meal in water for three weeks after decanted to eliminate the leached chemical in solution to prevent air from entering.The fermented ackee apple seed meal was added to boiling water at 1000c in a cooking pot and heated by naked fire from dried wood for 40 minutes.Boiled seeds were then strained off the boiling water sundried for five days, grind and packaged in a polythene bag labeled fermented – boiled ackee apple seed meal for laboratory analysis for proximate and anti-nutritional composition.

RESULTS AND DISCUSSION

The results of growth performance of crossbred weaned rabbits fed fermented – boiled ackee apple seed meal are presented in Table 2.0. There were significant differences ($P<0.05$) in all the parameters measured.The higher average final weight(650g) was obtained in diet 2 (10% inclusion of fermented – boiled ackee apple seed meal) while the lowest final live weight (350g) was recorded in diet 5(20%replacement level of fermented – boiled ackee apple seed meal).Rabbits fed diet 2 had the highest weight gain (250g) while the lowest average weight gain (50g) was recorded in rabbits fed diet 5.The highest average feed intake (419g) was obtained in rabbits fed diet 4 (15% inclusion of fermented – boiled ackee apple seed meal) while the lowest feed intake (328g) was recorded for rabbits fed diet 2.This result was in line with the findings of (Emenalom, *et al*, 2001) which showed that weaner rabbits fed 10% cooked Mucuna seed meal diet had depressed growth rate. The best feed conversion ratio (1.31) was obtained in rabbits fed diet 2.The highest protein intake (77.72%) was obtained in rabbits fed diet 4 while the rabbits maintained on diet 5 recorded the lowest value (60.10%).For the protein efficiency ratio, rabbits fed the control diet had the highest value (5.83%) while the lowest value was recorded in rabbits fed diets 2 (4.93%)and diet 3(4.93%) respectively.The result on mortalities does not follow any consistent trend as it fluctuate across the dietary treatments.

Table 1.0: composition of the experimental diets.

Treatments	**T1 (0%)**	**T2 (5%)**	**T3(10%)**	**T4 (15%)**	**T4 (20%)**
Maize	55.80	56.81	54.57	53.95	53.30
Soybean meal	23.00	21.84	20.70	19.55	18.41
FBAPSM	0.00	0.15	3.53	5.30	7.06
Wheat offal	10.80	10.80	10.80	10.80	10.80
Fishmeal	2.00	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	4.45	4.45	4.45	4.45	4.45
L-Lysine	0.10	0.10	0.10	0.10	0.10
D-Methionine	0.10	0.10	0.10	0.10	0.10
Salt	0.50	0.50	0.50	0.50	0.50
Premix	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Determined analysis					
Dry matter (%)	92.19	91.98	92.44	92.13	92.14
Crude protein (%)	20.01	20.30	20.30	20.22	20.35
Crude fibre (%)	4.00	4.00	4.00	4.00	4.00
Ether extract (%)	6.80	6.50	7.00	6.50	6.50
Ash (%)	9.20	9.00	9.04	9.00	9.21

M.E (kcal/kg)	3390.04	3419.90	3514.05	3413.02	3378.60

FBAPSM: Fermented –boiled ackee apple seed meal

Table 2.0: Growth response of rabbits fed experimental diets

Parameters	T1 (0%)	T2 (5%)	T3(10%)	T4 (15%)	T4 (20%)	SEM
Average initial weight (g)	400.00	400.00	400.00	400.00	400.00	0.00
Average final weight (g)	600.00	650.00	525.00	500.00	350.00	45.75
Average weight gain / rabbit (g)	200.00	250.00	125.00	100.00	50.00	31.88
Average feed intake / rabbit (g)	369.67	328.00	336.00	419.00	336.67	15.07
Feed conversion ratio	1.85	1.31	2.69	4.19	6.73	8.69
Protein intake (%)	63.40	66.58	68.21	77.72	60.10	2.66
Protein efficiency ratio (%)	5.83	4.93	4.93	5.39	5.60	1.61
Mortalities (%)	0.5	0.00	0.25	0.50	0.75	0.11

a, b, c, d means on the same row with different superscripts differ significantly ($P < 0.05$)

The dailyweight gain was significantly ($p<0.05$) influenced by the dietary treatments. It was as a result of the presence of anti-nutrients in ackee apple (hypoglycin A and B) that had affected the utilization at higher inclusion levels and this agrees with the reports of (Anya *et al.*, 2010) with African yam bean. The reduction in feed intake observed could be due to the presence of anti nutrients in fermented – boiled ackee apple seed meal thereby lowering the palatability and intake as some of the anti-nutrients were known to cause throat burning and irritation. It was also possible that fermentation and boiling might not had effectively reduced the level of anti-nutrients in ackee apple for three weeks and 40 minutes might not had been effective in completely detoxifying the ackee apple seed, thus the observed difference in results obtained in the study. Feed conversion ratio was influenced by dietary treatments. Feed conversion ratio ranged between 1.31 -6.73 and these was incomparable with values (4.22 – 5 13) obtained by (Nuhu, 2010). This showed that the experimental diet was poorly utilized by the animals as a result of phytotoxins (hypoglycin A and hypoglycin B) that exerts its toxicity on the animals. Numerically however, diet 2 had the highest final body weight and best feed conversion ratio and this might have implied that rabbits on diet 2 efficiently utilized their feed better than those on diets 1, 3, 4 and 5 respectively. The protein efficiency of rabbits fed the control diet was significantly ($P<0.01$) higher than those of rabbits fed the fermented – boiled ackee apple seed meal diet. The highest mortality percentage recorded in rabbits fed the test diet testify to the severity of the toxins in the ackee apple seed meal.

CONCLUSION

Results suggest that the optimum level of inclusion of fermented – boiled ackee apple seed meal based diets should not exceed 5% in the diet of weaned rabbits as there was no adverse effects on growth, weight gain and feed conversion ratio at these levels of inclusion.

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Performance of Weaner Rabbits fed Sole Concentrate, Sole Forage and their Mixtures

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Abstract: Replacement or supplementations of concentrate diets by forage is very promising in rabbit production since they are classified as pseudo-ruminants. The study assessed the effect of feeding sole concentrate, sole forage and their mixtures on the performance of weaner rabbits. The treatments (T) were: T_1 which was the control was fed with concentrate and forage simultaneously in the morning and afternoon, T_2 rabbits received forage in the morning and concentrate in the afternoon. T_3 diet was concentrate in the morning and forage in the afternoon, T_4 were given sole concentrate in the morning and afternoon while T_5 were fed sole forage in morning/ afternoon. Thirty (30) weaner crossbreed rabbits (both sexes) with an initial weight of 720-770 were divided into five groups of six rabbits each and randomly assigned to the five treatments in a completely randomized design with each treatment having three replicates of two rabbits in a 63-day feeding trial. Data collected were daily feed intake, weekly body weight, weekly body weight gain, feed conversion ratio (FCR) and cost of feed was computed. The results revealed significant ($p<0.05$) differences in the final body weight and daily weight gain among the treatment means. The growth performance of T_4 were better than T_1. However, rabbits on sole forage and concentrate/forage mixtures diets were cheaper and their performance relatively better compared with those on sole concentrate diet with respect to the FCR and feed cost and therefore recommended.

Keyword: Weaner Rabbits, Concentrate, Forage and Mixtures

INTRODUCTION

Rabbit production is one of the livestock enterprises with the greatest potential and room for expansion as a result of their minimal investment requirements and ability to reproduce fast (Ajaja & Balogun, 2004). Their feed requirement is low especially with regards to demand for grains, while their housing and disease control management requirements are equally low yet their meat is highly nutritious when compared with other meat sources (Nistor *et al.,* 2013). Replacement or supplementations of concentrate diets by forage is very promising in rabbit production since they are classified as pseudo-ruminants (Adegbola *et al.,* 1985. Domestic rabbits (Oryctolagus *cuniculus)* are ubiquitous, providing protein, fibre, research models and companionship. They have high reproductive potentials utilize low grain and high roughage diets and breed all year-round (Iribeck, 2001). Feeding of concentrates alone to animals reduces feed consumption and crude fibre digestion (Butcher *et al*., 1981, Adegbola *et al.,* 1985 Davidson and Spreadury, 1975). Forages, especially legumes with their protein content have the potential of meeting the needs of cheaper feed sources for rabbits (Iyegehe-Erakpotobor, 2007). However, feeding forage alone will not support adequate growth performance. This study is focused on the assessing the effect of feeding sole concentrate, sole forage and their mixtures on the growth performance of weaner rabbits.

MATERIALS AND METHODS

Location of the study: The study was conducted at the rabbit Unit of the Department of Animal Science Farm, Akwa Ibom State University, Obio Akpa Campus, located in Oruk Anam L.G.A., Akwa Ibom State in the southern part of the Nigeria. The area lies between latitude $4^0$50N and longitude $7^0$45 and $7^0$55E and it's in the

hot humid tropics with a climate that is characterized by two seasons (the rainy season which spans between April and October while the dry season spans between November and March). The rains are always heavy and of high intensity ranging between 2,250 and 2,500mmannually. Temperature are uniformly high throughout the year ranging between 26 and 28^0C, solar radiation ranges from 4.11 to 4.95mm, partly due to the high value of insulation and temperature (SLUS-AK, 1994).

Experimental diet and design: The ingredients used for the diet formulation were purchased from livestock shops in Uyo metropolis, Akwa Ibom State. Soya beans were toasted at temperature of 98-100^0C for 25 minutes in a condemned iron pot to remove the anti-nutrients present in it and then sprayed on corrugated roofing sheet to cool. Ingredients to be milled were milled using the Hammer feed mill available in the campus while the mixer in the mill was used for mixing before bagging and storing. The forages (*Calopogonium mucunoides, Panicum maximum, Pennisentum purpureum)* were harvested within the vicinity of the experimental site in the evening, washed and kept overnight to reduce the moisture content before being fed to the rabbits the following morning. Thirty (30) weaner rabbits of both sexes were randomly allotted to five treatments in a Completely Randomized Design (CRD) experiment that lasted for 63 days. The treatments (T) included: (T_1) concentrate and forage fed simultaneously in the morning and afternoon, (T_2)'forage fed in the morning, and concentrate in the afternoon, (T_3) concentrate fed in the morning and forage in the afternoon, (T_4) and (T_5) were fed only concentrates and forages in the morning and afternoon respectivly. Table 1 shows the composition of concentrate diet and blended forages fed to the rabbits.

Experimental Animals and Management: A total of 30 weaner rabbits of cross breeds of New Zealand white and Chinchilla of about 6-7 weeks old which were purchased from a reputable rabbit vendor in Uyo, Akwa Ibom State were used for the study. The animals were allowed one week for acclimatization and the concentrate diet and forages were weighed and supplied them separately in concrete feeders at 6.30am and 12.30 pm daily. Fresh clean water was provided for the rabbits every day, while the concentrate and forage left over and / or wastage were weighed daily before feeding. The animals were given anti-coccidial, medicaments and vitamin-based medications periodically as prophylactics to prevent and cure diseases incidences during the experimental period that lasted for 63 days. The rabbits were weighed at the beginning of the experiment and at weekly intervals to obtain the initial and weekly body weights respectively.

Data collection and analysis: Parameters collected include: Daily feed intake (g), Initial Body Weight, Weekly Body Weight, Weekly Body Weight Gain, and Feed Conversion Ratio (FCR). Data collected were analysed using Analysis of Variance (ANOVA) and significant means were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability.

RESULTS AND DISCUSSION

The proximate composition of the concentrate and forages fed to the experimental animals during the study is presented on Table 1. The crude protein (CP) of the concentrate and blended forages analysed were 18.37% and 18.49 % respectively which were higher than the 16% recommended by Lebas *et al.* (1986) for optimum performance. The crude fibre content of the concentrate and forages blended were 4.0% and 29.04% respectively. The value for concentrate was lower while that of forage was higher. Ekpeyong (1988) and Yusuf *et al.* (2010) recommended dietary fibre level of 13-14% and 12-15% for normal growth.

Table 1: Diet Composition/Proximate Analysis of Concentrate and Forages fed to the Weaner Rabbits

Ingredients	**Percentage (%)**
Maize	43.86

Soyabean meal	23.23	
Wheat offal	15.00	
Crayfish waste	11.61	
Bone meal	2.60	
Palm oil	3.0	
Vit/Min. premix	0.20	
Methionine	0.25	
Lysine	0.25	
Total	100	
Analysed Nutrient (%)	**Concentrate**	**Forages**
Dry matter (DM)	81.55	24.78
Crude protein (CP)	18.37	18.49
Crude fibre (CF)	4.0	29.04
Ether extract (EE)	8.53	5.52
Ash	4.5	5.63
Nitrogen free extract (NFE)	64.63	41.30

Table 2: Performance and Economics of Weaner Rabbits fed Sole Concentrate, Sole Forage and their Mixtures

Variables	**T1**	**T2**	**T3**	**T4**	**T5**
Initial body weight (g)	750	750	770	720	770
Final body weight (g)	1980^{b}	1950^{b}	1900^{c}	2000^{a}	1820^{d}
Daily body weight gain (g)	19.52^{b}	19.05^{b}	17.94^{c}	20.51^{a}	16.67^{d}
Feed conversion ratio (FCR)	1.87^{a}	1.98^{a}	1.94^{a}	1.48^{a}	2.50^{a}
Daily feed intake/rabbit (g)	36.55^{b}	37.80^{b}	4.73^{c}	30.45^{c}	41.75^{a}
Intake of Concentrate g)	15.78	18.39	11.68	30.45	-
Intake of Forage (g)	20.77	19.41	23.05	-	41.75
Feed intake/rabbit (Kg)					
Intake of Concentrate (kg)	0.99	1.16	0.74	1.92	-

Intake of Forage (kg)	1.31	1.22	1.45	-	2.63
Cost of feed consumed/rabbit(₦)					
(i).Cost of concentrate consumed (N/kg)	96.13	112.64	71.85	186.43	-
(ii). Cost of forage consumed (N/kg)	32.75	30.50	36.25	-	65.75
(iii)Total feed cost/rabbit (₦)	128.88	143.14	108.1	186.43	65.00

There were significant differences in the mean final body weight and body weight gains among the treatments. Rabbits on sole concentrate (T_4) had significantly ($p<0.05$) higher final body weight and daily weight gain of 2000g and 20.51g respectively followed by T_1 (1980g and 19.52 respectively) and T_2 (1950g and 19.05) while T_5 had the least values of 1820g and 16.67g respectively. Spreadbury and Davidson (1978) reported that high quality protein diets are known to improve growth rates and meat yield. The result further shows that rabbits on sole forage (T_5) had the highest ($P<0.05$) daily forage intake among the treatments while those on sole forage (T_4) treatment had the least feed intake (30.45g). This low value is due to the fact that a small quantity of the concentrate provides a balance ration for the growing rabbit (Ekereuke *et al*., 2013). On the other hand, large quantity of forage was consumed by the sole forage T_5 (41.75g) because of the high fibrous content, poor amino acid profile and low protein quality. There was no significant difference ($p>0.05$) in the feed conversion ratio among the treatments. The economics of feed consumption of the rabbits in all the treatments is also presented in Table 2. The result shows that sole forage treatment (T_5) had the lowest feed cost of ₦65.75 followed by concentrate in the morning/forage in the afternoon T_3 (₦108.10). The sole concentrate had the highest feed cost of ₦186.43 and best performance in terms of parameters measured. On the other hand, sole forage feeding had the lowest cost but and relatively lower performance.

CONCLUSION AND RECOMMENDATIONS

The growth performance parameters of the rabbits on the sole concentrate diet were better in terms of final weight and body weight gain than rabbits on the diets of sole forage. Rabbits on sole forage and concentrate forage mixtures diets were relatively cheaper. The growth performance of rabbits on T_1, T_2, T_3 were also good compared to the rabbits on sole concentrate diets with respect to the FCR. Therefore, diets T_1, T_2 and (concentrate/ forage mixtures) which are also good in term FCR performance and relatively cheap are recommended.

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Heamatology, Serum analysis, Cholesterol status, and Physico-chemical evaluation of rabbit fed Africa Sunflower Leaf Meal in their Diet

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Absract: A ten weeks of feeding trials was conducted to investigate the effects of African Sunflower Leaf Meal (ASLM) inclusion on weaners rabbit on hematology, serum analysis, cholesterol status and physico-chemical evaluation. 48 (weaners) White New Zealand male rabbit at six weeks of 9.5 to 1kg were allotted to four dietary treatments. Treatment 1: *Tridax procumbens*, Treatment 2 :100% Concentrates, Treatment 3: 50% ASLM + 50% concentrates, Treatment 4: 100% ASLM with twelve rabbits per treatment in a completely randomize design (CRD). Hematological indices were significant highest (P>0.05) in T4 with PCV (32.01%), RBC (6.15 x 10^6ul), WBC (8.950 x10^3Ul), lymphocyte (71.33%), platelet (109.7) than followed by T1, T2 and T3. Serum metabolites had significant highest valves in T4 for all parameters measured except for Alb (g/dl) than other treatments. When the dietary treatment on cholesterol was evaluated, T2 had the highest significant values for LDL (7.72 mg/dl) and HDL (60.43 mg/dl), followed by T1 with LDL (6.03 mg/dl) and HDL (59.12 mg/dl) while T4 had the least significant values of LDL (5.14 mg/dl) and (HDL 51.00 mg/dl). T4 had the highest (P>0.05) value for water holding capacity (80) followed by T1 (39) while T3 had the least (26). T3 and T4 were rated higher for color or appearance by the panelists than T1 and T2. Rabbits fed T4 100% ASLM in their diet, performed better that other treatments in all parameters measured.

Keywords: Rabbits, Haematology, Serum, Cholesterol, Physico-Chemical

INTRODUCTION

Malnutrition of animal protein is the major problem faced by majority of the ever increasing population of Nigeria. Production of animal protein from cattle, goat, sheep, swine and poultry requires much capital, time, space and their even their feeding competes with man for certain ingredients, which has led to increase in price of products. Ojewole *et al.,* (1999) reported that Animal protein is the best source of protein and often very expensive which it is not within the reach of an average Nigerian. Rabbit pay an important role in the supply of animal protein to Nigeria populace as reported by (Amaefule e*t al.*, 2005). Rabbits is close to modern broiler chicken in terms of growth rate, feed conversion efficiency and quality of meat produced (Anthony *et al.,* 1990). It could feed on non - conventional feeds and it does not compete with man for certain ingredients. Meat of rabbits is tasty, suitable as their cholesterol content is low, sodium and fat are low with high protein contents, no religion and cultural taboo against the consumption of their meat (Biobaku *et al.*, 1997).

With many advantages over others, availability and cost of conventional feed ingredients are some of the constraint to rabbit production and the use of non-conventional ingredients is an alternative to reduce cost of feed. The use of forage and agro-industrial by-products has become an area of interest to animal husbandry practioners, especially, in production of good quality meat and challenges posed by conventional feedstuffs as observed by (Olayeni *et al.*, 2006).

Their major forage crop is *Tridax procumbens*, which is known as rabbits weed for a very long time, incorporating other foliage or feeds, which could help to increase its production or the health status should be a welcome idea. Work have been going on, on African sunflower (*Tithonia diversifolia*) for a while now, since researchers has noticed that African sunflower is a good example of forage that contains essential amino acids and minerals (Farinu *et al.*, 1992), it crude protein has high concentration of methionine (FAO, 2000), but currently, they are in a limited use, either due to lack of adequate nutritional information's.

Mahecha *et al.,* (2005) noted that its protein content of Africa Sunflower could be compared favourably with other known conventional sources. It is rich in minerals and vitamins especially the B-complex vitamins, Day and Levin (1854). Odunsi *et al.,* (1999), state that wild sunflower leaf meal contained 16.61% crude protein, 12% crude fibre, 5% ether extract, 14% ash and 52,39% Nitrogen free. Onifade, (1993), Olayemi *et al*., (2006) also reported that, it has 11% crude fiber, 5.5% ether extract, 18.2% ash content and 18.9% DM.

Most times during the raining seasons, rabbits often had serious problems with cold weather which has resulted in death and folding up of most rabbit farm in masses, this could be attributed to their genetic make-up as it usually affects most rabbit in respective of their breeds. And so the health of rabbit before, during and after the cold weather needs to be serious look into, one of the ways to easily identify rabbit health status is through the blood of rabbit. Onifade (1993), explained that blood examination is a good way of assessing the health status of animals as it played a vital role in physiological, nutritional and pathological status on the animal. Most times feed ingested create a lot of problem on the blood which could result on the health problems on the animal. Church *et al*., (1989) said ingested of numerous dietary component has measurable effect on blood parameters. Therefore, inclusion of African Sunflower (*Tithonia diversifolia*) in the diet of rabbit production could have a positive impact on rabbit blood. So this study will evaluate haematology, serumanalysis, cholesterol status, and physico-chemical evaluation of rabbit fed Africa Sunflower Leaf Meal in their diet.

MATERIALS AND METHODS

Experimental Location / Site: This study was carried out at the rabbitory unit of the Teaching and Research farm of Osun State University, Faculty of Agriculture, Ejigbo, Osun State. The Teaching and Research farms is situated in Ejigbo, Osun State, Southwestern region of Nigeria. The annual rainfall and temperature of the experimental site is 1,2000 mm and 26.6 ^{0}C respectively and located on latitude 4^0 18 and an altitude of 426 above the sea level.

Experimental Animal and management: Forty-eight (48) (6 weeks olds) of weaner rabbits of male strain of New Zealand white were sourced from a reputable farm (Tao Rabbits Farm) in Osogbo. The cages were washed, disinfected and the animals were quarantined and acclimatized for a week and later allotted to four treatments and three replicate each. All routine management were carried out (feeding, clean water, observation of sick animal and mortality).

Experimental design and Treatment: The below dietary treatment was employed and the animals were allotted to the treatment in a Complete Randomized Design (CRD)

Treatment 1: Control 100% Tridax

Treatment 2: 100% Grower mash concentrate

Treatment 3: 50% Africa Sunflower Leaf Meal (ASLM) and 50% grower mash concentrate

Treatment 4: 100% Whole Africa Sunflower Leaf Meal

Table 1: Gross Composition of Grower's Mash

Ingredient	Percentage composition
Maize	47.7
Soya bean	20
Wheat offal	17
P.K.C	3.0
Bone meal	5.0
Oyster shell	6.5
Methionine	0.1
Lysine	0.1

Premix	0.5
Salt	0.1
	100
Calculated crude protein (%)	16.6
Metabolizable Energy (kcal/mg)	2600

Experimental Diets: Africa Sunflower Leaves were harvested at the vegetative stage around the school premises, chopped and air-dried on a concretes floor for three weeks and kept in an air-tight silo bag. Grower mash (concentrate) and *Tridax procumbens* were also fed to the animals.

Collection of blood samples and analysis: Blood samples were taken from the jugular veins and ear veins of the animals at the end of the feeding trial. The blood collected into sterilized plastic bottles one containing EDTA for haematological indices and the other bottles without EDTA for serum analysis. Packed cell volume was determined by centrifuging in a micro haematocrit capillary contained the blood for 5 mins at 3000rv/mins, RBC, WBC were determined by the used of neubauer haemocytometer while haemoglobin was determined by cyanmethaemoglobin method and appropriate formula as outlined by Jain (1986), Aspartate amino transaminase (AST), Alanine amino transaminase (ALT), glucose, albumin, total protein were determined by kinetic method of Sampson, et al., (1980) and kinetic method of Reichling and Kaplan (1988). Cholesterol contents were analyzed as reported by Wechelbaun, (2004), the low density lipoprotein (LDL) and high density lipoprotein were calculated by the use of FriedWald equation (Friedwald, 1992).

Physico-chemical analysis and meat colour determination: The parameter checked for the meat samples for physico-chemical analysis were; water holding capacity (WHC), determined by press method modified by Suzuki *et al*., (1991), cold shortening determined by Dun *et al*., (1995) method, thermal shortening determined by modified method of Mahendeakar *et al*., (1998), thaw rigor by mathematical formula. The colour of the meats were determined by the use of National Pork Colour Chart Unit of United State of America (NPB), (2009).

Statistical analysis and Design: All data collected from the study was subjected to analysis of variance (ANOVA) and significant mean were separated by Duncan's multiple tests using procedure of SAS (1999). Completely randomized design was used for the study.

RESULTS AND DISCUSSIONS

Table 2: Proximate Composition of Experimental Diet.

Constituents	**T1** ***Tridax***	**T2 Grower's mash**	**T3 Grower's mash** ***+Tithonia diversifolia***	**T4** ***Tithonia diversifolia***	**SEM**
Dry Matter (%)	90.10^{ab}	93.15^{a}	91.50^{ab}	88.12^{b}	0.249
Crude Protein (%)	22.98^{a}	19.25^{c}	22.05^{a}	22.35^{a}	0.341
Crude Fibre (%)	5.46^{c}	4.54^{c}	7.30^{b}	12.70^{a}	0.336
Ash (%)	3.10^{d}	5.50^{c}	10.30^{b}	15.70^{a}	0.190
Ether Extract (%)	5.10^{a}	5.50^{a}	3.50^{b}	2.11^{c}	0.275
Nitrogen Free Extract (%)	53.86^{c}	65.21^{a}	56.85^{b}	41.14^{d}	1.98

^{abcd} means on the same row with different superscripts are significantly different ($P<0.05$)

Table 3: Shows the effect of diet on the Haematological parameters of the experimental animal

Parameter	T1	T2	T3	T4
PCV (%)	29.01±3.79	33.78±2.32	26.88±3.57	32.01±0.57
H.b (g/dl)	9.53±1.37	11.05±0.51	8.28±1.01	9.41±0.40
RBC (10^6ul)	5.85±0.28^{ab}	5.36±0.11^{b}	5.30±0.06^{b}	6.15±0.08^{a}
WBC (10^3ul)	8950±862.17^{a}	8300±351.19^{ab}	6466.70±308.7^{b}	8390±195.19^{a}
Lymp (%)	70.80±0.92^{a}	65±0.003^{b}	65.68±2.33^{b}	71.33±0.33^{a}
Neut (%)	24.33±0.88^{b}	27.03±1.51^{ab}	40.82±8216.60^{a}	22.48±1.25^{c}
Mono (%)	2.33±0.67	2.67±0.67	2.00±0.58	3.67±0.67
Eos (%)	2.67±0.67	2.67±0.33	2.00±0.58	2.00±0.58
Platelet	104±3.61^{ab}	102.33±3.84^{ab}	93.00±4.73^{b}	109.7±3.90^{a}

^{a,b,c}Means within the same row with different superscripts differs significantly(P<0.05).

PCV- Parked cell volume, Hb- Haemoglobin, RBC-Red Blood Cell, WBC-White blood cell, Lymp-Lymphocyte, Neut-Neutrophil, Mono-Monocyte, Eos-Eosinophil, ±SEM-Standard Error of Mean

Table 4: Shows the effect of treatment on the serum metabolites

Parameters	T1	T2	T3	T4
AST (I.U/l)	41.56±2.61^{a}	39.41±0.47^{ab}	35.16±0.02^{b}	39.63±0.06^{ab}
ALT (I.U/l)	30.94±2.55^{ab}	30.25±5.77^{ab}	24.6±1.11^{b}	41.22±1.38^{a}
GLU (mg/dl)	24.67±2.70^{b}	39.97±1.52^{a}	41.10±1.67^{a}	40.30±0.20^{a}
Alb (g/dl)	3.83±0.14^{ab}	4.07±0.08^{a}	4.00±0.01^{a}	3.62±0.02^{b}
TP (g/dl)	6.15±0.04	7.26±0.14	6.27±0.82	7.37±0.54
Cholest (mg/dl)	137.83±8.82^{a}	73.25±2.63^{b}	80.66±5.43^{b}	160.30±19.38^{a}
LDL (mg/dl)	6.03±0.02^{b}	7.72±0.14^{a}	5.72±0.04^{c}	5.14±0.08^{d}
HDL (mg/dl)	59.12±0.02^{b}	60.43±0.29^{a}	52.77±0.11^{c}	51.00±0.03^{d}

^{a,,b}Means within the same row with different superscripts differs significantly(P<0.05)

AST-Aspartate amino transaminase, ALT-Alanine amino transaminase, GLU-Glucose level, Alb-Albumin, TP-Total protein, Cholest-Cholesterol content, HDL-High Density Lipoprotein, LDL-Low Density Lipoprotein. ±SEM-Standard Error of Mean

Table 5: Shows the effect of diets on the physio-chemical analysis of the animal

Parameters	T1	T2	T3	T4
Thermal shortening	13.33±0.27^{d}	19.95±0.72^{a}	17.43±0.40^{b}	10.18±1.02^{c}
Cold shortening	4.61±0.34^{c}	8.03±0.57^{b}	11.67±0.61^{a}	6.49±0.92^{bc}
Thaw rigor	18.70±0.91^{d}	39.12±2.14^{a}	26.58±0.32^{b}	22.66±0.73^{c}
Water Holding Capacity	39.90±4.93^{b}	51.16±6.38^{bb}	25.55±7.19^{c}	80.87±8.06^{a}

^{a,b,c}Means within a row with different superscripts differs significantly (P<0.05)

Table 2 shows the proximate composition of the experimental diets, T4 had the highest significant (p<0.05) values in crude protein, crude fiber and ash content with lowest value in dry matter, ether extract and Nitrogen free extract than in other experimental diets. In this table, T4 had the highest nutrients. The crude protein values (22.35%) was in line with the report of Nguyen *et al*., (2010) but greater than (20% and 18.9%) reported by (Patoummalangey, 2010 and Olaniyi *et al.,* 2006) however, the values are lower than 28 % reported by Katto and Salaza (1995). The crude fiber value is greater than the report of 11% reported by Olayemi *et al.,* (2006) while the ether extract and the nitrogen free extract are lower than the report of 5.5% for ether extract (Olayemi *et al*., 2006) and 38.4% Nitrogen free extract 38.4% (Ngugen *et al*., 2010). The variation observed in the different authors could be due to the different types of species, soil type and environmental condition African Sunflower were subjected to.

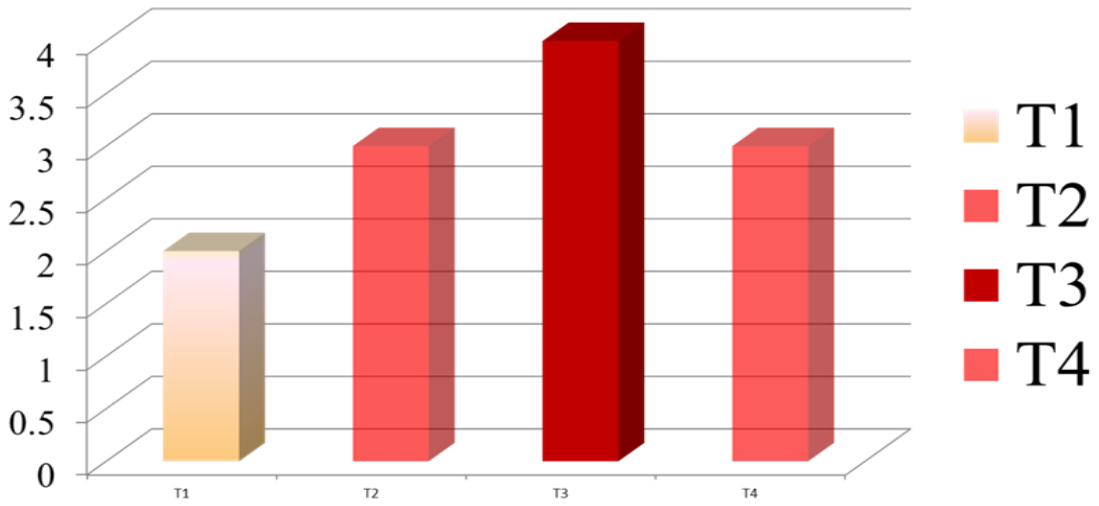

Figure 1: Effect of dietary treatment on the colour of the animals

Table 3 shows the effect of experimental diet on hematological parameters. T4 had the significant ($p<0.05$) highest values in PCV (32.01%), RBC (6.15 g/dl), WBC (8390 10^2ul), Lymphocyte (71.33%) and Platelet (109.7) than others experiment diets (T1 –T3). The values obtained were in agreement with the reported by Mitruka and Rawnsley, (1997) who work on the clinical biochemical and haematological reference value in Normal Experimental animals. All values obtained were within the range established for healthy rabbits by Mitruka and Rawnsley (2007) The diets contained essential nutrients for normal functioning of the hematopoietic tissues (Esonu *et al* 2006).

PCV value obtained fell within the range of the values reported by Iheukwumere *et al*., (2003), when tridax were given to rabbit at graded level and also Irekhore *et al*., (2016) with values of 28.0% - 38.0% when pigs were fed with L-carnitine supplemented diets. However, the value obtained was lower than (36.0 – 43.10%) reported by Duwa *et al*., (2015) when weaner rabbits were fed graded levels of sunflower seed meal. Haemoglobin obtained ranges from 8.28g/dl – 11.05g/dl, and the values fell within the values (9.30g/dl – 12.67g/dl) reported by Irekhore *et al*., (2016). RBC values obtained were in line with that of (Sirdhar, 2004 and Duwa *et al*., 2015) while the value obtained for WBC (6466.70 – 8950 x 10^3) agreed with Farinu (1999) when mango – seed kernel meal were fed to weaner rabbits and that of Iyayi (2001) when cassava leaves was supplemented for feeding of weaner swine.

Neutrophils results in this study fell within the report of Mitruka and Rawnslay (1997) for normal healthy rabbits and Ogbuewu (2015) when rabbits were fed with Neem leaf based diets. Lymphocyte values were within the range of Ogbuewu, (2015) but higher than 53.50% - 65.8% reported by Mitruka and Rawnsley (1997) for clinically healthy rabbits. Platelet values in this study also fell within the range of (Olabanji *et al*., 2007). Ikewuchi, (2009) concluded on haematological parameters that, the increase in monocytes counts and platelet numbers, increased haemoglobin concentration, neutrophil counts and the lymphocyte counts shows that both plant had improved haemoglobin concentration and had potential of anemia management. And Esonu *et al*., (2001) reported that haematological constituents reflects the responsiveness of the animal to its internal and external environment which include feed and feeding, indicating good nutritional adequacy of all the diet used. In this study, it shows that T4 had the best choice of haematological study constituents a healthy rabbit could have.

Table 4 shows the effect of the treatment on the serum metabolites. T4 showed highest ($p<0.05$) values for ALT (41.221ul), GLU (40.30 mg/dl), TP (7.37g/dl) and cholesterol (160.30mg/ul) than other treatment evaluated. T1

has the highest value of AST (41.561ul), T2 showed the highest value for albumin (4.07g/dl) and T3 as in T4 showed significant effect (P<0.05) on glucose with the value (41.10 and 40.30mg/dl). The values obtained for ALT were in line with Fasuyi *et al*., (2013) who fed growing pigs with varying levels of wild sunflower leaf meal. The value obtained for glucose were in line with Ogbuewu *et al*., (2015) when rabbits are fed with neem leaf meal based diets. TP values obtained agreed with the report of Irekhore *et al*., (2016) with (6.55g/dl -7 55g/dl) values. While the albumin values obtained were not in agreement with the report of Fasuyi (2007), who worked on *Telfaria Occidentalist* leaf meal. Cholesterol values were contrary to what was observed by Irekhore *et al*., (2016) when pigs were fed with L-carnitine supplemented diets (134.3mg/dl – 184.0mg/dl). The highest value in T4 could be attributed to the high saponin content which has been shown to bind to serum lipids especially cholesterol thereby easing their excretion from circulation as reported by (Matawall. 2009). LDL and HDL values were significantly different (P<0.05) The values obtained were in line as reported by Ogbuewu, (2008) of ASLM supplementation in pig increases serum HDL and lowers LDL. This is due to the secretion of Very Low Density Lipoproteins (VLDL).

Table 5 shows the physico-chemical parameters of rabbit meat fed African sunflower inclusion in their diet. T4 had the higher significant (p<0.05) values for water holding capacity with 80.87 than T1 – T3. T2 was higher in thermal shortening and thaw rigor while T3 had the greater value in cold shortening. Cold shortening has been reported in recent years as resulting from a low temperature in the muscle before the onset of rigor mortis, which causes contraction in muscle resulting in reduction in the length of muscle from the initial length (Hedrick et al., 1994) T1 and T4 had the least cold shortening and thermal shortening, which is the reduction in length of meat under a higher temperature. Thaw rigor also follows the same trend as in T1 and T4, but the water holding capacity followed different ways as T4 had the highest value and T3 had the least value. Water holding capacity is the ability of meat to retain its water during application of external forces such as cutting, grinding and pressing, is also used as a good indication for quality good meat product. It could also be loss evaporation from meat surface, as exudates or when muscles are cut (Hedrick *et al*., 1994). The value obtained in this study are less than (44.1- 69-1%) reported by Fakolade, (2008) and (42.2 -67.0%) reported for scalded, singed and skinned dressed rabbit reported by Omojola and Adesheyinwa, (2006) but were far greater than (1.3 – 2.0%) reported by Babiker and Lawrie (1983) for water holding capacity of hot deboned beef. The parameters in Table 5 indicate that T4 muscle is a choice muscle since it has the high water holding capacity, low thaw rigor and lower cold and thermal shortenings. Figure 1. Also indicate that the colour of T3 appear best while T2 and T4 follows with bright pinkished red muscle colour.

CONCLUSION

Rabbit can strive well with whole consumption of whole Africa Sunflower leave meal in their diets.

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Carcass and organ characteristics of broiler chicken fed boiled mango kernel composite meal (BMKCM)

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Abstract: A study on carcass and organ characteristics of broiler chicken fed boiled mango kernel composite meal (BMKCM) was carried out at the University of Agriculture Teaching and Research Farm Makurdi, Nigeria. One hundred and eighty (180) broiler chickens were randomly allotted to four dietary treatments comprising of 0% (control), 10%, 15% and 20% inclusion levels of boiled mango kernel composite meal labelled as T_1, T_2, T_3 and T_4 respectively in a completely randomized design (CRD). Each treatment was replicated thrice with fifteen (15) birds per replicate. The results of this study showed that there were no significant differences ($P< 0.05$) across treatments with respect to meat yield and meat distributions among carcass cut-off parts. In terms of organ weights, significant differences ($P< 0.05$) were observed in the heart, liver, kidney, spleen and gizzard weights, however, the result did not follow a regular pattern implying that, treatment would not have accounted for these differences. It is therefore concluded that, boiled mango kernel composite meal could be used up to 20% in the diets of broiler chickens without compromising the carcass and organ weights

Keywords: Boiled Mango, Maize, Broiler Finisher, Carcass Indices and Organ Indices

INTRODUCTION

Livestock feeds have become very expensive due to the high cost of conventional feedstuffs such as maize (Amao and Siyanbola, 2013; Daudu *et al.,* 2015). The focus in the livestock industry (involving intensive production) is on alternative feedstuff; mostly those that can reduce production cost though compare favourably in quality to the conventional feedstuffs (not being deleterious to the animal's health). The most relevant option to arrest the present feed crisis of livestock industry is by-product utilization. The use of these alternative feed stuffs in livestock feed production will cut down feed prices, thus, making them more affordable by livestock farmers (Amao and Siyanbola, 2013). Mango kernel meets these requirements. Mango is an important fruit crop grown in the tropics mostly for its pulp. Mango belongs to the family Anacardiacea (Okpala, and Gibson-Umeh, 2013). According to Diarra (2014), mango seed (kernel) represents about 20-60% of the fruits, it has limited food or industrial use in most producing countries and is therefore wasted. The kernel is a good source of carbohydrate (58-80%), moderate protein (6-13%) and fat (6-16%) (Diarra and Usman, 2008). Mango has the ability to supplement methionine and lysine which are limiting in plant protein feeds stuffs (Saleh and Bello, 2015).

Amao and Siyanbola (2013), reported that mango kernel is consumed in India by human beings in the form of porridges but in Nigeria, tonnes of mango seed kernel are generated from the fruits annually as waste and thereby constituting environmental nuisance (Kayode and Sani, 2008). Diarra *et al*. (2011) reported that 50% and 75% of maize can be replaced by mango seed kernel in broiler chicken starter and finisher diets respectively without adverse effect. The outstanding factors favouring the use of mango seed kernel meal as feed ingredients are its high energy contents, poor utilization by man and the facts that its production period (April-July) coincides with critical period for grain supply. Therefore, effort to substitute maize in poultry feed will significantly reduce the cost of production. The aim of this study is to determine the effect of various inclusion levels of boiled mango kernel composite meal on carcass and organs characteristics of broiler chicken as a replacement for maize.

MATERIALS AND METHODS

The study was carried out in the poultry unit of Livestock Teaching and Research Farm, Federal University of Agriculture, Makurdi, Benue State, Nigeria. Makurdi is located in the middle belt region of Nigeria. Its

geographic coordinates are latitude 7° 44' North, longitude 8° 32' East and has 104 meters elevation above the sea level. It has mean rainfall of 1259- 2000mm and mean annual temperature range of 23^0C to 32^0C. The rainy period is between April to October and dry period from November to March (Anon, 2004). Mango seeds were collected during the month of May (peak of the mango season) in Gboko Local Government Area of Benue State, Nigeria. Mango kernel was removed by cracking manually with the aid of hammer. The water was allowed to boil (100^0 C) before introducing mango kernel. Mango kernel was cooked for 20munites and rinsed thoroughly with cold water accompanied by sun-drying for 168hours (7 days) so as to reduce the moisture content to less than 10% for prolonged storage. Soybean was well toasted to a dark brown colour to reduce the level of anti-nutrients such as tannin, oxalate, trypsin inhibitors, saponin, phytate, flavonoid, cyanides etc. The ingredients were crushed separately into fine grit (maize and soybean) and were later mixed at varying inclusion levels with other ingredients to formulate the various diets. The various diets were formulated to meet the nutritive requirements for broiler chicken. Boiled mango kernel composite meal was used to replace maize at 0%, 10%, 15% and 20% (Table 1).

Table 1: Composition of diet for broiler finisher using boiled mango kernel composite meal

Ingredient	**0%**	**10%**	**15%**	**20%**
Maize	55.25	49.73	46.96	44.20
BMKCM	0.00	5.53	8.29	11.05
Soybean	31.00	31.50	32.00	32.00
BDG	6.00	5.00	5.00	5.00
Blood meal	3.00	3.50	3.00	3.00
Bone meal	3.00	3.00	3.00	3.00
Salt	0.50	0.50	0.50	0.50
Lysine	0.50	0.50	0.50	0.50
Methionine	0.50	0.50	0.50	0.50
Premix	0.25	0.25	0.25	0.25
Analyzed nutrients:				
ME (Kcal/kg)	3102.72	2920.59	2945.00	2978.00
CP (%)	20.63	20.53	20.51	20.40
Lysine (%)	1.06	1.05	1.10	1.10
Methionine (%)	0.31	0.20	0.30	0.30
EE (%)	3.60	3.63	3.70	3.80
CF (%)	4.08	3.81	3.88	3.86
Ca^{2+} (%)	1.20	1.20	1.21	1.21
P (%)	0.70	0.70	0.70	0.70

One hundred and eighty (180) broiler chickens about same weights were randomly selected at eight (8) weeks old and assigned to four treatments (T_1, T_2, T_3 and T_4) in a completely randomized design. Each treatment consisting of fourty five (45) birds and was replicated into three (3) with 15 birds each per replicate. The house was half walled, roofed with zinc coated metal sheets. The birds were managed intensively in cages of three tiers. Each tier was separated with wood. Wire mesh was used for the walls and doors to allow adequate ventilation/lighting. The dimension of each tier was (1.0 m2 x 0.78 m2). Litter materials (wood shavings) were used on the wooden floors. Each tier was equipped with adequate drinkers and feeding troughs. A floor space of about $0.007m^2$ to $0.009m^2$ per bird was provided. Source of lighting was provided with the use of electric bulbs to ensure adequate feed intake and local stove (Abacha) as source of heat. Conventional management practices were adopted. The initial body weights of the birds were taken and the birds were randomly distributed into the various experimental units. A known quantity of diets was served to the birds and the left over weighed. Feed and drinking water were given separate *ad libitum* throughout the period of experiment which lasted for eight (8) weeks. Mean daily feed consumption and weekly body weight gain were determined. At the end of eight (8) weeks, six (6) birds were randomly selected from each replicate and slaughtered. Birds were slaughtered by cutting their jugular veins with a sharp knife and allowed to bleed. After that the carcasses were weighed one

after the other in the various treatments and scalded in warm water to soften the follicle of the feathers for easy removal followed by de-feathering and then evisceration. The carcasses were finally cut into various parts and each part was weighed and kept separately according to treatments. Weight of cut-off parts and internal organs were determined using a sensitive digital scale. Processed boiled mango kernel composite meal was analyzed for proximate fractions according to the methods described by AOAC (1980). The data obtained on all the parameters studied were subjected to one-way analysis of variance (ANOVA) using Minitab statistical software version and least significant method (LSD) was used to separate means that differed significantly ($P< 0.05$) according to Steel and Torrie (1980).

RESULTS AND DISCUSSION

The mean values for cut off parts of broilers fed different inclusion levels of boiled mango kernel composite meal (BMKCM) is presented in Table 2. The mean values for live weight ranged from 1783.3 to 1883.3g, slaughtered weight from 1613.3 to 1701.3g, de feathered weight from 1537.8 to 1629g, eviscerated weight from 1275.8 to1350.5g, dressed weight from 1159.3 to 1221.2g, breast weight from 345.67- 358.17g, drumstick from 185.83 to 197.83g, thigh weight from 178.83 to 182.50g, back weight from 169.50 to 190.50g, neck weight from 97.83 to107.83g, head weight from 39.50 to 44.67g, shank weight from 72.00 to 83.33g and wings weight from 137.17 to 143.17g. All the treatments showed no significant difference ($P<0.05$) on the carcass and cut off parts. This result agrees with the work of Diarra *et al.* (2010) and Ate- Biam (2016) who reported no significant differences ($P< 0.05$) in the parameters measured when boiled mango kernel meal (BMKCM) and fermented mango kernel composite meal (FMKCM) was replaced with maize in broiler finisher diets. The results for the present study contradicts the findings of Abang *et al.* (2017) who observed significant ($P< 0.05$) differences in the drum stick weights, head weights, breast weights, back weights and shank weights across treatment groups, with quails fed control diet having the highest mean weights and those placed on 50% least weights in all the aforementioned parameters when quails were fed sun-dried mango kernel meal.

It appears that the weights of these various cut- off parts reduced with increased supplementation of SMKM across treatments. Mango kernel is a rich source of tannin; tannins are known to interfere with protein digestibility and thereby rendering it unavailable. Sun- drying process may not have efficiently reduced this anti-nutrient to a more tolerable level and this may have accounted for the better results recorded with birds fed BMKCM in the present study. Similar low weights of cut- off parts were also recorded across treatment by Amao and Sinyanbola (2013) and Rafiu *et al.* (2014) when broilers were fed heat treated mango kernel meal (HMKM) and sun- dried mango kernel meal (SMKM) respectively. The mean values for organ weights of broilers fed different inclusion levels of boiled mango kernel composite meal (BMKCM) is presented in Table 3. The mean values for heart ranged from 7.17- 9.67g, liver ranged from 32.67- 41.50g, kidney from 10.00- 14.00g, spleen from 1.00- 2.17g, lungs from 10.67- 12.00g, gizzard from 47.00- 56.67g and intestine from 121.50- 134.17g. There were no significant differences ($P<0.05$) across the treatments for lungs and intestine weights, significant differences were recorded across the treatment groups for heart, liver, kidney, spleen and gizzard weights. This result partially agrees with the findings of Abang *et al.* (2017) who found no significant difference across the treatments for the Liver, gizzard and intestine weights while significant ($P < 0.05$) differences were recorded on heart, lungs and kidney weights. Amao and Siyanbola (2013) reported significant ($p < 0.05$) differences in internal organs of broilers fed SMKM on all the parameters measured with the control experiment having the highest weights. Again this may be due to the processing methods employed. Boiling is a better way of reducing anti- nutrients like tannins, phytates, etc. when compared with sun- drying. Birds placed on 0% inclusion were found to record the highest values for heart, liver, kidney, spleen, gizzard and intestine weights exception of lungs weights whose weight was highest in 15% inclusion level. This result agrees with that of Abang *et al.* (2017) who recorded the highest weights in quails fed control diet. Similarly, Amao and Siyanbola (2013) also reported highest mean values in the control diet. Birds placed on 10%inclusion level of BMKCM were found to record least values for heart, kidney, spleen and gizzard weights with exception of liver whose least weight was

found with birds fed 20% BMKCM. There was no sign of abnormal increase (inflammation) of the organs measured in all the treatments. The differences observed in the treatments may be physiological as the results did not follow the regular pattern.

Table 2: Effect of Boiled Mango Kernel Composite Meal (BMKCM) on Carcass Cut-off Parts of Broilers

Parameters	Treatments				P-values
	0%	10%	15%	20%	
Live Weight	1883.3±318.90	1783.3±116.90	1808.3±241.70	1816.7±231.70	0.900
Slaughtered Weight	1701.3±330.40	1613.3±107.90	1665.2±235.60	1656.0±224.50	0.936
De feathered Weight	1629.5±311.00	1537.8±101.60	1588.0±214.80	1586.5±215.50	0.916
Eviscerated Weight	1350.5±226.50	1275.8±124.30	1305.3±185.10	1332.8±203.90	0.927
Dressed Weight	1221.2±267.10	1159.3±123.90	1192.7±177.60	1204.3±185.40	0.955
Breast	358.17±99.92	345.67±42.94	358.17±76.39	356.83±61.23	0.989
Drumsticks	195.00±34.08	190.67±21.18	185.83±22.76	197.83±29.78	0.882
Thighs	182.50±36.89	178.83±23.35	179.67±28.42	181.83±34.29	0.996
Back	190.50±51.47	169.50±23.36	184.67±29.36	180.33±25.45	0.753
Neck	107.83±19.56	97.83±10.70	106.00±16.49	103.00±16.24	0.724
Head	44.67±6.06	39.50±2.07	40.17±4.83	44.67±5.57	0.150
Shanks	82.50±15.83	76.33±11.72	72.00±9.94	83.33±15.27	0.431
Wings	143.17±27.53	137.17±9.45	140.33±17.05	143.17±18.15	0.939

Mean values are presented as mean ± standard deviation. Means with different superscript in the same row shows that there is significant difference at (P< 0.05).

Table 3: Effect of boiled mango kernel composite meal (CBMKM) on internal organs of broilers

Parameters	Treatments				P- values
	0%	10%	15%	20%	
Heart	9.67±2.58^{a}	7.17±0.98^{b}	9.00±1.41^{ab}	8.67±1.97^{ab}	0.148
Liver	41.50±5.54^{a}	33.83±3.55^{b}	37.17±5.53^{ab}	32.67±3.45^{b}	0.016
Kidney	14.00±2.83^{a}	10.00±1.27^{b}	13.17±2.79^{a}	11.67±1.21^{ab}	0.023
Spleen	2.17±0.98^{a}	1.00±0.00^{b}	1.50±0.55^{ab}	1.83±0.41^{a}	0.019
Lungs	11.67±2.88	10.67±2.16	12.00±3.46	10.83±1.72	0.785
Gizzard (Intact)	56.67±10.46^{a}	47.00±5.33^{b}	50.67±7.37^{ab}	50.83±4.45^{ab}	0.178
Intestine	134.17±22.17	129.17±30.56	127.33±21.32	121.50±8.19	0.799

(Intact)

Mean values are presented as mean ± standard deviation. Means with different superscript in the same row shows that there is significant difference at (P< 0.05).

CONCLUSION

Results revealed that boiled mango kernel composite meal could replace maize in broiler diet without affecting the carcass and organ weights of broiler chickens.

RECOMMENDATION

Boiled mango kernel composite meal can be recommended as a replacement for maize in broiler chicken feed up to 20% level of inclusion.

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MONGASTRIC ANIMAL NUTRITION AND PRODUCTION

Performance Evaluation of Growing Pigs Fed Graded Levels of Pineapple (*Ananas comosus*) Wine Sediment

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Abstract: This experiment was conducted to boost animal protein consumption in the Nigerian populace using an unconventional feedstuff –pineapple wine sediment meal (PWSM) which is a waste product of the winery. In the study, PWSM was used to evaluate the growth performance of grower pigs using 32 large white x landrace strains of pigs with average initial weight of 32 ± 0.07kg. Four treatment diets coded T_1, T_2, T_3 and T_4 replicated 3 times were formulated to replace maize at 0%, 10%, 20% and 30% levels respectively and the study lasted for 35 days. The result of the experiment indicated that PWSM enhanced the palatability and feed intake of the growing pigs because of the proteolytic enzyme in the ingredient which stimulated healthy metabolism. Hence, 20% inclusion level is recommended for optimum productivity and for maximization of profit in the industry.

Key words: Grower pigs, pineapple wine sediment, palatability, unconventional feedstuff, feed intake.

INTRODUCTION

Population in the world is increasing in geometric progression and in the year 2050, the world population is predicted to increase to 8.9 billion (Nkwocha *et al*., 2018). The implication is that the global demand for food will increase and the fate of Sub-Saharan African countries of which Nigeria is a classical example will hitherto become bleak as extreme hunger and poverty would revolve in vicious cycle. Increasing the production of animal protein at a reasonable cost to enhance the diet quality of the populace has been part of the objectives of the National Agriculture Policy of Nigeria (Amaefula *et al.*, 2006a).

The world trend today is towards the consumption of more white than red meat because white meat yields less cholesterol than red meat (Holness, 2005). Pineapple wine sediment meal (PWSM) is a residue obtained from wine industry. The interest in this research was generated due to high cost and scarcity of conventional feedstuffs in the country and since pineapple wine sediment is not directly consumed by man but could be utilized by monogastrics and its availability is ensured, the study is therefore an in road towards agro-industrial revolutionisation in Nigeria.

MATERIALS AND METHODS

Location of study

The study was carried out at the Teaching and Research Farm of the Imo State University, Owerri which lies within the humid tropical rainforest zone of South Eastern Nigeria. The climatic data of Owerri obtained from NIMET, (2015) Official Website (nimet.gov.ng/content/nimet-weather) showed that Owerri lies within latitudes 5°45'N and 7°15'N, and longitude 6°50'E and 7°25'E with an annual rainfall range of 2400-2500mm and annual temperature range of 26°C- 29°C while relative humidity is between 70-78% annually.

Experimental Animals and Design

Thirty- two (32) growing pigs of 3-4 months old with similar live weights averaging between 21±0.7kg were used for the study. The pigs were housed in pens measuring 48m^2 divided into 16 compartments with each floor measuring 2.0 x1.5 m. The 32 grower pigs used for the study were randomly divided into 4 treatment groups of eight pigs and fed the experimental diets as specified in Table 3.5. Each treatment was replicated four times in a Completely Randomized Design (CRD) experiment with 2 grower pigs per replicate.

Experimental Diets/Feed Preparation

The wet pineapple wine sediment was collected from Jacobs Wines Limited, Mgbidi, Imo State, and sun-dried for seven days after which it was pulverized and used in ration formulation. Four experimental diets were formulated such that PWSM replaced maize at 0%, 10%. 20% and 30% dietary levels coded as T_1, T_2, T_3 and T_4 respectively (table 1). Other ingredients apart from PWSM in the diets were included at equal ratios. Table 3.5 shows the ingredient composition of the experimental diets. The experimental diets were subjected to proximate analysis using AOAC, (2005) method and resulting proximate composition is shown in Tables 4.1-4.3 respectively.

Table 1.0: Percentage composition of grower pigs ration containing graded levels of PWSM.

Ingredients	Dietary treatments			
	T_1	T_2	T_3	T_4
Pineapple wine sediment meal	0.00	4.00	8.00	12.00
Maize meal	40.00	36.00	32.00	28.00
Groundnut cake	12.00	12.00	12.00	12.00
Wheat offal	20.00	20.00	20.00	20.00
Rice meal	11.00	11.00	11.00	11.00
Fish meal	3.00	3.00	3.00	3.00
Palm kernel cake	10.50	10.50	10.50	10.50
Bone meal	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25
Vit/min.premix	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**

Data analysis

Data collected were subjected to analysis of variance (ANOVA) (Steel and Torrie (1980)) while significant treatment means were separated using Duncan's New Multiple Range Test (DNMRT) as outlined by Obi (2002).

RESULTS AND DISCUSSION

The average feed intake (table 2) showed that T_4 recorded the highest while T_1 was numerically the least consumed though there was no significant difference ($P > 0.05$) among the treatment diets. There was a proportional increase in daily feed intake as PWSM increased in diets and this was because of the PWSM appetizing properties and palatability attributes which according to Muller, (1978), Rutagwenda *et al*., (1990) enhances the palatability of livestock feeds. The body weight gain of the growing pigs was highest in T_2 (10% PWSM) with value of 0.72kg while the least value of 0.67kg was recorded by T_1 (control) and T_4 (30%) respectively($p < .0.05$). There were no significant differences ($P > 0.05$) among grower pigs fed PWSM based diets and the control diet.

Table 2: Performance of grower pigs fed PWSM based diets

Parameters	Dietary Treatments				
	T_1	T_2	T_3	T_4	SEM
Initial body Weight (kg)	21.01	21.50	21.21	21.41	0.11
Final body weight (kg)	44.30^{b}	46.81^{a}	45.55^{a}	44.67^{b}	0.65
Body weight change (kg)	23.29^{b}	25.31^{a}	24.34^{a}	23.23^{b}	0.57
Daily feed intake (kg)	1.84	1.86	1.86	1.87	0.01
Daily body weight gain (kg)	0.67^{b}	0.72^{a}	0.70^{ab}	0.67^{b}	0.01
Feed conversion ratio (FCR)	2.75^{a}	2.58^{b}	2.66^{ab}	2.79^{a}	0.05
Feed cost/KG weight gain (N)	263.57^{a}	254.13^{ab}	244.89^{bc}	235.24^{c}	6.10

^{abcd} Means along the row having different superscript differ significantly ($P<0.05$ level).

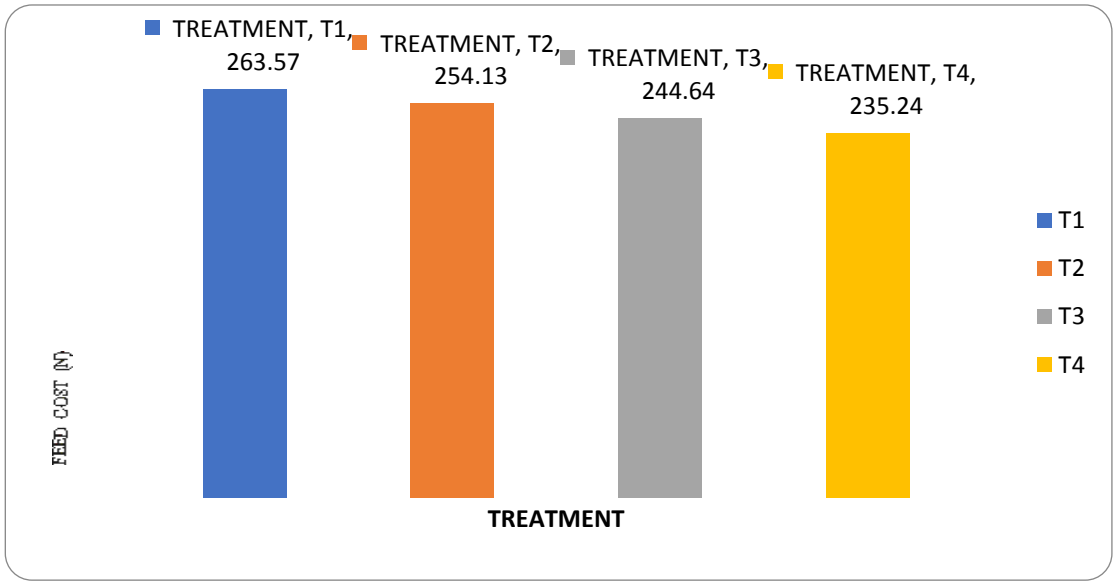

Fig. 1: Feed cost per kilogramme weight gain (N) of grower pigs fed PWSM based dietary levels

The feed conversion ratio (FCR) of the experimental diets showed that T_2 (10%) which recorded 2.58 was most efficiently utilized but not significantly different ($P > 0.05$) from T_3, T_1 and T_4 which pulled 2.66, 2.75 and 2.79 in that order. However, the values obtained in this study aligns with the specifications of Olomu, 2010, NRC 2005, Izunobi, 2006 and the result obtained by Agbabiaka *et al.*, (2014) in a study on the Evaluation of Roselle (*Hibiscus Sabdariffa lin*) calyx meal as dietary supplement in grower pig production. Feed cost of the diets reduced significantly ($P < 0.05$) as dietary levels of PWSM increased progressively. The cheapest cost per 25kg feed was obtained in T_4 (30%) with the value of N235.24 while the control diet T_1 (0% PWSM) recorded the highest value of N263.37 (Fig. 1).

CONCLUSION AND RECOMMENDATIONS

Economic optimization which is one of the major reasons for use of alternative feed could be achieved with the inclusion of PWSM up to 20% level since feed cost of the diets reduced significantly ($P<0.05$) as dietary levels of PWSM increased progressively.

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Performance and Haematological Parameters of Broilers Fed Ricinus communis Seed Meal as Feed Additive

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Abstract: The study was carried out to determine the performance such as feed intake, groth rate of Broilers fed Ricinus Communis Seed Meal as Feed additive and to examine its effect on the haematological parameters such as RBC, WBC, PCV on Broiler Birds. The experiment was conducted using 105 one-week old Arbor acre chicks, laid out in a completely randomized design of 5 treatments and 3 replicates each of 7 birds. The birds were fed adlibitum with different inclusion level of RCSM at 0%, 0.02%, 0.04%, 0.06% & 0.08% for 8 weeks. The birds weighed daily on their feed intake, weekly on their weight and samples were collected at the end of the experiment for haematological examination. The average performance of birds fed RCSM as feed additive shows T3 (0.04% inclusion level) had the lowest initial live weight (0.221kg) and T4(0.06% inclusion level) had the lowest final live weight (2.123kg) with an average body weight gain of 1.894kg after consuming 9.24kg feed. There is no significant difference ($p>0.05$) in the level of PCV and Hb in T2 and T3. T1-T5 showed no significant difference ($p>0.05$) in RBC level. Increased blood platelet production observed in the experiment could be as a result of increasing physiological stress created in the birds as RCSM as feed additive increased. It can therefore be concluded that RCSM as feed additive (0.08% inclusion level) can be used to replace vaccines in broiler production since it has no deleterious effect on birds.

Performance Evaluation of Growing Pigs Fed Graded Levels of Pineapple (*Ananas comosus*) Wine Sediment

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Abstract: This experiment was conducted to boost animal protein consumption in the Nigerian populace using an unconventional feedstuff –pineapple wine sediment meal (PWSM) which is a waste product of the winery. In the study, PWSM was used to evaluate the growth performance of grower pigs using 32 large white x landrace strains of pigs with average initial weight of 32 ± 0.07kg. Four treatment diets coded T_1, T_2, T_3 and T_4 replicated 3 times were formulated to replace maize at 0%, 10%, 20% and 30% levels respectively and the study lasted for 35 days. The result of the experiment indicated that PWSM enhanced the palatability and feed intake of the growing pigs because of the proteolytic enzyme in the ingredient which stimulated healthy metabolism. Hence, 20% inclusion level is recommended for optimum productivity and for maximization of profit in the industry.

Key words: Grower pigs, pineapple wine sediment, palatability, unconventional feedstuff, feed intake.

DESCRIPTION OF PROBLEM

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Experimental Diets/Feed Preparation: The wet pineapple wine sediment was collected from Jacobs Wines Limited, Mgbidi, Imo State, and sun-dried for seven days after which it was pulverized and used in ration formulation. Four experimental diets were formulated such that PWSM replaced maize at 0%, 10%. 20% and 30% dietary levels coded as T_1, T_2, T_3 and T_4 respectively (table 1). Other ingredients apart from PWSM in the diets were included at equal ratios. Table 3.5 shows the ingredient composition of the experimental diets. The experimental diets were subjected to proximate analysis using AOAC, (2005) method and resulting proximate composition is shown in Tables 4.1-4.3 respectively.

Table 1.0: Percentage composition of grower pigs ration containing graded levels of PWSM.

Ingredients	Dietary treatments			
	T_1	T_2	T_3	T_4
Pineapple wine sediment meal	0.00	4.00	8.00	12.00
Maize meal	40.00	36.00	32.00	28.00
Groundnut cake	12.00	12.00	12.00	12.00
Wheat offal	20.00	20.00	20.00	20.00
Rice meal	11.00	11.00	11.00	11.00
Fish meal	3.00	3.00	3.00	3.00
Palm kernel cake	10.50	10.50	10.50	10.50
Bone meal	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25
Vit/min.premix	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00

Data analysis: Data collected were subjected to analysis of variance (ANOVA) (Steel and Torrie (1980)) while significant treatment means were separated using Duncan's New Multiple Range Test (DNMRT) as outlined by Obi (2002).

RESULTS AND DISCUSSION

The average feed intake (table 2) showed that T_4 recorded the highest while T_1 was numerically the least consumed though there was no significant difference ($P > 0.05$) among the treatment diets. There was a proportional increase in daily feed intake as PWSM increased in diets and this was because of the PWSM appetizing properties and palatability attributes which according to Muller, (1978), Rutagwenda *et al*., (1990) enhances the palatability of livestock feeds. The body weight gain of the growing pigs was highest in T_2 (10% PWSM) with value of 0.72kg while the least value of 0.67kg was recorded by T_1 (control) and T_4 (30%) respectively ($p < .0.05$). There were no significant differences ($P > 0.05$) among grower pigs fed PWSM based diets and the control diet.

Table 2: Performance of grower pigs fed PWSM based diets

	Dietary treatments				
PARAMETERS	**T_1**	**T_2**	**T_3**	**T_4**	**SEM**
Initial body Weight (kg)	21.01	21.50	21.21	21.41	0.11
Final body weight (kg)	44.30^{b}	46.81^{a}	45.55^{a}	44.67^{b}	0.65
Body weight change (kg)	23.29^{b}	25.31^{a}	24.34^{a}	23.23^{b}	0.57
Daily feed intake (kg)	1.84	1.86	1.86	1.87	0.01
Daily body weight gain (kg)	0.67^{b}	0.72^{a}	0.70^{ab}	0.67^{b}	0.01
Feed conversion ratio (FCR)	2.75^{a}	2.58^{b}	2.66^{ab}	2.79^{a}	0.05
Feed cost/KG weight gain (N)	263.57^{a}	254.13^{ab}	244.89^{bc}	235.24^{c}	6.10

^{abcd} Means along the row having different superscript differ significantly ($P<0.05$ level).

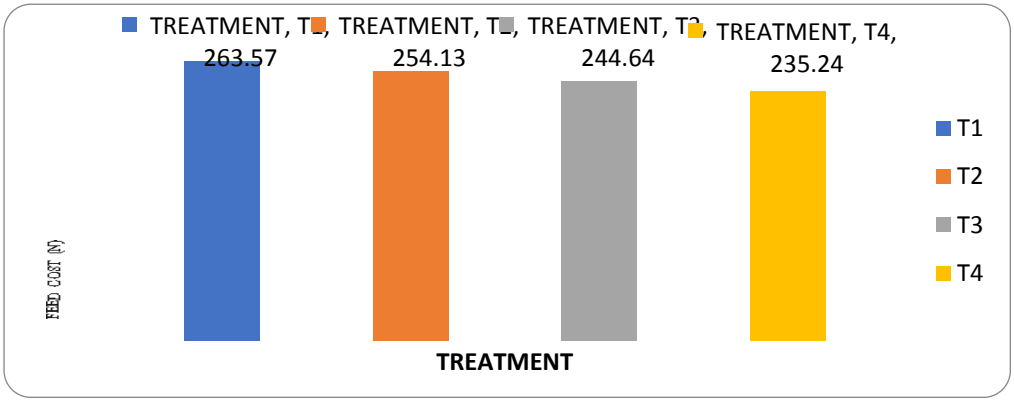

Fig. 1: Feed cost per kilogramme weight gain (N) of grower pigs fed PWSM based dietary levels.

The feed conversion ratio (FCR) of the experimental diets showed that T_2 (10%) which recorded 2.58 was most efficiently utilized but not significantly different ($P > 0.05$) from T_3, T_1 and T_4 which pulled 2.66, 2.75 and 2.79 in that order. However, the values obtained in this study aligns with the specifications of Olomu, 2010, NRC 2005, Izunobi, 2006 and the result obtained by Agbabiaka *et al.*, (2014) in a study on the Evaluation of Roselle (*Hibiscus Sabdariffa lin*) calyx meal as dietary supplement in grower pig production. Feed cost of the diets reduced significantly ($P < 0.05$) as dietary levels of PWSM increased progressively. The cheapest cost per 25kg feed was obtained in T_4 (30%) with the value of N235.24 while the control diet T_1 (0% PWSM) recorded the highest value of N263.37 (Fig. 1).

CONCLUSION AND RECOMMENDATIONS

Economic optimization which is one of the major reasons for use of alternative feed could be achieved with the inclusion of PWSM up to 20% level since feed cost of the diets reduced significantly ($P<0.05$) as dietary levels of PWSM increased progressively.

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Effects of Feeding Four Varieties of Sorghum Supplemented with Maxigrain® Enzyme on Haematological Parameters of Broiler Finishers

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Abstract: A study was carried out to evaluate the effects of feeding four varieties of *Sorghum bicolor* with Maxigrain enzyme supplementation on growth performance of broiler chickens in Kaduna state, Northern guinea Savannah of Nigeria. Five diets were formulated for the broiler starter phase namely T_1 – Maize without 0.01 % Maxigrain ® enzyme supplementation, T_2 –Samsorg-14 supplemented with 0.01 % Maxigrain ® enzyme, T_3 – Samsorg-40 supplemented with 0.01 % Maxigrain ® enzyme, T_4 –Samsorg-17 supplemented with 0.01 % Maxigrain ® enzyme and T_5 –KSV-15 supplemented with 0.01 % Maxigrain ® enzyme in replacement for maize (T_1) on the performance of broiler chickens. Two hundred and twenty-five (225), five days old Arbor acre chicks were randomly distributed into five dietary treatments in a completely randomized design (CRD) with each treatment having forty-five (45) birds per treatment and birds were allotted into three (3) replicates of 15 birds in each replicate.

INTRODUCTION

Blood is used as a means of assessing the clinical and nutritional health status of animals in feeding trials, most of the haematological parameters commonly used in nutritional studies include the packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC), haemoglobin (HB) as reported by (1).Haematological examinations provide valuable information on the metabolic profile, support objective assessment of the state of health, and are often helpful in the revelation of health disorders already at the preclinical stage (2). The blood picture changes with the advancement of an animal's age and also varies with certain conditions as stress, bacteria or viral infections and intoxication (3). The evaluation of the levels of total protein and its fractions supply the information required to interpret the occurrence of dehydration, infections, immune diseases, and inflammatory responses (4).

A few authors have reported that sorghum had no negative effects on blood parameters in turkey (5,6) reported that total replacement of maize with sorghum grains had no apparent effects on the health of finishing broiler chickens. It was reported that sorghum varieties such as Samsorg-17 and ICSV400 (Samsorg-40) could completely be used to feed local turkeys without any deleterious effects on the haematological and serum biochemical parameters (5). For the above reasons the objective of this research was designed to determine the effect of feeding four sorghum varieties supplemented with Maxigrain ® enzyme on haematological parameters of broiler chickens at the finisher phase.

MATERIALS AND METHODS

Location of study: The experiments was conducted at the Poultry Unit, Department of Animal Science Teaching and Research farm, Ahmadu Bello University, Zaria, Kaduna State, which is within the northern Guinea savannah zone of Nigeria on latitude $11^0$14`44 N and longitude $7^0$33'65 E at an altitude of 610m above sea level. The climate is relatively dry, with a mean annual rainfall of 700-1400mm (7).

Experimental birds and feed ingredients: Abor- acre broiler chicks were obtained from Zamfy Farms, Ilemono, Kwara State, Nigeria. Four varieties of sorghum grains were used for this study and were obtained from Samaru and Giwa open markets in Kaduna State. While other feed ingredients and Maxigrain ® enzyme were purchased in Rebson Feed Mill, Samaru, Zaria.

Experimental design and management of experimental birds: Two hundred and twenty-five (225) four weeks old broiler chickens from the starter phase of mixed sexes were used. The birds were weighed at the beginning of the experiment and maintained their allocation of five different dietary treatments in a completely randomized design (CRD). The birds were housed in deep litter pens; each treatment group had total number of forty-five (45) birds in three replicates of 15 birds per pen. Routine vaccination and medications were given as at when due. Feed and water were provided ad-libitum.

Experimental diets: Five diets were formulated as follows; T_1 – Maize without Maxigrain ® enzyme supplementation, T_2 –Samsorg-14, T_3 –Samsorg-40, T_4 –Samsorg-17 and T_5 – KSV-15, T_2 - T_5 were supplemented with 0.01 % Maxigrain® enzyme as presented in Table 1.

Data collection: Blood samples were collected at the 8thweek of age from nine birds per treatment via the wing vein according to the procedure by (8). Bijou test tubes containing ethylene-diamine tetra-acetic acid (EDTA) an anticoagulant, at a ratio of 5 mg/ml of blood were used for blood sampling according to the procedure by (9). The blood samples were put in an ice pack to prevent deterioration of blood samples according to the procedure by (10) and transported to the faculty of Veterinary Medicine Haematology Laboratory of the Ahmadu Bello University, Zaria to determine the Pack cell volume (PCV), Red blood cells (RBC), White blood cell (WBC), Haemoglobin (Hb), Total blood protein (TP) and differential blood counts.

Statistical Analysis: All data obtained from the study were subjected to analysis of variance (ANOVA) using general linear model procedure of SAS (2008). Significant levels of differences among treatment means were determined using the Tukey`s test as reported by (10) to separate the means.

RESULTS AND DISCUSSION

The effects of feeding four varieties of sorghum supplemented with Maxigrain® enzyme on the haematological parameters are presented in Table 2.

Table 1: Composition of the experimental broiler finisher diets supplemente with Maxigrain® enzyme

Ingredients (%)	**Dietary Treatments**				
	T_1 (Control)	**T_2 (Samsorg-14)**	**T_3 (Samsorg-40)**	**T_4 (Samsorg-17)**	**T_5 (KSV-15)**
Maize	57.00	0.00	0.00	0.00	0.00
Sorghum	0.00	57.00	57.00	57.00	57.00
Palm oil	3.00	3.00	3.00	3.00	3.00
Soyabean cake	15.00	15.00	15.00	15.00	15.00
Groundnut cake	20.60	20.60	20.60	20.60	20.60
Limestone	0.50	0.50	0.50	0.50	0.50
Bone meal	3.00	3.00	3.00	3.00	3.00
Common salt	0.25	0.25	0.25	0.25	0.25
Vitamin premix*	0.30	0.30	0.30	0.30	0.30
Synthetic lysine	0.20	0.20	0.20	0.20	0.20
Synthetic methionine	0.15	0.15	0.15	0.15	0.15
Total	**100**	**100**	**100**	**100**	**100**
Calculated analysis					
Maxigrain® enzyme	0.00	0.01	0.01	0.01	0.01
ME (Kcal/kg)	3085	3063	3051	3096	3044
Crude protein (%)	20.58	20.72	21.20	20.92	21.39
Ether extract (%)	6.47	6.07	6.22	5.84	5.96
Crude fibre (%)	3.28	3.23	3.57	3.23	3.51
Calcium (%)	1.18	1.17	1.17	1.17	1.17
Available phosphorus (%)	0.57	0.58	0.58	0.58	0.59

Lysine (%)	1.09	1.15	1.14	1.16	1.14
Methionine (%)	0.46	0.46	0.46	0.46	0.48
Methionine + cysteine (%)	0.76	0.76	0.80	0.81	0.86
Cost/kg feed (N)	75.86	73.06	73.06	73.06	87.31

* Biomix broiler finisher premix supplied the following per kg diet: Vit. A, 10,000 I.U; Vit. D_3, 2000I.U; Vit. E, 23mg; Vit.K, 2mg; Vit.B_1, 1.80mg; Vit.B2, 0.0mg; Niacin, 5.5mg; Pantothenic acid, 7.5mg; Vit.B_6, 3.0mg; Vit. B_{12}, 0.015mg; Folic acid, 7.5mg; Biotin, 0.06mg; Choline Chloride, 300mg; Cobalt, 0.2mg; Copper, 3mg; Iodine, 1mg; Iron, 20mg; Manganese, 40mg; Selenium, 0.2mg; Zinc, 30 mg; Antioxidant, 1.25mg, ME = Metabolizable Energy.

The result showed that there were no significant (P > 0.05) differences in all the haematological parameters measured indicating that feeding broiler chickens with sorghum supplemented with Maxigrain® enzyme at the finisher phase had no negative effect on the packed cell volume (PCV), haemoglobin (Hb), total protein (TP), red blood cell (RBC), white blood cell (WBC), eosinophils and monocyte as they were all within normal range for healthy chickens. The results agreed with the reports by (8) for PCV (22 – 35 %), Hb (7-13g/dl); TP (3.0 – 4.9 mg/dl) (11), RBC (2.0 – 4.0 x 10^6 / l) as reported by (12), WBC (9.20 – 31.0 x 10^9 / l) as reported by (13), heterophils (4.57-24.2 %) as reported
by (14), eosinphils (0.0-1.8%) as reported by (15) and monocytes (0.0- 1.0 %) and band (rare) as reported by (15).

Table 2: Haematological parameters of broiler chickens fed S*orghum bicolor* varieties supplemented with Maxigrain ® enzyme at 8 weeks

Parameter	Treatments						
	T1	T2	T3	T4	T5	Normal range	SEM
PCV (%)	26.00	27.00	24.67	27.00	27.17	22-35	1.19
Hb (g/dl)	8.65	8.97	8.15	8.95	9.02	7.0-13	0.39
TP (g/dl)	4.53	4.82	4.32	4.65	4.72	3.0-4.9	1.79
RBC (x10^6/l)	2.37	2.35	2.00	2.31	2.13	2.00-4.0	0.32
WBC (x10^3/l)	10.85	12.15	11.40	13.18	13.67	9.20-31.0	0.94
Heterophils (%)	11.17	9.50	8.33	10.83	12.50	4.57-24.2	1.29
Lymphocytes (%)	88.83	90.50	91.67	89.17	87.50	40-70	1.78
Eosinophils (%)	0.00	0.00	0.00	0.00	0.00	0.0-1.8	0.00
Monocyte	0.00	0.00	0.00	0.00	0.00	0.0-1.0	0.00
Band	0.00	0.00	0.00	0.00	0.00	Rare	0.00

[a,b.] Means on the same row with different superscripts are significantly (P<0.05) different.
SEM = Standard Error of Means.
T1- Control (0% sorghum supplemented with 0% Maxigrain® enzyme), T2- Samsorg 14 with 0.01g/kg Maxigrain® enzyme, T3- Samsorg-40 supplemented with 0.01g/kg Maxigrain® enzyme, T4- Samsorg -17 supplemented with 0.01g/kg Maxigrain® enzyme, T5- KSV-15 supplemented with 0.01g/kg Maxigrain® enzyme. PCV =Packed Cell Volume, Hb = Haemoglobin, TP =Total Protein, RBC=Red blood cell, WBC=White blood cell.

The results indicated that enzymes have positive effects on the health of the birds by reducing anti-nutritional factors and toxicity (16). The haematology index and use of multi-enzyme were not compromised when broiler chickens were fed sorghum with Maxigrain ® enzyme, this result is similar to the reports by (17) that the use of multi enzyme in sorghum diets did not compromise the haematological index. The lymphocyte values were not significantly different this indicated that there was no adverse immune response in broiler chickens fed sorghum diets supplemented with Maxigrain ® enzyme. The lymphocyte values were above the normal values when compared to the reports by (6), this indicated stressors were applied on chickens but did not exceed the threshold levels to affect bird's performance (6) as the health of birds were not compromised. The non-significant effect

(P>0.05) of some varieties of sorghum diet supplemented with Maxigrain ® enzymes (T_2, T_3, T_4) and maize diet with 0% Maxigrain ® enzymes (T_1) on heterophils, monocytes and band showed the effectiveness of enzymes in reducing the anti-nutritional factors in sorghum (17).

CONCLUSION

The replacement of sorghum varieties for maize at 100 % supplemented with 0.01 % Maxigrain ® enzyme did not compromise the health of broiler chickens at the finisher phase.

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Performance of Broiler Chickens Fed Diets containing Four Varieties of Sorghum bicolor Supplemented with Maxigrain ® Enzyme

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Abstract: A study was carried out to evaluate the effects of feeding four varieties of *Sorghum bicolor* with Maxigrain®enzymesupplementation on growth performance of broiler chickens in Kaduna state, Northern guinea Savannah of Nigeria. Five diets were formulated for the broiler starter phase namely T_1– Maize without 0.01 % Maxigrain ® enzyme supplementation, T_2 –Samsorg-14 supplemented with 0.01 % Maxigrain ® enzyme, T_3 – Samsorg-40 supplemented with 0.01 % Maxigrain ® enzyme, T_4 –Samsorg-17 supplemented with 0.01 % Maxigrain ® enzymeand T_5 –KSV-15 supplemented with 0.01 % Maxigrain ® enzyme in replacement for maize (T_1) on the performance of broiler chickens. Two hundred and twenty-five (225), five days old Arbor acre chicks were randomly distributed into five dietary treatments in a completely randomized design (CRD) with each treatment having forty-five (45) birds per treatment and birds were allotted into three (3) replicates of 15 birds in each replicate. At the starter phase the result showed that birds in T_1 and T_4 were significantly ($P<0.05$) higher than birds fed T_2, T_3 and T_5 in terms of final weight, daily weight gain and feed conversion ratio. The feed cost/kg gain was best in birds fed T_1, T_2 and T_4 and were significantly ($P<0.05$) better than those of birds in T_3 and T_5. At the finisher phase birds in T_1 and T_4 had significantly ($P<0.05$) higher final weight and weight gain. Birds fed T_4 had the best Feed conversion ratio and feed cost/kg gain. In conclusion total replacement of Samsorg-17 (T_4) for maize (T_1) in broiler chicks' diet had no negative impact on performance at the starter phase; therefore, Samsorg-17 supplemented with 0.01 % Maxigrain ® enzyme can be incorporated in the diets of broiler chicks at 100%.

Keywords: Broiler chicks, Sorghum varieties, Maxigrain® enzyme, growth performance.

DESCRIPTION OF PROBLEM

Cereal grains are the major sources of energy in poultry diets in the tropics (10). Common cereals used in tropical countries include maize and guinea corn (sorghum) and to a less extent, millet and wheat (9). Sorghum is an indigenous cereal crop of Africa; it has the ability to tolerate drought, soil toxicities and temperature extremes effectively than other cereals. It is cultivated worldwide in warmer climate and can be grown on poor soil and in drier conditions than maize (9). Sorghum grain is probably the next alternative to maize in poultry feed (6) but farmers have the notion that sorghum has tannin and has lower energy (2650 kcal/kg) compared to maize (3300kcal/kg). Tannin content in the pericarp is one of the most important factors affecting the feeding value of sorghum grain and adversely affecting its metabolizable energy and protein utilization in poultry (13).

Exogenous enzymes have been used extensively in the diets of poultry to improve productive performance and nutrient utilization (7, 8, 1). Studies showed that the use of protease and xylanase in sorghum based broiler diets have the potential to increase protein and starch digestibility (3). Maxigrain® enzyme is a cocktail enzyme which has a number of benefits ranging from optimizing the use of non- conventional feed ingredients, improving weight gain in broilers, improve litter quality and dropping consistency, improving feed conversion ratio (FCR), reduces levels of Di-calcium Phosphate (DCP) incorporation in the feed substantially.

For the above reasons the objective of this research was designed to determine the effect of Maxigrain®enzyme supplementation on four sorghum varieties on the performance of broiler chickens and improving the value of sorghum for optimum productivity.

MATERIALS AND METHODS

Location of study: The experiment was conducted at the Poultry Unit, Department of Animal Science Teaching and Research farm, Ahmadu Bello University, Zaria, Kaduna State, which is within the northern Guinea savannah zone of Nigeria on latitude $11^0$14`44N and longitude $7^0$33'65 E at an altitude of 610m above sea level. The climate is relatively dry, with a mean annual rainfall of 700-1400mm (11).

Experimental birds and feed ingredients: Two hundred and twenty – five Abor- Acre broiler chicks were obtained from Zamfy Farms, Ilemono, Kwara State, Nigeria. The sorghum grains used for this study were obtained from Samaru and Giwa markets in Kaduna State. While other feed ingredients were purchased in Rebson Feed Mill, Samaru, Zaria.

Experimental design and management of experimental birds: At the starter phase two hundred and twenty-five (225) five days old broiler chicks of mixed sexes were used. The birds were weighed at the beginning of the experiment and allotted into five different dietary treatments after four days in a completely randomized design (CRD). The birds were housed in deep litter pens; each treatment group had total number of forty-five (45) birds in three replicates of 15 birds per pen. Routine vaccination and medications were given as at when due. Feed and water were provided *ad- libitum.*

Experimental diets: Five diets were formulated as follows; T_1 – Maize without 0.01 % Maxigrain®enzyme supplementation, T_2 –Samsorg-14 supplementedwith 0.01 % Maxigrain® enzyme, T_3 –Samsorg-40 supplemented with 0.01 % Maxigrain® enzyme, T_4 –Samsorg-17 supplemented with 0.01 % Maxigrain® enzyme and T_5 –KSV-15 supplemented with 0.01 % Maxigrain® enzyme as presented in Table 1.

Data collection: Growth parameters were measured and calculated, these included final body weight, daily weight gain, daily feed intake, feed to gain ratio and feed cost per kg gain.

Table 1: Composition of the experimental broiler starter diets supplemented with Maxigrain® Enzyme (5 days - 4 weeks)

Ingredients (%)	**Dietary Treatments**				
	T_1 (Control)	**T_2 (Samsorg-14)**	**T_3 (Samsorg-40)**	**T_4 (Samsorg-17)**	**T_5 (KSV-15)**
Maize	51.00	0.00	0.00	0.00	0.00
Sorghum	0.00	51.00	51.00	51.00	51.00
Palm oil	2.00	2.00	2.00	2.00	2.00
Soyabean cake	15.60	15.60	15.60	15.60	15.60
Groundnut cake	27.00	27.00	27.00	27.00	27.00
Limestone	0.50	0.50	0.50	0.50	0.50
Bone meal	3.00	3.00	3.00	3.00	3.00
Common salt	0.25	0.25	0.25	0.25	0.25
Vitamin premix*	0.30	0.30	0.30	0.30	0.30
Synthetic lysine	0.20	0.20	0.20	0.20	0.20
Synthetic methionine	0.15	0.15	0.15	0.15	0.15
Total	**100**	**100**	**100**	**100**	**100**
Calculated analysis					
Maxigrain® enzyme	0.00	0.01	0.01	0.01	0.01
ME (Kcal/kg)	2981	2952	2941	2989	2935
Crude protein (%)	23.05	23.17	23.49	23.36	23.57
Ether extract (%)	5.83	5.46	5.60	5.27	6.03
Crude fibre (%)	4.03	4.81	3.98	3.98	5.37
Calcium (%)	1.19	1.18	1.18	1.18	1.18
Available phosphorus (%)	0.58	0.59	0.59	0.59	0.59
Lysine (%)	1.20	1.25	1.24	1.26	1.24
Methionine (%)	0.50	0.48	0.48	0.48	0.48
Methionine + cysteine (%)	0.83	0.83	0.87	0.86	0.91
Cost/kg feed (N)	78.76	76.26	76.26	76.26	89.01

* Biomix broiler starter premix supplied the following per kg diet: Vit. A, 1,000 I.U; Vit. D_3, 2000 I.U, Vit. E, 5.0mg; Vit.K, 2mg; Vit. $B_1$1.8mg; VitB_2, 5.5mg; Niacin, 27.5mg; Pantothenic acid, 0.5mg Vit.B_6, 0.30mg; Vit. B_{12}, 0.015mg; Folic acid, 0.75mg; Biotin 0.6mg; Choline Chloride,3000mg; Copper,3mg; Iodine, 1mg; Iron,20 mg; Manganese, 40mg; Selenium,0.2mg; Zinc,30mg; Antioxidant, 1.25mg, ME= Metabolizable Energy.

Statistical Analysis: All data obtained from the study were subjected to analysis of variance (ANOVA) using general linear model procedure of SAS (2008). Significant levels of differences among treatment means were determined using the Tukey`s test (14) to separate the means.

RESULTS AND DISCUSSION

Table 2: Performance of Broiler Chickens Fed Four *Sorghum bicolor* varieties Supplemented with Maxigrain® enzyme (5 days - 4weeks)

Parameters	Treatments					
	T1	T2	T3	T4	T5	SEM
Initial weight (g / bird)	102.20	102.20	102.20	102.20	102.20	102.20
Final weight (g / bird)	1111.11[a]	1023.81[b]	755.56[c]	1068.26[a]	800.00[c]	32.44
Daily weight gain(g / bird)	36.03[a]	32.91[b]	23.33[c]	34.50[a]	24.92[c]	1.16
Daily feed intake (g / bird)	63.13[a]	60.32[a]	55.99[b]	60.52[a]	53.01[b]	1.78
Feed conversion ratio	1.75[a]	1.83[a]	2.41[c]	1.75[a]	1.99[b]	0.06
Feed cost / kg gain (N)	138.09[a]	139.81[a]	184.04[b]	133.71[a]	176.83[b]	4.73
Mortality (%)	0.00[a]	2.22[b]	0.00[a]	0.00[a]	0.00[a]	0.99

[a,b,c.] Means on the same row with different superscripts are significantly (P<0.05) different. SEM = Standard error of means.

T1- Control 0% sorghum supplemented with 0% Maxigrain® enzyme, T2- Samsorg-14 supplemented with 0.01g/kg Maxigrain ® enzyme, T3- Samsorg-40 supplemented with 0.01g/kg Maxigrain ® enzyme, T4- Samsorg-17 supplemented with 0.01g/kg Maxigrain ® enzyme, T5- KSV-15 supplemented with 0.01g/kg Maxigrain ®enzyme.

Table 2 presents the effect of feeding broiler chicks four varieties of sorghum supplemented with 0.01 % Maxigrain® enzyme. The results showed that there were significant (P<0.05) differences in all the growth parameters measured at the starter phase. The birds in T_1(maize based diet) and T_4 (Samsorg-17 supplemented with 0.01 % Maxigrain® enzyme) had similar performance and were significantly (P<0.05) better than other dietary treatments in terms of final body weight, daily weight gain, daily feed intake, feed conversion ratio and cost /kg gain. The feed intake and feed conversion ratio of birds in T_1 and T_4 were similar to that of T_2 (Samsorg-14 supplemented with 0.01 % Maxigrain® enzyme), while birds in T_3 (Samsorg-40 supplemented with 0.01 % Maxigrain® enzyme) and T_5- (KSV-15 supplemented with 0.01 % Maxigrain® enzyme) had the least values. The result above agreed with the reports of (2) and (8) that Live-weight changes between birds fed maize-based diet and sorghum-based diet supplemented with enzyme were similar for broiler chicks at the starter phase.

Birds in T_1 had similar feed intake and feed conversion ratio with birds in T_2 and T_4 whose diets were supplemented with 0.01% Maxigrain® enzyme, this agrees with the findings of (12) and (2) that when birds were fed sorghum diets supplemented with multi-enzymes containing xylanase, phytase and protease, it reduced the negative effect of anti-nutritional factors such as phytate and polyphenols, thus enhancing feed intake, nutrient digestibility and bird performance. It might also be due to high levels of anti-nutritional factors such as polyphenols, phytate and kafirins present in the sorghum grains (4) ;(16) which made it difficult to access by digestive proteases and the enzyme used due to γ-kafirins present in the grains (5). It might also be due to lack of tannase in the enzyme used.

Mortality was significantly (P<0.05) higher for birds in T_2 compared to birds fed other dietary treatments, this might be due to high oxalate present in the diet which could not be degraded by the enzyme used since it does not have the specific enzyme to target the substrate oxalate.

CONCLUSION

The replacement of Samsorg-17 at 100 % supplemented with Maxigrain® enzyme at 0.01% for maize as an energy source did not compromise the growth performance of broiler chicks; in addition, the cost of production was reduced by 3.17 % compared to the maize based diet.

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Performance and Nutrient Digestibility of Broilers Chickens Fed Differently Processed Rubber Seed Meal (*Hevea bransiliensis*)

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Target Audience; Farmers and Academia

Abstract: A fifty-six (56) days feeding trial was conducted to evaluate the performance and nutrient digestibility of broiler chickens fed differently processed rubber (Hevea bransiliensis) seed meal (RSM) based diet as a supplement for the protein source. One hundred and thirty-five (135) birds were randomly allocated into five treatments of twenty-seven birds each and each treatment replicated thrice with nine birds per replicate. At the end of the feeding trial, results revealed that after fermentation, the level of Cyanide in RSM was reduced from 315.89mg/100g in the raw seed to 43.48mg/100g and the level of Tannin was reduced from 4.16mg/100g in the raw seed to 1.68mg/100g which shows some level of significant difference ($p<0.05$). It was also discovered that no significant difference exists ($p>0.05$) in the apparent nutrient digestibility except in protein with the fermented RSM having the highest value (84.07%) and boiled RSM having the lowest value (68.86%). The results also revealed that the highest weight gain was seen in the birds fed fermented RSM based diet (1970.37g) and the lowest was seen in birds fed boiled RSM (1513.11g). Calculation of the food Conversion Ratio (FCR) and Protein Efficiency Ratio (PER) also revealed that fermented RSM based diet is the best with values of 1.47 FCR and 0.11 PER while the boiled RSM based diet has the least quality with 1.74 FCR and 1.64 PER. It is thus concluded that fermentation is the best way of processing RSM before incorporation into the diets of monogastrics.

Keywords: Fermentation; Toasting; Iso-caloric; Iso-nitrogenous; Digestibility.

DESCRIPTION OF THE PROBLEMS

Availability of animal protein to the populace especially in the developing countries is becoming a mirage due to decreasing resources and genetic variation (1) and poultry products is considered to be to be one of the most popular options in Nigeria in reducing the incidence of malnutrition particularly protein deficiency in the diets of populace (2) but the high cost of most conventional protein rich feed ingredients such as soya bean, groundnut cake and fish meals made it necessary to tilt research towards non-conventional protein sources (3) such as Rubber seeds which have very low human food preference unlike soybean and groundnut cake and no industrial use has been recorded as at the time of carrying out this research. Its utilization in broiler's diet when properly processed to eliminate the effects of its anti-nutritional factors will reduce the over dependence of the scarce and expensive conventional feed stuffs and may enhance profitability of broiler chicken production as well as maximize the returns from poultry farming. Thus, this work is directed at determining the growth performance of broilers fed differently processed rubber seed meal-based diets and to determine the nutrient digestibility of broilers fed diets containing differently processed rubber seed meal.

MATERIALS AND METHODS

The study was carried out at the Poultry Unit of the Teaching and Research Farm of the Federal College of Wildlife Management, New bussa, Niger State, Nigeria.

Collection and processing of rubber seed: Fresh rubber seeds sourced for at Udo Rubber Plantation located in Ovia Southeast Local Government Area of Edo State in Nigeria were divided into four equal portions and each portion was processed in the following ways: (a) **Soaking:** The first portion of the seeds was soaked in water for seventy-two hours under an aerobic environment and the water was frequently changed. After seventy-two hours the soaked seeds were sieved and later sun-dried. (b) ***Boiling:*** The second portion of the seeds was immersed inside water at boiling point and allowed to boil for forty-five minutes prior to sun-drying**.** (c) ***Toasting*:** The third portion of the seeds was dry heated in a pot until it turns brownish at a monitored temperature of 105^0C.

The method was carried out locally for a duration of twenty minutes. (d) ***Fermentation*:** The fourth portion was fermented under anaerobic condition that is soaking without the interference of oxygen for three days inside an air-tight container and later sundried.

Experimental diet layout: After treatment and sun drying the RSM differently, the rubber seeds were milled into smaller pieces with hammer mill before incorporation at 0.09% in the starter diets and 0.078% in the finisher's diet as shown in tables 1 and 2. Five iso-caloric and iso-nitrogenous dietary treatments were formulated with the inclusion of RSM and designated as follows:

T_1 contains no Rubber Seed Meal (RSM) and it is used as the control diet in the experiment, T_2 contained boiled RSM (BRSM), T_3 contained soaked RSM (SRSM), T_4 contained toasted RSM (TRSM) and T_5 containing fermented RSM (FRSM).

Table 1: Percentage composition of experimental diets for broiler starters

Feed ingredients	Control	SRSM	BRSM	TRSM	FRSM
Maize	655.00	555.00	555.00	555.00	555.00
Soyabean meal	260.00	260.00	260.00	260.00	260.00
Rubber seed meal	0.00	90.00	90.00	90.00	90.00
Fish meal	40.00	50.00	50.00	50.00	50.00
DCP	25.00	25.00	25.00	25.00	25.00
Limestone	10.00	10.00	10.00	10.00	10.00
Salt	2.50	2.50	2.50	2.50	2.50
Vitamins-premix	2.50	2.50	2.50	2.50	2.50
DL-Methionine	2.50	2.50	2.50	2.50	2.50
DL-Lysine	2.50	2.50	2.50	2.50	2.50
Total	1000.00	1000.00	1000.00	1000.00	1000.00
Calculated analysis					
ME (Kcal/kg)	3171.60	3240.80	3160.35	3110.50	3210.10
Crude Protein (%)	22.89	22.36	22.20	22.01	22.50
Calcium %	11.13	10.33	10.39	10.36	10.38
Total Phosphorus %	7.67	6.77	6.83	6.78	10.40

Table 2: Percentage composition of experimental diets for broiler finishers

Feed ingredients	Control	SRSM	BRSM	TRSM	FRSM
Maize	655.00	644.50	644.50	644.50	644.50
Soyabean meal	260.00	182.00	182.00	182.00	182.00
Rubber seed meal	0.00	78.00	78.00	78.00	78.00
Fish meal	40.00	50.00	50.00	50.00	50.00
DCP	25.00	25.00	25.00	25.00	25.00
Limestone	10.00	10.00	10.00	10.00	10.00
Salt	2.50	2.50	2.50	2.50	2.50
Vitamins-premix	2.50	2.50	2.50	2.50	2.50
DL-Methionine	2.50	2.50	2.50	2.50	2.50
DL-Lysine	2.50	3.00	3.00	3.00	3.00
Total	1000.00	1000.00	1000.00	1000.00	1000.00
Calculated analysis					
ME (Kcal/kg)	3088.76	3081.96	3060.35	3073.50	3069.10
Crude Protein (%)	19.94	19.71	19.82	19.86	19.89
Calcium %	10.03	10.09	10.01	9.98	10.15
Total Phosphorus %	6.77	6.44	6.33	6.38	10.40

Experimental birds

One hundred and thirty five day old arbor acre broilers day old chicks were purchased from a reputable farm in Ibadan, Oyo state, Nigeria. After brooding for the first two weeks of life after their arrival, the birds were randomly distributed into five treatments of twenty seven birds each and each treatment replicated thrice with each replicate consisting nine birds each in a completely randomized design and were fed with the experimental

diet for fifty six days. The initial weights of the birds were taken after the allotment into treatments and replicates and on weekly basis thereafter. The records of daily feed intake were also taken till the end of the feeding trial.

Chemical analysis: Samples of raw Rubber Seed Meal, differently processed RSM, and faecal samples in all treatments were taken to laboratory for the analysis of proximate compositions using the procedures of (4) and the results are shown in tables 3 and 4.

Data analysis: All data obtained were analyzed by using Analysis of variance (ANOVA) according to the GLM procedure of (5) and the means were separated using Duncan multiple range test (6) at 5% level of significance.

RESULTS AND DISCUSSION

At the end of the feeding trial the final weight of birds in each treatment and replicate were also determined and this was used in the calculation of the growth performance, average body weight gain, average feed intake, feed conversion ratio and protein efficiency ratio as shown on table 5.

Two broilers from each replicate pen were also selected randomly for metabolic trial. Excreta collection was taken daily for a period of three days after two days of adjustment period for the determination of the apparent nutrient digestibility of the experimental diets and the results is shown on table 4.

Table 3: Proximate composition of raw and differently processed Rubber Seed Meal (RSM)

Parameters	**Raw**	**BRSM**	**SRSM**	**TRSM**	**FRSM**
Moisture (%)	4.80	5.07	6.01	4.60	5.60
Crude protein (%)	32.25	27.92	30.67	31.65	33.48
Ether extracts (%)	12.57	10.87	11.34	10.77	11.85
Crude fibre (%)	5.61	5.81	6.10	4.70	4.21
Ash (%)	4.34	3.98	3.51	4.47	4.52
NFE (%)	50.84	55.40	48.38	68.35	54.67
Cyanide (mg/100g)	315.89	97.96	82.85	58.06	43.48
Tannin (mg/100g)	4.16	1.68	0.81	0.65	0.62

Table 3 above shows that treatments of rubber seeds reduce the concentration of the anti-nutritional factors such as cyanide and tannin in the rubber seeds but the best treatment method is fermentation under anaerobic condition. This observation agreed with the findings of (7), who reported that heat treatment and fermentation were effective ways of eliminating anti-nutritional factors in rubber seed meal.

Table 4: Apparent nutrient digestibility of broiler chicken fed differently processed Rubber Seed Meal (RSM) based diets

	Dietary treatments					
Parameters	**T1 Control**	**T2 BRSM**	**T3 SRSM**	**T4 TRSM**	**T5 FRSM**	**SEM***
Dry matter (%)	71.76	70.55	71.45	72.96	72.76	1.87^{NS}
Crude protein (%)	82.65^{a}	68.86^{b}	79.54^{a}	83.54^{a}	84.07^{a}	3.12*
Crude fibre (%)	53.97	50.08	53.47	55.17	54.20	2.10^{NS}
Ether extracts (%)	65.86	63.07	64.56	65.07	66.87	7.14^{NS}
Ash (%)	62.66	59.65	62.89	53.98	63.09	2.78^{NS}
NFE (%)	74.78	73.90	74.55	75.91	76.02	1.80^{NS}

From table 4 above it can be observed that no significant differences exist between and within the apparent digestibility of all measured parameters except in the crude protein where the addition of fermented RSM tend to increase the apparent digestibility of crude protein to 84.07 and boiled RSM having the lowest value of 68.86 This could be attributed to the effect of heat on the protein content of the diet, which has been implicated in reducing protein digestibility (8). This was observed to be reflected in the lower performance of birds fed BSRM diet in this study.

Table 5: Growth Performance of broiler chicken fed different processed Rubber Seed Meal (RSM)

	Dietary treatments					
	T1	**T2**	**T3**	**T4**	**T5**	**SEM***

Parameters	Control	BRSM	SRSM	TRSM	FRSM	
Initial Weight g/bird	114.82	116.52	114.82	116.52	114.82	2.95^{NS}
Final Weight g/bird	2071.39^{a}	1629.63^{b}	2057.18^{a}	2129.63^{a}	2085.19^{a}	32.05*
Daily weight gain g/bird	37.63^{a}	29.10^{b}	37.35^{a}	38.71^{a}	37.89^{a}	0.31*
Daily feed intake g/bird	59.52^{a}	50.65^{c}	58.24^{ab}	61.20^{a}	55.56^{b}	1.49*
Feed conversion ratio	1.58	1.74	1.56	1.58	1.47	0.21^{NS}
Protein efficiency ratio	1.65	1.64	1.53	1.56	1.52	0.11^{NS}

The result showed that all the performance parameters measured were significantly ($p<0.05$) affected by the dietary treatments except the Food Conversion Ratio and Protein Efficiency Ratio with the highest weight gain observed in birds fed fermented RSM based diet (1970.37g) and the lowest weight gain was observed in birds fed boiled RSM based diet (1513.11g).

CONCLUSION AND APPLICATION

- The results of this study show that processing of the seed exhibited a huge reduction in the level of its anti-nutritional factors such as hydrogen cyanide and tannin to a non-toxic level.
- Therefore, birds fed on fermented (FRSM) and toasted (TRSM) rubber seed meal recorded an improved performance and nutrient digestibility at a lower cost of production more than those on soaked (SRSM) and boiled (BRSM) diet.
- Observation from this study revealed that fermentation is the best method of processing RSM before inclusion in broiler's feed, further studies should be carried out on the tolerable level of RSM in the diet of broiler chickens.

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Comparative effects of feeding Sorghum SK-5912 Versus White Sorghum (*Fara - fara*) based diets on Haematological parameters and Serum biochemical indices of Broiler Chickens

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Abstract: An experiment was conducted to investigate the effects of feeding sorghum *SK-5912* and white sorghum *(Fara-fara)* based diets on the blood components of broiler chickens. Five experimental diets were formulated in which sorghum *SK-5912*, white sorghum (WS) and their combinations i.e. 100% WS, 75% WS + 25% *SK-5912*, 50% WS + 50% *SK-5912*, 75% WS + 25% *SK-5912* and 100% *SK-5912* coded as diets 1, 2, 3, 4 and 5, respectively for finisher rations. Three hundred unsexed broiler chicks 'Marshal strains' were randomly allotted to five dietary treatments with four replications of sixty birds per treatment in a completely randomized design (CRD). Feed and water were supplied *ad libitum* and experiment lasted for a period of eight weeks. At the end of the experiment eight birds per treatment were randomly selected and their blood samples collected for haematological and serum biochemical analysis. Results showed that most of the blood parameters measured were not affected by the dietary treatments except the total cholesterol (3.68 - 5.85mmol/L; $P < 0.01$) and low-density lipoproteins (1.55 – 2.30mmol/L; $P < 0.05$) that were significantly affected, and all values obtained are within the normal ranges for healthy birds. This study therefore, revealed that sorghum *SK-5912*, white sorghum and their combinations can be utilized as dietary energy sources without adverse effects on the blood constituents of broiler chickens.

Keywords: Broiler chickens, Haematological, Serum, Sorghum *SK-5912*, White sorghum

DESCRIPTION OF PROBLEM

Sorghum (*Sorghum bicolor* L. Moench) is widely cultivated in the semi-arid and arid savannah regions of Nigeria because of its benefits of an ability to tolerate drought, soil toxicities and temperature extremes effectively than other cereal grains [1], and its nutritive values that is comparable to that of maize, [2]. Sorghum had slightly lower fat and energy than maize but higher values of proteins [2, 3]. Some varieties of sorghum have been reported to contain tannin an anti-nutritional factor that binds protein and impairs digestion [2, 4] while some such as the newlyimproved sorghum *SK-5912*, local white sorghum *(fara – fara)* have lower content of tannins hence the need for their incorporation in to poultry diets [5, 1]. [5] have reported that Sorghum *SK-5912* can play an important role in poultry diets in a trial using two new improved varieties of sorghum (SAMSORG-17 and ICSV 400) as sources of dietary energy for grower turkeys, the authors reported that much variation were not observed on their haematological and serum biochemical parameters from the normal.They further suggested that the utilization of these new sorghum varieties in poultry diets will improve the feed supply system of the birds at affordable cost[5].Thus, it is important to determine the effects of these varieties of sorghum on the health of the broiler chickens. The objective of this study therefore, was to investigate theeffects of sorghum *SK-5912*, white sorghum and their combinations as dietary sources of energy on the haematological and serum biochemical indices of broiler chickens.

MATERIALS AND METHODS

A total of three hundred experimental birds were randomly allotted to five experimental diets that were replicated four times in a completely randomized design of fifteen birds per replicate. Feed and water were supplied to them *ad libitum* during the experiment which lasted for eight weeks. Five

experimental diets for finisher phase (20%CP) was formulated in which sorghum *SK-5912* replaced white sorghum at 0, 25, 50, 75 and 100% tagged as diets 1 (control), 2, 3, 4, and 5, respectively, using boiled soya bean as plant protein. Routine vaccinations and medications were carried out accordingly. At the end of the experimental period, eight birds per treatment were randomly selected, fasted for 12 hours, blood samples were collected for haematological and serum biochemistry analysis. Haematological samples were collected into sample tubes containing Ethylene Diamine Tetra-acetic acid (EDTA) as anticoagulant while serological samples were collected into anticoagulant free tubes. Haematological parameters analyzed were Packed Cell Volume (PCV), Red Blood Cells (RBC) count, White Blood Cells (WBC) count, Haemoglobin (Hb) concentration, Mean Cell Volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC) and platelet. They were measured according to the methods by [6]. Total Proteins (TP), Albumin, Globulin, Creatinine, Total cholesterol, High Density Lipoproteins (HDLP), Low Density Lipoproteins (LDLP), Triglycerides, Alanine Amino Transferase (ALT), and Aspatate Amino Transferase (AST) formed the serum biochemical indices. Data collected were subjected to analysis of variance techniques as outlined by [7] using Minitab software statistical package [8]. Differences between treatment means were separated using Duncan's Multiple Range Test, DMRT, [9].

Table 1: Percentage composition of graded levels of Sorghum SK-5912 as replacement for white sorghum in broiler finisher diets (5-8 weeks)

Ingredients	**Diets (%)**				
	1 (0)	**2 (25)**	**3 (50)**	**4 (75)**	**5 (100)**
White Sorghum	55.31	41.48	27.66	13.83	0.00
Sorghum (SK-5912)	0.00	13.83	27.66	41.48	55.31
Boiled Soya bean	23.79	23.79	23.79	23.79	23.79
Wheat offal	15.00	15.00	15.00	15.00	15.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00	3.00
+Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.35	0.35	0.35	0.35	0.35
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.20	0.20	0.20	0.20	0.20
Total	100	100	100	100	100
Calculated Analysis					
Crude protein (%)	20.00	20.00	20.00	20.00	20.00
ME (Kcal/kg)	2950	2950	2950	2950	2950
Crude fibre (%)	3.71	3.71	3.71	3.71	3.71
Ca (%)	1.43	1.43	1.43	1.43	1.43
P (%)	0.88	0.88	0.88	0.88	0.88
Lysine (%)	1.09	1.09	1.09	1.09	1.09
Methionine (%)	0.46	0.46	0.46	0.46	0.46

+A bio-organics nutrient supplement containing Vit. A; 4000000 i.u,Vit. D3; 800000 i.u, Vit. E; 9200mg; Niacin 11000mg; Vit.B2 2000mg; Vit.B6, 1200mg; Vit.B12 6mg; Vit. K3 800mg; Pantothenic acid 3000mg; Biotin 24mg; Folic acid 300mg; Choline Chloride 120000mg; Cobalt 80mg; Copper 1200mg; Iodine 400mg; Iron 8000mg; Manganese 16000mg; Selenium 80mg; Zinc 12000mg; Anti-oxidant 500mg.

RESULTS AND DISCUSSION

The calculated crude protein values (Table 1) are adequate and within the recommended levels for raising broiler chickens in the tropics [2, 10]. The results of the haematological and serum biochemistry indices are presented in Tables 2 and 3 respectively. The haematological values observed include packed cell volume which ranges between 27.58% to 30.93% on diets 2 and1 respectively, white blood cells 25.93 to 27.64×10^3/µL for diets 5 and 3, red blood cells 2.02 to 2.30×10^6/ µL for diets 2 and 1, haemoglobin 8.00 to 10.16g/dl on diets 5 and 1

respectively, MCV values ranged between 136.30 to 138.68fl for diets 4 and 3, MCH were between 41.83 to 44.13pg for diets 3 and 5, MCHC values ranged between 24.75 to 36.08g/dl on diets 1 and 3, and platelet 12.00 to 24.75×10^3/µL on diets 2 and 1 respectively. All of these were not significantly influenced across the dietary levels of sorghum *SK-5912* variety replacing white sorghum. Thus, the packed cell volume, white blood cells counts, haemoglobin and all the corpuscular parameters measured were all similar among the treatment groups and the values obtained are all within the normal range as reported by [11] when maize, sorghum and millet, and their combinations was fed to broilers and when SAMSORG 17 (sorghum SK-5912) was fed to turkey poults there was no adverse effect on their blood parameters [2].

The results of the serum biochemical indices observed showed that total protein values ranged between 44.50 to 60.25 g/l on diets 5 and 4 respectively, where albumin ranged between 18.50 to 20.00 g/l on diets 5 and 3, and globulin 26.00 to 40.75 g/l for diets 5 and 4. Also values obtained for creatinine were between 4.73 and 7.60 µmol/L on diets 3 and 5, while total cholesterol values were between 3.68 and 5.85mmol/L on diets 5 (100% sorghum *SK-5912*) and 2 (75% white sorghum) and there was a high significant (P<0.01) among the treatment groups. High Density Lipoprotein did not differ across the treatment means, values obtained ranged between 2.80 and 3.05 mmol/L, for diet 3 and diet 5 respectively. However, Low Density Lipoprotein differ significantly (P<0.05) across the treatment means, values obtained are between 1.55 for diet 4 (75% sorghum *SK-5912*) and 2.30 mmol/L for diet 5 (100% sorghum *SK-5912*). Glucose did not differ across the treatment groups, values obtained are between 12.85 to 13.85g on diets 2 and 4 respectively. Similarly, values observed for AST ranged from 338.25 to 371.00IU/L for diets 2 and 4 respectively, and ALT ranged between 18.50 and 28.75IU/L on diet 1 and 5, respectively and were similar across the treatment groups. The serum biochemical indices therefore, showed no significant differences among the treatment groups. Although, the total serum protein values were higher than the range of 16.00-34.00g/dl reported by [11] for broiler chickens, and since total protein is usually a reflection of the protein quality of feed [12]and thus higher values obtained indicated that the protein levels were sufficient to sustain the normal physiological process of the birds. This observation indicates that sorghum *SK-5912,* white sorghum and their combinations did not have adverse effects on blood parameters.

Table 2: Haematological values of broiler chickens fed graded levels of sorghum *SK-5912*, white sorghum and their combinations

Parameters	**Diets (%)**					**SEM**
	1 (0)	**2 (25)**	**3 (50)**	**4 (75)**	**5 (100)**	
PCV (%)	30.93	27.58	29.10	29.05	28.80	01.62^{NS}
RBC (×10^6/µL)	2.30	2.02	2.11	2.14	2.10	0.14 ^{NS}
Hb (g/dl)	10.16	8.60	9.38	9.28	8.00	0.73 ^{NS}
MCV (fl)	136.40	136.93	138.68	136.30	137.53	2.55 ^{NS}
MCH (pg)	42.58	42.73	41.83	43.50	44.13	1.70 ^{NS}
MCHC (g/dl)	24.75	26.60	36.08	32.00	31.93	4.49 ^{NS}
WBC (×10^3/µL)	27.27	26.19	27.64	27.18	25.93	4.49 ^{NS}
PLT (×10^3/µL)	24.75	12.00	20.75	18.25	14.75	6.05 ^{NS}

NS= Not significant, SEM= Standard error of mean, PCV= Packed Cell Volume, RBC= Red Blood Cell, WBC= White Blood Cell, Hb= Haemoglobin Concentration, MCV= mean corpuscular volume, MCH= mean corpuscular haemoglobin, MCHC= mean corpuscular haemoglobin concentration, PLT= Platelet.

Table 3: Serum biochemical values of broiler chickens fed graded levels of sorghum*SK- 5912*, white sorghum and their combinations

Parameters	**Diets (%)**					**SEM**
	1 (0)	**2 (25)**	**3 (50)**	**4 (75)**	**5 (100)**	
Total Protein (g/L)	58.25	53.25	59.00	60.25	44.50	5.59 ^{NS}

Albumin (g/L)	19.00	19.75	20.00	19.50	18.50	1.36 ^{NS}
Globulin (g/L)	39.25	33.50	39.00	40.75	26.00	5.53 ^{NS}
Creatinine (µmol/L)	7.05	5.83	4.73	7.43	7.60	1.13 ^{NS}
Cholesterol (mmol/L)	5.85^{a}	3.68^{c}	3.98^{ab}	4.78^{ab}	5.53^{b}	0.84 **
HDL (mmol/L)	3.03	2.83	2.80	3.03	3.05	0.30 ^{NS}
LDL (mmol/L)	2.18^{a}	1.63^{ab}	1.78^{ab}	1.55^{b}	2.30^{a}	0.52 *
Glucose (g)	13.73	12.85	13.35	13.85	12.88	0.85 ^{NS}
AST (IU/L)	358.00	338.25	359.75	371.00	344.00	47.56 ^{NS}
ALT (IU/L)	18.50	26.50	20.75	24.50	28.75	8.72 ^{NS}

^{abc}Means bearing different superscripts within the same row differ **= (P< 0.01), * = (P< 0.05), NS= Not significant; SEM= Standard error of means, AST= Aspartate Amino Transferase, ALT= Alanine Amino Transferase

CONCLUSION AND APPLICATION

This study revealed that haematological and serum biochemical indices of broiler chickens were not adversely affected by the use of sorghum *SK – 5912,* white sorghum and their combinations. It can therefore be concluded that either of these sorghum varieties or its combinationscan be used as energy sources in broiler chickens without adverse effects on the health of the birds.

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Egg Quality Parameters of Brown Egg-Type Layers Fed Biscuit Dough in Place of Maize

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Abstract: This study was conducted to examine the effect of substituting maize with biscuit dough (BD) on internal and external egg quality characteristics of brown egg type layers. 108 point of lay ISA brown strain of layers was used for the study. Four diets were formulated with diet 1without the inclusion of BD as the control while diets 2, 3, and 4 had BD included to replace maize of the control diet at 10, 20 and 30%, respectively. The birds were divided into four treatments groups and assigned the four diets in a completely randomize design experiment. Three eggs were randomly picked as replicate per week for analysis. This was done for 10 weeks. Results showed that replacing maize with biscuit dough had no significant ($P>0.05$) effect on the external egg characteristics. However higher ($p<0.05$) values were observed in 0, 20 and 30% BD for yolk percentage, albumen length of eggs with inclusion of BD were lower ($p>0.05$) than the control, albumen height of eggs with inclusion of BD were higher ($p<0.05$) than the control and the haugh unit of eggs with inclusion of BD were higher ($p<0.05$) than the control were significantly ($P<0.05$) affected. It was concluded that the biscuit dough could be used to replace maize in laying birds up to 30% without negative effects on important egg quality parameters.

Keywords: Biscuit dough, External egg quality, internal egg quality, Layer

DESCRIPTION OF PROBLEM

Biscuit dough (BD) is an agro-industrial waste product found in substantial quantities in biscuit producing industries. Biscuit is a palatable, high energy food produced from wheat flour, skimmed milk powder, vegetable fat, sugar, salt and flavor materials consequently biscuit waste a by-product from biscuit is expected to contain substantial amount of nutrients such as protein, energy and mineral required for animal growth and performance (Longe, 1986; Olayeni *et al*., 2007).

Biscuit waste generally has no anti-nutritional factor and could make a good replacement for maize and other cereal grains in feeding broilers, snails and fattening ram for market or for slaughter (Olayeni *et al.,* 2007). It is the left over after shaping of biscuit which fail the first-time biscuit quality and are yet to undergone baking. The cost of biscuit dough and biscuit waste is relatively low compared to that of maize because they are considered a waste product. Biscuit waste has been included in the diets of snails and rams which has resulted in reduction in the cost of feed without any adverse effect on their performance (Longe, 2010; Apata *et al.,* 2010). Egg is the most nutritious and complete food known to man (Mabe, 2003). Although the use of close substitutes to conventional ingredients may result in comparably lower production costs consequent upon reduction in cost of feeding, the effects of such replacement on products (eggs, meat, milk among others) needs to be investigated. Thus, the aim of this experiment is to evaluate the egg quality parameters of brown egg-type layers fed biscuit dough in place of maize.

MATERIALS AND METHODS

Experimental site: The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Oyo state, Nigeria.

The test ingredient and processing: This test ingredient (biscuit dough) in pasty form was purchased from a BD distributor that has direct access to the Yale Biscuit Industry in Ibadan. It was sun-dried with turning at

intervals to moisture content of between 10-12%. The sun-dried biscuit dough was milled into BD meal and mixed with other feed ingredients to formulate experimental diets.

Formulation of experimental diets: Four experimental diets were formulated as follows diet 1- 100% maize + 0% BD, diet 2- 90% maize + 10% BD, diet 3- 80% maize + 20% BD, diet 4-70% maize + 30% BD (Table 1).

Experimental Animals and Management: One hundred and eight (108) point of lay Isa Brown strain of layers were used for the experiment. The birds were weighed and randomly divided into four (4) treatments of 3 replicates each; each replicate has 9 birds to make a total of 27 birds in a treatment. The experiment commenced when the birds were 25% in production. The birds were managed intensively in a two-tier cage system and stocked at the rate of 3 birds per cell measuring (15cm by 15cm by 16cm). They were offered adequate feed, clean and fresh water on daily basis throughout the experiment which lasted for 10 weeks.

Data Collection: Data were collected on external and internal egg parameters.

External and Internal egg qualities: The following egg quality traits (external and internal) were assessed: Egg weight (g), yolk weight (g), albumen weight (g) and shell weight (g) were measured with digital scale with 0.01 g accuracy. To determine the proportions of egg parts, each egg was carefully broken and shell separated. Egg shell (not dried) was weighed and the relative weight calculated by relating the shell weight to the weight of the egg. An egg separator was used to separate the yolk from the albumen. Relative yolk weight was calculated in percentages by relating the yolk weight measured to the nearest gram to the whole weight of that particular egg and multiplied by 100. The albumen weight was calculated by subtracting the yolk and shell weights from the whole egg weight. The albumen weight relative to the individual egg weight was calculated. Yolk index (%) was calculated according to the formula: Yolk index = yolk height (mm) / yolk width (mm) x 100. Haugh unit was calculated by taking the average values of albumen height and weight of the eggs using the equation below (Haugh, 1937)

$HU = 100 \log (H+7.57-1.7W^{0.37})$

Where;

H = Albumen Height in millimetres

W = Egg weight in grams

Laboratory analysis: The experiment diets, as well as the test ingredient were analyzed for proximate composition by method of (AOAC, 2005).

Data analysis: All data collected were subjected to one-way analysis of variance using the GLM of SAS (2000). Means were separated using Duncan's Multiple Range Test of the same.

RESULTS AND DISCUSSION

The proximate composition of the BD used shows that it has 91.05, 10.5, 9.51, 9.24, 1.75 and 69.35% dry matter content, crude fat, total ash, crude protein, crude fibre and NFE values, respectively.

The effect of feeding BD on external and internal parameters of eggs is presented in Tables 2 and 3. Replacement of maize with biscuit dough did not significantly ($P>0.05$) affect the external egg parameters measured. This implies a positive grain replacement value of BD. Egg weight and egg length obtained in this study was similar to Onyimonyi and Ugwu (2007). The egg width obtained in this study is higher than that of Onyimonyi and Ugwu (2007). Egg size is a function of so mainly factors, notably, quality and quantity of feed, strain of the birds, stage of lay and management system. The value for egg size in this report is similar to the value obtained by Onyimonyi and Ugwu (2007). The values obtained for shell thickness were similar ($P>0.05$) across the treatment groups. The improvement in shell thickness may be a consequence of the increased mineral and protein absorption. Increased calcium and protein deposition in the shell improve it's quality which may results in reduced breaking of the shells (Haddadin *et al.* 1996).

Table 1: Gross composition of experimental diets

Ingredients	**Replacement of maize with biscuit dough (%)**			
	0	**10**	**20**	**30**
Maize	46.00	41.40	36.80	32.20
Biscuit dough	0.00	4.60	9.20	13.80
Fixed ingredients	54.00	54.00	54.00	54.00
Total	**100.00**	**100.00**	**100.00**	**100.00**
Analysis				
Crude protein	16.91	17.34	17.77	18.19
Crude fat	3.35	3.35	3.35	3.35
Crude fibre	3.94	4.04	4.14	4.24
Calcium	4.69	4.69	4.69	4.69
Phosphorous	0.75	0.75	0.74	0.74
Lysine	0.86	0.85	0.84	0.83
Methionine	0.77	0.76	0.75	0.75
Energy (kcal/kg)	2500.34	2471.27	2442.20	2413.12
Cost per kg of feed (₦)	72.61	71.69	70.77	69.85

Fixed ingredients: Soybean meal 15.00, Wheat offal 19.50, Fish meal 3.00, Palm kernel cake 3.00, Bone meal 3.50, Oyster shell 9.00, Salt 0.25, Methionine 0.25, Lysine 0.25, Premix 0.25

Table 3: External Egg quality Parameters of Brown Egg type Layers Fed biscuit dough in place of maize

	Replacement of maize with Biscuit dough (%)					
Parameters	0	10	20	30	SEM	P-value
Egg weight (g)	61.39	61.92	61.27	61.42	0.24	0.79
Egg mass (g)	45.3	43.6	45.0	45.1	0.04	0.33
Egg width (cm)	4.37	4.41	4.37	4.37	0.00	0.22
Egg length (cm)	5.61	5.62	5.58	5.58	0.01	0.52
Shell thickness (mm)	0.38	0.38	0.37	0.38	0.00	0.57
Egg Shape Index	0.78	0.79	0.79	0.78	0.00	0.06
Shell Surface Area	75.82	76.27	75.71	75.56	0.21	0.69
Percentage Shell Weight (%)	10.23	10.72	10.20	10.42	0.08	0.09

[ab]Means with different superscripts along the same row are significantly ($p<0.05$) different SEM- Standard Error of Mean

Table 4: Internal Egg quality parameters of Brown egg type Layers fed biscuit dough in place of maize

	Replacement of maize with Biscuit dough (%)					
Parameters	0	10	20	30	SEM	P-value
Yolk Colour	1.50	1.37	1.50	1.23	0.05	0.15
Yolk height (cm)	11.96	12.11	12.17	12.11	0.06	0.65
Yolk weight (g)	14.18	14.35	14.50	14.51	0.09	0.13
Yolk index	3.04	3.11	3.06	3.11	0.02	0.28
Yolk (%)	23.00^{ab}	22.66^{b}	23.74^{a}	23.5^{ab}	0.15	0.05
Albumen length (cm)	7.05^{a}	6.89^{b}	6.88^{b}	6.77^{c}	0.02	0.00
Albumen weight (g)	36.51	37.89	36.54	37.16	0.18	0.06
Albumen height (cm)	6.65^{b}	6.98^{a}	6.92^{a}	6.97^{a}	0.04	0.03
Albumen (%)	59.46^{c}	61.20^{a}	59.64^{bc}	60.52^{ab}	0.18	0.01
Haugh unit	80.55^{b}	82.31^{a}	82.64^{a}	82.83^{a}	0.32	0.04

[abc]Means with different superscripts along the same row are significantly ($p<0.05$) different SEM- Standard Error of mean

CONCLUSION

It could be concluded from the results of this study that the biscuit dough could be used to replace maize in laying birds up to 30% without negative effects on egg quality parameters.

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In-Vitro Effects of Feed Additives on Growth of Fungi (*Aspergillus parasiticus*)

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Abstarct: Molds and fungi produce secondary toxic metabolites which are known as mycotoxins. Ochratoxin A, Aflatoxin, and T-2 toxin are few examples of secondary metabolites of *Aspergillus spp* which are often found in poultry feeds and feedstuffs. The aim of this trial is to ascertain the effectiveness of selected commercial enzyme from fungi source and herbal products that are rich in anti-oxidant to inhibit *Aspergillus parasiticus.* There were 30 treatments made up of 5x6 factorial combinations of concentration and herbal extracts. All treatments were set up in triplicates. Data were subjected to analysis of variance using the factorial design, significant differences between treatments means were separated using the Duncan multiple range test ($P \leq 0.05$). Based on the results of this study, it can be concluded that the three extracts at 30mg/l (Tumeric *Curcuma longa*, Ginger *Zingiber officinale* and Garlic *Allium sativum*) in the order listed were effective in controlling the growth of *Aspergillus parasiticus*.

INTRODUCTION

Poultry feeds by virtue of their high nutrients generously support the growth of molds and fungi. These molds and fungi produce secondary toxic metabolites which are known as mycotoxins. OchratoxinA, Aflatoxin, and T-2 toxin are few examples of secondary metabolites of *Aspergillus spp* which are often found in poultry feeds and feedstuffs. Ingestion of mycotoxins may show negative effects on the wellness and performance (Raju and Devegowda, 2000; Yegani *et al*., 2006). Several approaches have been used to neutralize Aflatoxicosis in poultry, using single or synergy of physical, chemical, nutritional and biological methods. Herbal components like turmeric (*Curcuma longa*), garlic (*Allium sativum*) and green algae (*Spirulina plantesis*) and other mineral materials have shown a good prospect to neutralize mycotoxin and they also act as good antioxidants and binder, however, the search is still on for a natural, cost effective and available solution to this mycotoxins in poultry. The present study is conducted to ascertain the effectiveness of selected commercial enzyme from fungi source and herbal products that are rich in antioxidants to inhibit *Aspergillus parasiticus*.

MATERIALS AND METHODS

Experimental site: The research was carried out at University of Ilorin, Ilorin, Nigeria. Ilorin is situated in the Guinea Savannah belt. Location: "latitude 8° 20'N and longitude 4° 35'E and an approximate altitude of 306 m above sea level".

Microorganisms: The toxigenic strain of *Aspergillus parasiticus* was donated by International Institute of Tropical Agriculture (IITA), Ibadan, Oyo State Nigeria. The strain was tested for its capacity to produce Aflatoxin on Carrot-Potato Dextrose agar media (CPDAM).

Preparation 0f Herb Extracts: Herb materials of three plant species (Tumeric *Curcuma longa*, Ginger *Zingiber officinale* and Garlic *Allium sativum*), washed with tap water, disinfected by immersion in 2% sodium hypochlorite solution for 30 min, rinsed with sterile distilled water to eliminate residual hypochlorite and dried in shade for 14days. The shade-dried material of each plant species was grounded into a powdered material using a blender to pass 100 mm sieve and the mince was sealed in polyethylene bags until extraction. For preparation of aqueous extracts, 50 g of dry powder plant material from each plant species was soaked in sterilized water (10 ml of water/g of plant material) with stirring for 48 h then filtered through double layers of muslin, centrifuged at 9000 rpm for 10 min and finally filtered again through Whatman filter paper No. (41) to remove debris and obtain a clear filtrate. The filtrates were evaporated and dried under reduced pressure and temperature below 40°C. Each of the plants extracted were diluted to meet up the concentration needed to inhibit *Aspergillus* growth.

Antifungal Screening test of Plant Extracts and Xylanase: Antifungal activity was evaluated on the toxigenic *A. flavus and Parasiticus* strain using Czapek dox broth medium (sucrose, 30g; sodium nitrate, 3g; dipotassium phosphate, 0.5g; magnesium sulfate, 0.5g; potassium chloride, 0.5g; ferrous sulfate, 0.01g; distilled water,

1000ml; pH, 6.5). The plant extract residues and xylanase were re-dissolved in 5 ml of Czapek broth, sterilized in disposable Millipore filter (0.22 µm pores) and mixed with 45ml, 40ml, 35ml, 30ml and 25ml of sterile Czapek broth in 150 ml Erlenmyer flasks to obtain final concentration of 10mg/ml, 20mg/ml, 30/mg ml, 40mg/ml and 50mg/ml respectivelyof each plant extract and xylanase. The control (positive and negative) set were kept parallel to the treatment sets without plant extracts. The flasks were inoculated with 1.02 x 10^7 conidial/ml with the toxigenic *Aspergillus parasiticus* isolate and incubated at 25 ± 2°C for 7 days. After incubation, content of each flask was filtered (Whatman No.1) and Mycellia weight of the filtered mycelium was determined after drying at 70°C for 4 days till their weights remains constant". There were 30 treatments made up of 5x6 factorial combinations of concentration and herbal extarcts. All treatments were set up in triplicates.

The percentage of mycelial inhibition was calculated using the following formula:

Percentage of Mycelial inhibition = [C – T / C] x 100.

Where, C and T are the mycelial dry weight (mg) in control and treatment respectively.

Statistical Analysis: Data collected were subjected to analysis of variance appropriate for a 5x6 the factorial design (Steel and Torrie, 1980) and General Linear Model procedure (SAS Institute, 2000). Significant differences between treatments means were separated using the Duncan multiple range test (Duncan, 1955)

RESULTS

Table 1 shows the effects of plant extracts and xylanase on the mycellia weight and inhibition of *Aspergillus parasiticus*. The different plant extracts (*Zingiber officinale, Curcuma longa and Allium sativum*) reduces the Mycellia weight of the tested organisms, the effects of the three of them were statistically comparable ($p< 0.05$) and values lower to the control and xylanase ($p< 0.05$). The reverse trend was noticed for the inhibition rate of this plant extracts as compared to the control and xylanase ($p< 0.05$). There were significant interactions between concentrations and types of extract for mycellia weight and percentage inhibition ($p<0.05$). The detailed interactions is shown in Tables 2a and 2b

Table 1: The effects of plant extracts and their concentrations on mycellia weight of *Aspergillus parasiticus*.

	Mycellia Weight (g)	Inhibition (%)
Extracts		
Control	0.120^{a}	0.00^{d}
Xylanase	0.104^{a}	13.48^{c}
Zingiber officinale	0.040^{b}	67.42^{a}
Curcuma longa	0.036^{b}	70.21^{a}
Alliumsativum	0.044^{b}	63.21^{b}
Concentration (mg/ml)		
0	0.120^{a}	0.00^{c}
10	0.045^{b}	62.67^{b}
20	0.046^{b}	61.74^{b}
30	0.045^{b}	63.55^{ab}
40	0.041^{b}	66.63^{a}
50	0.040^{b}	66.91^{a}
Extracts*Concentration	S	S
SEM±	0.008	5.158

^{abcde}: means in the same column with different superscripts are significantly different ($p<0.005$)

Table 1a shows the interactions of plant extracts and their concentrations to reduce mycellia weight of *Aspergillus parasiticus* in a liquid broth for 7days. At 0 mg/l concentrations, the Mycellia weight were comparable for all the plant extracts ($p>0.05$). *Zingiber officinale* showed to be more effective at 10mg/l and lower compared to *Curcuma longa, Allium sativum* that are statistically comparable ($p<0.05$). *Zingiber officinale* and *Allium sativum* were comparable but less effective to *Curcuma longa* at 20, 30 and 40mg/l ($p<0.05$). The three plants extracts were comparable at 50mg/l xylanase was all time higher at whatever concentrations used ($p<0.05$).

Table 1b shows the interactions of plant extracts and their concentrations on growth of *Aspergillus parasiticus* in a liquid broth for 7days. At 0 mg/l concentrations, the inhibition was statistically the same for all the plant extracts. *Zingiber officinale* showed to be more effective at 10mg/l followed *Curcuma longa* then *Allium sativum* ($p<0.05$). At 20mg/l and 40mg/l *Curcuma longa* showed to be more effective compared to *Zingiber officinale* that is statistically more effective than *Alliumsativum* ($p<0.05$). 30mg/l and 50mg/l showed the same trend. The inhibition percentage was higher in *Curcuma longa* while *Zingiber officinale* and *Allium sativum* were statistically comparable ($p<0.05$). Xylanase was all time lower at all the concentrations tested ($p<0.05$).

Table 2a: Details of interaction of plant extracts and their concentrations on mycellia weight of *Aspergillus parasiticus.*

Plant Extracts	Concentration (mg/l)					
	0	10	20	30	40	50
Xylanase	0.120^{a}	0.09^{b}	0.10^{ab}	0.11^{ab}	0.09^{b}	0.10^{ab}
Zingiber officinale	0.120^{a}	0.02^{d}	0.03^{c}	0.03^{c}	0.03^{c}	0.02^{d}
Curcuma longa	0.120^{a}	0.03^{c}	0.02^{d}	0.02^{d}	0.01^{e}	0.02^{d}
Alliumsativum	0.120^{a}	0.03^{c}	0.03^{c}	0.03^{c}	0.03^{c}	0.02^{d}

Table 2b: The Details of interaction between plant extracts and their concentrations on inhibition of *Aspergillus parasiticus*.

Plant Extracts	Concentration (mg/l)					
	0	10	20	30	40	50
Xylanase	0.00^{g}	22.09^{f}	13.71^{f}	8.37^{f}	22.81^{f}	13.93^{f}
Zingiber officinale	0.00^{g}	83.26^{bc}	78.12^{c}	79.30^{d}	80.59^{c}	83.26^{bc}
Curcuma longa	0.00^{g}	74.88^{d}	80.23^{c}	87.21^{c}	91.75^{a}	87.21^{b}
Allium sativum	0.00^{g}	70.46^{e}	74.88^{d}	79.30^{d}	71.39^{de}	83.26^{bc}

^{abcde}: means in the same column and row with different superscripts are significantly different ($P<0.005$)

DISCUSSION

The results obtained from the present investigation revealed that the highest antifungal activities were exhibited by the plant extracts (*Zingiber officinale, Curcuma longa* and *Allium sativum*) than the commercial enzyme. The basis of the reaction might be due to the nature and combinations of phytocompounds present in the crude extracts. At different concentrations of extracts that were added to the fungal cultures in liquid media, a remarkable reduction in mycelia was noticed and which in turn will reduce the aflatoxin concentration (Sindhu *et al*. 2011; Komala *et al*., 2012)

Turmeric, ginger and garlic in this study inhibited mycelia growth and spore formation, there is a positive correlation between spore count and aflatoxin production from the previous study. It has been suggested that the regulation of aflatoxin synthesis and conidiogenesis may be interlinked, since the loss of aflatoxigenic capabilities in the nona-flatoxigenic variant strains of *Aspergillus parasiticus* was correlated with alterations in the conidial morphology (Kale *et al*.,1996). Curcumin is an activie ingredient in turmeric which has been implicated to inhibit mycelia growth and spore formation (Soni *et al*.,1992 and Gowda *et al*., 2004). The inhibition observed by treatment with Ginger extracts might be linked to volatile essential oils which include zingeberene, curcumene and farnesene and nonvolatile bioactive polyphenol compounds (gingerol, shogaol and their derivatives), which have a high antioxidant activity. This was attributed to the presence of α, β- unsaturated ketones moieties of (6)–shogaol, and the presence of short carbon chains of (6)–gingerol and (6)–shogaol, which made their antioxidants more potent than the other four long carbon chain compounds (Offei-Oknye *et al.*, 2015). Garlic (*Allium sativum*) has inhibitory activity on the growth of fungi *invitro*. The antimicrobial activity of garlic is believed to be due to the effect of allicin, the main ingredient in garlic, generated by the phosphopyridoxal enzyme allinase and ajoene (Ankri *et al.*, 1999). Thus, inhibition of fungi observed may be related to allicin or ajoene which curbs the performance of some enzymes that are important to fungi.

The possible mechanism of action of extract components on the growth of fungi was reported in several studies. It is generally accepted that the extracts components act on the functionality and the structure of the cell membrane of fungi. Low concentrations result in changes of the cell structure, inhibiting respiration and

changing the permeability of the cell membrane, whereas high concentrations lead to severe membrane damage, loss of homeostasis and cell death (Viuda-Marthos *et al*. 2008). Conner and Beuchat, (1984) suggested that the antifungal activity is the product of extracts components' interaction with enzymes responsible for energy production and the synthesis of structural compounds of the cell. On the other hand, Omidbeygi *et al*; (2007) suggested that the extracts components pass through the cell membrane, integrating with enzymes and proteins of membranes, causing loss of macromolecules from the interior of the cell, leading to changes in the cell and ultimately to its death. Cristani *et al*; 2007 reported that the antifungal activity of terpene relates to their ability to act not only on the permeability, but also on other functions of cell membranes. These components can pass through the cell membrane and interact with intracellular structures. Daferera *et al*; (2000) reported that fungitoxic effect of extracts could result to hydrogen bonds formation between hydroxyl groups of phenolic compounds and active sites of cellular enzymes.

CONCLUSION

Based on the results of this study, it can be concluded that the three extracts at 30mg/l (Tumeric *Curcuma longa*, Ginger *Zingiber officinale* and Garlic *Allium sativum*) in the order listed were effective in controlling the growth of *Aspergillus parasiticus*. These extracts may be subjected to further study to characterize the active compound and evaluate economic feasibility.

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Effect of Graded Levels of Dietary Kidney Bean Seeds on the Profitability of Broiler Chicken Production in Nigeria

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Abstract: A study was conducted to compare the profitability of broiler chicken production using broiler chickens fed diets containing graded levels of boiled kidney bean (Phaseolus vulgaris L.) seeds. Sun-dried kidney beans procured from a local market were boiled to destroy the inherent anti-nutritional factors. They were then dried, ground and incorporated into the diets of broiler chickens at both starter and finisher phases. There were five dietary treatments replicated four times in a completely randomized design. Diet 1, the control diet, had no kidney beans. Diets 2, 3, 4, and 5 contained kidney beans at 7.5, 15.0, 22.5 and 30.0%, respectively, of the total diet. At the end of the finisher phase the cumulative cost-benefit analysis was made. The profitability was determined by obtaining the difference between the income and expenditure. This difference was divided by the expenditure to determine the profitability index. The highest profitability index was 0.41 (i.e. 41 kobo per naira invested) recorded on the chickens fed the control diet. Out of the chickens fed kidney bean diets, the birds with the highest profitability index were those fed 7.5% kidney bean diet, with an index of 0.32. They were closely followed by those fed 15.0% which had a profitability index of 0.31. The chickens fed 22.5% had an index of 0.26. The birds fed 30.0% kidney bean diets had the lowest profitability index, 0.19. Among the birds fed kidney bean diets, the chickens that had the highest return on naira invested were those fed 7.5% kidney bean diet. For every naira invested there was a return of 32 kobo.

Keywords: Dietary Levels, Kidney Beans, Broiler Chickens.

INTRODUCTION

The primary purposes of keeping poultry are for dietary and economic reasons. Today, poultry keeping in Nigeria has developed from a backyard production system to a commercially oriented industry. Poultry production offers the highest turnover rate and the quickest returns to investment outlay of all livestock enterprises. Funds invested in poultry production are recovered faster than in any other livestock enterprise (Ogundipe and Sanni, 2002). The production cycle could be as short as four weeks for brooding, eight weeks for broiler production and 72 weeks from brooding to end of lay for layer chickens. Depending on the poultry enterprise, objective and management expertise of the poultry farmer, two to six turnovers are possible in a year.

The rationale for looking into the economics of poultry production is to ensure that scarce resources are used to derive optimum benefit. The economic efficiency of investments into the poultry industry depends, to a large extent, on environmental factors such as nutrition and general management. Since feeds accounts for over 60% of the total cost of production of poultry (Ogundipe, 1992; Ikani *et al*., 2001), a reduction in feed cost will facilitate the profitability of the enterprise. The conventional protein feedstuffs for broiler chickens such as soyabeans and groundnut cake are fast becoming unaffordable to poultry farmers due to the high demand for them by the human population. This has made the search for alternative ingredients inevitable. The availability of cheaper alternative sources of nutrients will facilitate a reduction in the cost of feeds and higher profit margins for broiler chicken producers. One of such ingredients is the kidney beans (*Phaseolus vulgaris* L.).

Kidney bean is a leguminous crop grown in different parts of the world. Several varieties of this crop are currently cultivated in fairly large quantities in Mangu and Bokkos on the Jos Plateau, Nigeria. The varieties

cultivated have crude protein contents ranging from 17 to 28% (Olomu, 2011), and are worth investigating for possible use as an alternative protein ingredient in the diets of broiler chickens.
However, like other grain legumes, the usefulness of kidney bean seeds as a feed ingredient for poultry may be limited due to the presence of some anti-nutritional factors (Kingsley, 1995). The presence of these anti-nutritional substances has been associated with growth depression and pancreatic hypertrophy in many species of monogastric animals (Birk, 1988). It has been established that heat treatment and other processing methods exert beneficial effects on the seeds of grain legumes by destroying the anti-nutritional factors inherent in them (Balogun *et al*., 2001).
The use of boiled kidney beans as a protein feedstuff for broiler chickens, however, has cost implications which will add to the overall cost of broiler production; hence the need to study the profitability of broiler chicken production fed diets containing kidney beans at various inclusion levels.

Objective
To determine the profitability of broiler chicken production using boiled kidney bean seeds as a feedstuff at various dietary levels.

MATERIALS AND METHODS
The red kidney bean variety, the most widely cultivated variety on the Jos Plateau, Nigeria, was selected for the study. It was procured and boiled with the aim of destroying the anti-nutritional factors. The boiling of the kidney bean seeds involved heating the water until it began to boil (100^0C) before turning the seeds into the boiling water. Care was taken at the onset to ensure that the water was sufficient to cover the seeds throughout the cooking time. The seeds were then cooked for 60 minutes. The cooking time was taken from the moment the seeds were turned into the boiling water. Thereafter, the cooked seeds were turned into a basket to drain off the water. The seeds were subsequently sun-dried for five days and then ground for use in making the feeds.
The boiled kidney beans were used to formulate the experimental diets. Diet 1, which served as the control treatment, had no kidney beans. It was a conventional corn-groundnut cake-based diet. Diets 2, 3, 4 and 5 contained kidney beans at 7.5, 15.0, 22.5, and 30.0 per cent, respectively, of the total diet for both starter and finisher phases. The diets were iso-caloric and iso-nitrogenous; the variations were only in the dietary levels of kidney beans.

Determination of profitability
The cost components in this study included fixed and variable costs. The fixed cost factors were cost of housing and of equipment such as feeders, drinkers lighting and heating equipment and cost of day-old chicks. The variable cost factors included cost of feeds and water, drugs and vaccines, fuels for lighting and heating especially during brooding, cost of labour, transportation and cost of boiling the experimental material – the kidney beans – which were included in the diets at varying levels. Out of all the production cost factors, only the cost of the graded levels of the dietary kidney beans varied from one treatment to another. All the other cost factors were common to all treatments in the studies. For instance, the cost of heating and lighting was common to all treatments since the same amounts of heat and light were provided to all. Therefore the focus of this analysis was on the variations in the cost of the inclusion levels of kidney beans used in the dietary treatments. The costs of boiling the dietary kidney beans were as presented in Table 1.

The selling price of the birds was estimated at ₦800.00 per kilogramme dressed weight based on the current price of dressed broiler chickens in Nigeria. The dressed weights were determined based on the final live weights of the birds at the end of the finisher phase and the dressing percentages obtained during carcass analyses.

The profitability was determined by obtaining the difference between the income and expenditure. The profitability index was determined by dividing this difference by the expenditure according the procedure described by Olukosi and Erhabor (1988).

$$\text{Profitability index} = \frac{\text{Income} - \text{Expenditure}}{\text{Expenditure}}$$

The profitability index shows the net return on every ₦1.00 invested.

RESULTS

Table 1: Costs of Processing Kidney Beans for Broiler Chicken Feed Production (Per 100kg)

Processing Method	Materials Used	Unit Cost	Total Cost
Boiling	Water (550 litres)	₦0.55 per litre	₦300.00
	Hiring of half drum for 1 day	₦300.00	₦300.00
	Firewood (6 bundles)	₦250.00 per bundle	₦1,500.00
	Labour to boil the beans	₦500.00 per man-hour	₦2,000.00
	Labour to dry the beans for 5 days	₦200.00 per day	₦1,000.00
Grinding	Grinding	₦15.00 per kg	₦1,500.00
	Cost	**₦66.00 per kg**	**₦6,600.00**

Table 2: Cost-Benefit Analysis of Broiler Chickens Fed Diets Containing Graded Levels of Kidney Beans

Parameters	Percent Dietary Levels of Kidney Beans				
	0	**7.5**	**15**	**22.5**	**30**
Total Feed intake/bird (g)	5434	5466	5869.3	6219.3	6564.25
Final Live weight/bird (g)	2489.25	2355.75	2536.75	2559	2618
Dressed weight/bird (g)	1820	1730	1870	1910	1900
Feed cost/bird (₦)	384.03	400.62	488.87	558.4	632.65
Other costs/bird (₦)	650	650	650	650	650
Total cost/bird (₦)	1034.03	1050.62	1138.87	1208.4	1282.65
Price/bird (₦)	1456	1384	1496	1528	1520
Profitability index	0.41	0.32	0.31	0.26	0.19

The result of the cost – benefit analysis of graded levels of kidney beans in broiler diets was as presented in Table 2. The costs of production factors other than the cost of feeds were similar in all the dietary treatments. The birds fed 30.0% kidney bean diet had the highest cost of feed consumed per bird. They were followed in decreasing order of magnitude by those fed 22.5, 15.0 and 7.5% kidney bean diets. The birds fed the control diet had the least feed cost. The chickens with the highest profitability index were those fed the control diet. Their value of 0.41 showed that for every naira invested, there was a net return of 41 kobo. Out of all the birds fed kidney bean diets, those fed 7.5% inclusion level had the highest profitability index of 0.32. They were followed in decreasing order by those fed 15.0%, 22.5% and 30.0% kidney bean diets with index values of 0.31, 0.26 and 0.19, respectively.

DISCUSSION

The chickens fed the control diet had a profitability index of 0.41; this was higher than all other dietary treatments (Table 2). This showed that for every naira invested, there was a net return of 41 kobo. The profitability index of the birds fed kidney bean diets decreased progressively with increase in the dietary level of the kidney beans. The birds in this category that had the highest profitability index were those fed 7.5% kidney bean diet, with 0.32; they were followed by those fed 15.0, 22.5 and 30.0% kidney bean diets with profitability indices of 0.31, 0.26 and 0.19, respectively. This result showed that increase in dietary kidney beans beyond 15.0% resulted to

a significant decrease in the profitability of the investment. This can be seen from the sharp decrease in the profitability index between the 15.0% and 22.5% dietary levels of kidney beans (0.31 and 0.26) when compared to the small difference between the 7.5% and 15.0% dietary levels (0.32 and 0.31). The relatively high profitability index of the birds in these studies indicates that processed kidney beans is a viable alternative protein ingredient in the production of feeds for broiler chickens.

CONCLUSION

Boiled kidney beans can be included in the diets of broiler chickens up to 30.0% at both starter and finisher phases without any negative effects on feed intake, weight gain and the general wellbeing of the birds. However, the recommended dietary level of kidney beans should not exceed 15.0% in order to avoid decreased profitability on invested capital.

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Evaluation of the Growth Performance, Carcass Characteristics and Cost of Broiler Chickens Fed Commercial and On-Farm Formulated Diets

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Abstract: The study compared the growth performance, carcass yield and cost benefits of broilers fed two commercial feeds against two on-farm feeds for a period of eight weeks. 180, day-old broiler chicks were assigned to the four experimental diets with 30 birds per treatment and 10 birds per replicate in a completely randomized design. Feed and water was provided *ad libitum* and the birds were managed under the deep litter system. Data were collected on the growth rate, carcass and economics of production; these were subjected to the one-way ANOVA. Results showed that final body weight, weekly feed intake and weekly weight gain were higher ($P<0.05$) in birds fed C1 diet compared to those on other dietary treatments. However, value for FCR did not differ ($P>0.05$) between treatments. Birds on on-farm formulated diets recorded better feed cost per kg gain ($P<0.05$) and cost of feed consumed per bird ($P<0.01$). Results for carcass characteristics indicated significant ($P< 0.05$) effects of treatment on the dressed weight, wings, shank and head weight. Relative organ weights of the full gizzard, empty gizzard, spleen, lungs, oesophagus and trachea were also significantly ($P< 0.05$) different between treatments. From these results, it can be concluded that though commercial feeds resulted in higher live weight, on-farm feeds especially sorghum-based was cheaper and resulted in better cost/kg gain and cost of feed consumed per bird. It is therefore recommended that, poultry farmers should consult animal nutritionist for feed formulation to enable them produce least cost feed for profit maximization.

Keywords: Performance, Commercial diets and Compounded diets

INTRODUCTION

Sustainable poultry production is seen as one of the fastest means of ameliorating the incessant animal protein intake shortage in many developing countries (Oyewole *et al*., 2015; Oko *et al*., 2017). Therefore there is increasing number of people venturing into poultry business and the consequent high demand for commercial feeds could result to feed manufacturers producing substandard feeds moreso with less supervision from quality control agencies in Nigeria.

In Nigeria, feed alone accounts for 70 - 80% of total variable cost of intensive broiler production (Afolayan *et al*., 2014; Oyewole *et al*., 2015), depending on the region and season of production (Amir *et al*., 2001) leading to high cost of production (Afolayan *et al*., 2014). These had resulted to the collapse of many commercial poultry farms while some others experienced slow growth as a result of fluctuation or sudden rise in the cost of poultry feeds (Onimisi, 2004). Reports by Sanusi *et al*. (2015) indicated that some commercial feeds were of low quality and have resulted to poor broiler performances. Many farmers change from one commercial feed to another in search of a better feed (Ogundipe *et al*., 1986) while some have resulted to producing their feeds. Many farmers also believe that self-made feeds are cheaper than the commercial feeds (Oyewole *et al*., 2015). To increase profitability in the poultry industry, there is the need to formulate practical rations that will help in reducing the cost of production and still maintain high broiler performance (Oko *et al*., 2017).

The poultry nutritionist is therefore challenged to formulate diets at least cost for profit maximization. Therefore, this study compared the growth performance, carcass yield as well as cost benefits of broilers when fed on-farm versus commercial feeds.

MATERIALS AND METHODS

This experiment was conducted at the poultry unit of the Teaching and Research farm, University of Calabar, Calabar, Nigeria. Calabar is located in South south region of Nigeria at Latitude $4^{0}57^{1}$N and Longitude $8^{0}19^{1}$E

with annual rainfall ranged from 1260mm to 1280mm, average temperature of 27.5^{0}C with a relative humidity of 55 - 99% and an elevation above sea level of 99 meters (NMA, 2016).

To compare the growth performance and profitability of broilers, two popular commercial diets (C1 – Vital Feeds and C2 - Top Feed) marketed in Cross River were compared to two on-farm formulated (F1-Maize based and F2 - Sorghum-based) diets (Table 1). Therefore, a total of four experimental diets were studied.

Table 1: Gross composition of on-farm formulated diets (%)

Ingredients	**Maize diet**		**Sorghum diet**	
	Starter	**Finisher**	**Starter**	**Finisher**
Maize	41.50	47.50	0.00	0.00
Sorghum	0.00	0.00	41.50	47.50
Soybean meal	32.75	22.25	32.75	22.25
Palm kernel cake	4.00	4.45	4.00	4.45
Wheat offal	5.00	7.00	5.00	7.00
Crayfish dust	2.00	2.00	2.00	2.00
Brewers' Dried Grain	10.00	12.00	10.00	12.00
Bone meal	3.50	3.00	3.50	3.00
Methionine	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Palm oil	0.50	0.50	0.50	0.50
Salt	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated nutrient				
% Crude protein	23.07	19.93	23.90	20.88
% Crude fibre	5.25	5.21	3.18	2.84
ME (Kcal/kg)	2959.25	2914.15	2917.75	2866.65

A total of 180, day-old broiler chicks were assigned to the four dietary treatments in a completely randomized design throughout the eight weeks of experiment. Each treatment had 30 birds which were further subdivided into three replicates of 10 birds each. Each replicate was housed in individual pen under the deep litter system in line with the approved animal care guidelines of the Ethical Committee of the Department of Animal Science, University of Calabar. Feed and water were provided *ad libitum* throughout the experiment.

Data were collected on the growth performance, carcass characteristics and cost benefit ratio of birds fed the different diets.

At the end of the feeding trial (day 56), two birds were randomly picked per replicate (that is a total of 24 birds), starved overnight and weighed individually before slaughter. The dressed weights were determined. The dressing percentages were calculated; prime cut parts (back, breast, drum stick, thigh, wing, neck, shank and head) and organ weights (crop, proventriculus, gizzard, gall bladder, heart, liver, spleen, lung and pancreas and kidney) were individually measured and expressed as percentages of the live weights.

Data collected were subjected to the one-way analysis of variance in a completely randomized design according to the methods of Steel and Torrie (1980). Significant means were separated using Duncan's multiple range test of GENSTAT Release 8.1 (GENSTAT, 2011) software package.

RESULTS AND DISCUSSION

The performance of broilers fed the experimental diets is presented in Table 2. Live weight was significantly ($P<0.05$) influenced by dietary treatments. Birds fed C1 had significantly ($P<0.05$) higher value but statistically similar ($P>0.05$) with the value obtained for C2 which was not different ($P>0.05$) from on-farm formulated diets.

Birds fed on-farm feed recorded higher live weights (2441.73 and 2454.57 g) than the value of 2155 g reported by Dafwang (2006) but comparable to the report of Doma *et al*. (2001) for broilers fed different commercial diets. The present findings are consistent with the reports of Sanusi *et al*. (2015) and Oyewole *et al*. (2015a) that birds on commercial diet had better performance than those on on-farm diet but contrary to the report of Doma *et al*. (2001) that significantly ($P < 0.01$) higher final live weight was observed in broilers fed self-formulated diet compared to those on commercial diets. Birds on commercial diets consumed significantly ($P<0.05$) higher feed than those produced on the farm.

The higher feed intake observed for commercial diets, may be that, they were more palatable and acceptable to the birds or the birds consumed more to be able to satisfy their nutrient requirement. Feed conversion ratio was not significantly ($P>0.05$) different between dietary treatments. The appreciable performance of birds fed on-farm feed may be because the feed was fresher than the commercial feeds. Therefore, it is expected to possess more potent nutrients particularly vitamins and amino acids, as against commercial feeds whose nutrient potency may have deteriorated due to long period of storage before reaching the end users. The better performance (live weight and weight gain) observed for birds fed commercial diets may be attributed to inclusion of other performance enhancers for which information was not provided by the manufacturers. Abeke *et al*. (2008) earlier reported that the current trend in feed manufacturing involves the use of bio-acids, enzymes, coccidiostats, toxin binders and anti-oxidants among others to enhance better nutrient utilization and therefore promote better performance of birds. Birds fed sorghum-base on-farm feed had numerically better feed cost per kg. Feed cost/kg gain was also better ($P<0.05$) for sorghum base on-farm feeds. F2 also resulted in lower but better ($P<0.05$) cost of feed consumed per bird. The lower cost per kg gain ($P<0.05$) observed with on-farm formulated diets is in line with the report of Adebayo *et al*. (2002) and Oyewole *et al*. (2015) who had lower feed cost per kg gain when compared with commercial diets.

The carcass and organ characteristics of the experimental birds are shown in Tables 3 and 4, respectively. There were significant ($P<0.05$) effects of treatment on the live weight, dressed weight and the relative weights of wings, shank, head gizzard, spleen, lungs, oesophagus and trachea whereas, dressing percent, back, breast, drum stick, thigh and neck were not significantly ($P>0.05$) different. This may suggest that the on-farm and commercial feeds promoted similar carcass characteristics. Thus identical carcass and muscle developments are attainable by feeding all the diets.

CONCLUSION

From these results, it was concluded that though commercial feeds resulted in higher live weight, on-farm feeds especially sorghum-based (F2) was cheaper and resulted in better cost/kg gain and cost of feed consumed per bird. It is therefore recommended that for sustainable production, poultry farmers should consult animal nutritionist for feed formulation to enable them produce least cost feed for profit maximization.

Table 2: Growth performance of broilers fed on-farm and commercial diets

Parameters	Treatments				SEM	P-value	Sig. level
	C1	C2	F1	F2			
Initial weight (g)	48.83	48.83	48.83	48.83	1.17	1.00	NS
Final weight (g)	2617.07^{a}	2561.83^{ab}	2441.73^{b}	2454.57^{b}	40.46	0.04	*
Av. weekly wt gain (g)	327.13^{a}	320.23^{ab}	305.22^{b}	306.82^{b}	5.06	0.04	*
Av. weekly feed intake	662.08^{a}	657.00^{a}	610.00^{b}	609.17^{b}	9.47	0.01	*
FCR	2.02	2.05	2.00	1.99	0.04	0.61	NS
Cost/kg feed (N)	148.00	152.00	149.57	140.67	0.00	-	NS
Cost/kg gain (N)	299.58^{a}	312.35^{a}	298.85^{a}	279.31^{b}	5.84	0.03	*
Cost of feed consumed/bird (N)	783.91^{a}	798.91^{a}	729.90^{b}	685.53^{c}	11.28	<0.001	**

SEM= standard error of mean; *=significant at $P<0.05$; **=significant at $P<0.01$ and NS= not significant

Table 3
Carcass cuts of broiler chickens fed on-farm formulated and commercial diets

Parameters	Treatments				SEM	P-value	Sig. level
	C1	C2	F1	F2			
Live weight (g)	2333.33[a]	2140.00[b]	2150.00[b]	2200.00[b]	44.97	0.01	*
Dressed weight (g)	1816.67[a]	1593.33[b]	1650.00[b]	1650.00[b]	37.35	0.01	*
Dressing %	77.82	74.48	76.74	74.99	0.98	0.14	NS
Prime cuts (relative weight) %							
Back	14.15	14.27	14.28	14.07	0.19	0.85	NS
Breast	18.71	19.86	19.48	19.36	0.42	0.34	NS
Drumstick	11.43	10.64	10.56	10.26	0.59	0.57	NS
Thigh	13.52	12.17	12.57	11.99	0.47	0.18	NS
Wings	8.68[a]	7.65[b]	8.30[ab]	8.47[a]	0.24	0.05	NS
Neck	4.48	4.18	4.75	4.51	0.17	0.22	NS
Shank	4.58[a]	3.70[c]	4.49[ab]	4.00[b]	0.09	<0.001	**
Head	2.27[a]	2.00[b]	2.31[b]	2.32[b]	0.07	0.04	*

SEM= standard error of mean
*=significant at P<0.05
**=significant at P<0.01
NS= not significant

Table 4
Relative organ weight of broilers fed on-farm formulated and commercial diets

Parameters (%)	Treatments				SEM	P-value	Sig. level
	C1	C2	F1	F2			
Heart	0.46	0.46	0.47	0.45	0.04	1.00	NS
Liver	1.79	1.84	1.89	1.91	0.06	0.52	NS
Full gizzard	2.55[a]	2.40[a]	1.91[b]	1.88[b]	0.10	0.002	**
Empty gizzard	2.25[a]	2.01[a]	1.65[b]	1.54[b]	0.09	0.002	**
Spleen	0.09[a]	0.07[b]	0.06[b]	0.08[a]	0.003	0.01	*
Lungs	0.57[a]	0.47[b]	0.48[b]	0.56[a]	0.02	0.02	*
Proventriculus	0.45	0.42	0.50	0.53	0.03	0.24	NS
Pancreas	0.38	0.37	0.35	0.43	0.02	0.16	NS
Abdominal fat	1.00	0.98	0.84	1.13	0.08	0.17	NS
Oesophagus	0.14[a]	0.10[b]	0.13[a]	0.10[b]	0.01	0.001	**
Crop	0.27	0.32	0.27	0.31	0.02	0.26	NS
Gall bladder	0.14	0.15	0.13	0.14	0.01	0.86	NS
Trachea	0.11[ab]	0.10[ab]	0.12[a]	0.09[b]	0.01	0.04	*

SEM= standard error of mean
*=significant at P<0.05
**=significant at P<0.01
NS= not significant

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Nutrient Digestibility of Laying Quails Fed Graded Levels of Yam Peel Meal (YPM) Based Diet Supplemented With Maxigrain® Enzyme

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Target Audience; Farmers and Academia

Abstract

A 10-week feeding trial study was conducted to determine the nutrient digestibility of laying quails fed diets containing maize replaced with graded level of enzyme supplemented Yam Peel Meal (YPM) based diets. Four diets were formulated in which maize was substituted with YPM at 0, 25, 50 and 75% dietary levels designated as T_1, T_2, T_3 and T_4 respectively. A total of one hundred and sixty (160), 6 weeks old female quails were randomly allotted to four diets in a completely randomized design. Each treatment was replicated four (4) times having ten (10) birds each. Experimental diets and clean water were provided ad-libitum. At the end of 10 weeks feeding trial, 3 birds were randomly selected for faecal collection, using a metabolic cage which lasted for 3 days after 2 days adjustment period. The results showed that there were no significant ($P>0.05$) difference in the digestibility of Dry Matter (DM), Crude Protein (CP), Crude Fiber (CF), Ether Extract (EE) and Nitrogen Free Extract (NFE) except for ash, Calcium and phosphorus which were significantly ($P<0.05$) affected by dietary treatments due to enzyme supplementation. However, birds on 75% YPM-enzyme treated diets had an improved nutrient digestibility compared to other treatment groups. Therefore, it was concluded that yam peel meal can replace maize in the diet of laying quails up to 75% inclusion dietary level with enzyme (Maxigrain®) supplementation without any depression and adverse effects on digestibility of nutrients and is hereby recommended for quail farmers.

Keywords: Quail; Digestibility; Maxigrain®*; Yam* peel; Enzyme.

Description of the Problems

Japanese quails are small-sized early maturing hardy and prolific birds (1). They came into egg production between the 5th and 6th week of life, but adult plumage is not attained until the 12th week of age (2). The eggs are small, mottled and weight between 8 and 10g each (3), with egg fertility and hatchability levels of 90% and 65% respectively, (4). The meat and eggs are low in body fat and cholesterol (5), which is of public health significance. Maize, most often, constitutes the highest proportion of ingredient in diet formulation of any poultry ration (6). This high inclusion rate translates into high cost of feed because of the seasonality of maize production and competition for its use by man (6). This indicates the need to replace maize in poultry diets with non-conventional feeds to reduce feed cost and overall production cost. One of such alternative base diet is yam peel meal. Yam peels are available at several commercial points like restaurants, local eateries and processing point for processed yam powder of our towns and villages and sometimes constitute a waste disposal burden. The escalating cost of poultry feed could effectively be alleviated by use of cheaper resources like yam peel. The

use of enzyme supplementation is one of the important techniques for enhancing the efficiency of feed utilization in monogastric nutrition. Thus, this work is directed at determining the proximate composition of Yam peel as a potential feed stuff in laying quail diet and evaluating the nutrient digestibility of laying quails fed yam peel meal based diet with enzyme (Maxigrain®) supplementation.

Materials and Methods

The study area was Poultry Unit of Teaching and Research Farm of the Department of Animal Production Technology, Federal College of Wildlife Management, New Bussa, Niger State Nigeria.

Preparation of the Yam Peal Meal (YPM)

Fresh yam peels were collected from several commercial processing points in New Bussa, Borgu Local Government Area, Niger State. They were dehydrated by sun-drying for 5 days to reduce enzymatic and microbial reactions leading to spoilage nutrient leaching. The sun-dried peel is then milled in hammer mill to fine particles to produce the meal.

Experimental Birds and Management

A total of one hundred and sixty (160) seven-weeks old Japanese laying quails were used in the experiment. They were randomly allocated to four treatment groups each containing forty (40) quails per treatment and each treatment replicated four times with ten birds per replicate in completely randomized design (CRD).

Experimental Diets and Treatments

Four iso-caloric and iso-nitrogenous diet containing graded levels (0, 25, 50 and 75%) of yam peel meals in replacement for maize were formulated for the study and were designated as T_1,T_2,T_3 and T_4 respectively as shown in table 1. Maxigrain® enzyme was supplemented at the rate of 0.01% to diets T_2, T_3 and T_4 only, where T_1 serve as the control diet without enzyme inclusion.

Table 1: Gross composition of Experimental Diets

Ingredient	**T_1 (0% YPM)**	**T_2 (25% YPM)**	**T_3 (50% YPM)**	**T_4 (75% YPM)**
Maize	53.0	39.75	26.5	13.25
Soyabean	30	30	30	30
YPM	0.00	13.25	26.5	39.75
Rice Offal	5.0	5.0	5.0	5.0
Fish meal	2.0	2.0	2.0	2.0
Bone meal	3.5	3.5	3.5	3.5
Oyster shell	6.5	6.5	6.5	6.5
Methionine	0.2	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
*Vitamin premix	0.4	0.4	0.4	0.4
Salt	0.25	0.25	0.25	0.25
Maxigrain®	-	++	++	++
Total	100	100	100	100
Calculated Analysis				
Crude Protein (CP %)	20.04	20.09	20.34	20.82
Metabolizable Energy (MEKcal/kg)	2980.66	2975.54	2977.14	2903.93

Crude Fibre (CF %)	4.54	5.89	6.55	7.53

**Premix (Vitamin-mineral mixture) was composed to contain: Vit. A 12000000 IU, Vit.D3 2000000 IU, Vit.E 10000mg, Vit.K3 2000mg, Vit.B1 1000mg, Vit. B2 5000mg,Vit. B6 1500, Vit B12 10mg, Biotin 50mg, Pantothenic acid 10000mg,Nicotinic acid 30000mg,Folic acid 1000mg,Manganese 60000mg,Zinc 50000mg,Iron 30000mg,Copper 10000mg,Iodine 1000mg,Selenim 100mg,Cobalt 100mg. ++ Maxigrain enzyme at 100g per one tone of feed.*

Metabolic Cage Trial

At the end of the 10 weeks feeding trial, five (5) quail birds were randomly selected per replicate and arranged in clean, separate and disinfected metabolic cages. Two days of acclimatization period prior to the commencement of three days metabolic trial were allowed while a given quantity of feed which matched their previous feed intake was offered daily to each replicate housed in the metabolic cages. Daily excreta voided per replicate were collected and dried in the drying chamber for 12 hours at 60^{o}C. Dried excreta voided per replicate for the period of the trial were pooled together and representative samples were used to determine the proximate composition (7).

Chemical and Statistical Analysis

The proximate composition of the test ingredient and experimental diets shown on tables 2 and 3 were determined by method (7) and the all the data obtained were subjected to analysis of various (ANOVA) using (8), significant means were separated using Duncan multiple range test (9).

Results and Discussion

Proximate composition of yam peel and experimental diets.

Table 2 results revealed that yam peel meal contained 91.1%, DM, 10.52%, CP, 11.52 CF, 2%, EE, 10.05, Ash, 67.41% NFE and 2940.47 Kcal/kgME which makes it a potential feedstuff for livestock. The nutrient composition of the experimental diets for growing quails is presented in Table 3. The CP ranges from 19.40-20.80% and increases as the inclusion level of YPM increased in the diets.

Table 2: Proximate Composition of Yam Peel Meal (YPM)

Parameters	**Percentage Composition**
Dry matter (DM)	91.1
Crude protein (CP	11.52
Crude Fibre (CF)	6.64
Ether extract (EE)	2.4
Metabolizable energy (Kcal/kg)	2940.5
Ash	10.25
Calcium (Ca)	0.07
Potassium (P)	0.15

Table 3: Proximate Composition of Experimental Diets

Constituent (%)	**T_1(0%)**	**T_2(25%)**	**T_3(50%)**	**T_4(75%)**

Dry matter (DM)	89.55	89.98	90.63	90.88
Crude protein (CP)	19.40	19.85	20.46	20.80
Crude Fibre (CF)	4.56	5.86	6.20	7.43
Ash	4.65	5.98	7.12	8.42
Ether extract (EE)	4.55	4.63	4.54	4.49
NFE	66.84	63.68	61.68	58.86
Metabolizable Energy (Kcal/kg)	3459.63	3370.58	3314.85	3223.27

Apparent Nutrient Digestibility

The result of the effect of Maxigrain enzyme supplementation on the apparent nutrient digestibility of laying quails is presented in Table 4. The digestibility of dry matter (DM), crude protein (CP), crude fiber (CF), ether extract (EE), nitrogen free extract (NFE) and Metabolizable energy (ME) did not differ significantly (P>0.05). However there is significant (P<0.05) difference in values obtained for ash, calcium and phosphorus digestibility. Birds fed control diet had lower digestibility coefficients than birds fed enzyme supplemented diet. Thus 75% inclusion level of Maxigrain enzyme supplemented YPM diet was more digestible having recorded the highest value of the nutrients measured compared to 0%, 25% and 50% inclusion level of YPM. The result showed that as the inclusion level of Maxigrain supplemented YPM across the treatment increased, the nutrient digestibility of the birds also increased. This collaborate earlier reports (10, l1) that enzymes increase digestibility of feed ingredients by reducing the viscosity of the gut contents.

Table 4: Nutrient digestibility by laying quails Fed diets containing Maxigrain Supplemented YPM

Parameters	T_1	T_2	T_3	T_4	SEM
DM %	56.84	57.05	59.48	40.04	2.14
CP %	65.50	66.77	68.68	69.30	2.24
CF %	67.41	68.43	66.57	66.60	2.87
EE %	75.73	75.68	76.29	77.34	3.63
ASH %	50.14	53.57^{ab}	55.71^{a}	56.22	4.38
NFE%	84.45	83.98	84.18	84.55	1.19
Ca %	68.28^{b}	69.28^{b}	79.45	82.30	3.31
P %	53.30	54.78^{b}	61.24	73.24^{a}	3.53
ME %	65.70	67.02	68.05	69.10	2.64

^{ab}: Means with the same superscripts in a row are not significantly (P<0.05) different.

Conclusion and Application

The findings of the study revealed thatYPM is high in energy content and fair in crude protein implying that the test ingredient is a good potential feedstuff and can support growth in the diets of laying quails. There is non-significant (p>0.05) influence due to the enzyme supplementation in the nutrient digestibility of birds except for ash, calcium and phosphorus. Moreover, the result of the study had shown that inclusion of Maxigrain enzyme supplemented yam-peel meal at 75% level in the diet of laying quail recorded greater improvement in their nutrient digestibility and utilization without any adverse effect. In view of the outstanding improvements of the quails fed enzyme supplemented yam peel meal diets, quail farmers can incorporate yam peel meal up to 75% inclusion level for compounding laying quail diets without impairing the availability and utilization of nutrients of the birds.

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Reproductive Response of Growing Rabbit Bucks to Aqueous Leaf Extract of *Moringa oleifera* Lam. At Early Age of Sexual Maturity

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Abstract: The reproductive response of growing rabbit bucks to *Moringa oleifera* Lam. aqueous leaf extract at the early age of sexual maturity was studied in a Completely Randomized Design experiment. The lethal dose 50 of the leaf extract was also investigated. Artificial vagina was used for collection of the semen, while the testis and the prostate gland were harvested and weighed. Data were computed and analyzed using General Linear Model (GLM) procedure of SAS System; and Duncan's New Multiple Range Test was then used in separating the significant means. The result for LD 50 was 8.5 ml/kg body weight of the rabbit buck; while increasing significant differences ($P<0.05$) with increase concentration of the leaf extract were recorded for sperm concentration, motility, normality, semen volume as well as weight of testis. Weight of prostate gland decreased with increased concentration of the test extract. Sperm progressivity and semen pH of both the treated and control bucks were statistically the same; while the appearance of the semen for the control and 2.5ml, and 5.0ml and 7.5 ml groups were watery, and creamy white respectively. It could then be concluded that aqueous leaf extract of *Moringa oleifera* Lam. enhances the reproductive response and may be recommended for use to eliminate the difficulties encountered in rabbit production of optimum quality here in the tropics.

Keys: Reproductive response; *Moringa oleifera* Lam.; aqueous leaf extract; lethal dose 50, testis; prostate gland and rabbit bucks.

Description of Problem

Dearth of information in the use of medicinal plants to cure or reduce male infertility in livestock animals is one of the factors working against increased productivity in rabbit farming; whereas quite a good number of medicinal plants are available that could assist in boosting productivity and prevent sexual disorders in rabbit bucks (1). These plants are used as whole, part(s), and or extract; and one of such plants is *Moringa oleifera* Lam (2).

Accordingly, (3) maintained that *Moringa oleifera* Lam leaf extract provide a boost of nutritional value thereby improving sexual performance and libido. Therefore, this study was to assess the contributions of *Moringa oleifera* Lam. leaf extract to the reproductive performance of the rabbit bucks to eliminate the difficulties encountered in rabbit production of optimum quality here in the tropics.

Methodology

This study was carried out at the University of Uyo Teaching and Research Farm, Use Offot, Uyo Local Government Area of Akwa Ibom State, Nigeria. A total 36 mixed breeds (Chinchilla and New Zealand) domesticated rabbit bucks of 5 - 6 weeks old were randomly allocated to 4 treatment (T) groups (T1, T2, T3 and T4) in a Completely Randomized Design (CRD) and 0 ml, 2.5 ml, 5.0 and 7.5 ml of the test extract per kg body weight of the bucks administered respectively. Each treatment had three replicates accommodating three bucks making a total of 36 rabbit bucks

The *Moringa oleifera* Lam. leaf were harvested from the arboretum of the department of Forestry and Wildlife, processed into leaf extract and stored in a refrigerator at 2°C for this experiment. Another 15 bucks from the total of 51 bucks acquired were used for finding the lethal dose $_{50}$ of the test leaf extract following the Fixed – dose procedure (FDP) (4) for 3 trials at 5 ml, 8.5 ml and 10 ml/ kg body weight of the bucks. The administration of the test extract was done orally via syringe to each of the bucks in single dose LD50 test, and 5 days within the experimental period. Fresh feed and drinking water were provided with normal daily routine management practices in all treatment groups.

At the end of the 12th week of the buck's age, semen collection was done using Artificial Vagina (AV) (5) between 9.00am and 10.00am for optimum quality semen samples and analyzed accordingly (6,7). The testis and prostate gland were harvested and weighed.

Data analysis was done using General Linear Model (GLM) procedure of SAS System (8); and Duncan's New Multiple Range Test (9) used in separating the significant means.

Results and Discussion

The result of lethal dose investigation showed no mortality at 5ml, dull and inactive bucks at 8.5ml and death of two bucks at10ml. This was supported by (10) who reported LD_{50} estimated value of 2000 mg/kg oral route as having a low toxicity and safe.

The findings in this study indicates that the test extract in an increasing concentrations induced significant increase ($p<0.05$) on sperm concentration, progressivity, motility, normality, semen volume; as well as weights of testis. The increased sperm concentration could be attributed to the absent of anti- androgenic and anti- spermatogenic properties in the leaf extract. This result was at variance with (11) who reported reduced fertility status of spermatozoa *Moringa oleifera* Lam. leaf meal diets rabbit bucks.

A similar result was also noted for sperm motility and normality rates were significantly ($p<0.05$) influenced by the oral treatment which promoted the released of mature sperm due to high level of protein content, vitamins and phytochemicals and was supported (12). The increase in the volume of ejaculated semen was a suggestive of their superior growth rate that enhanced early maturity of their pituitaries and was in line with (3) who stated that the volume of semen depends on the growth pattern of the animal.

Weight of prostate gland decreased with the increase in the concentration of the leaf extract due to depletion in some tissues as earlier reported (10). Sperm progressivity and semen pH of both the test extract and the control groups were not significantly ($p>0.5$) different. The pH of semen medium is lowered as a result of lactic acid (a product of spermatozoa metabolism) and needs to be protected from auto-oxidation which is formed as a result of lactic acid, a product of metabolism of semen (13). The administration of the leaf extract up to 7.5ml/kg body weight of the bucks promoted the change in the colour/ appearance of semen which was supported by (12).

Conclusion and Recommendation

(1) Aqueous leaf extract of *Moringa oliefera* Lam. is seen to enhance the reproductive performance via improved semen parameters of the rabbit bucks.

(2) Therefore, *Moringa oliefera* Lam. aqueous leaf extract may be incorporated in production of rabbit bucks to enhance optimum productivity here in the tropics.

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TABLE 1. Effect of *Moringa oleifera* leaf extract on semen characteristics of rabbit bucks.

	1 (0 ml/ kg)	**2 (2.5 ml/ kg)**	**3 (5.0ml/ kg)**	**4 (7.5ml/ kg)**	
Sperm Concentration (%)	71.00_{c}	81.00_{b}	84.33_{ab}	90.00_{a}	2.05
Sperm Progressivity (%)	60.00	59.20	53.55	42.42	5.24
Sperm Motility (%)	71.67_{c}	76.00_{c}	81.67_{ab}	85.00_{a}	1.93
Sperm Normality (%)	71.67_{b}	74.33_{ab}	81.00_{ab}	81.67_{a}	2.83
Semen Volume	0.50_{b}	0.47_{b}	0.45_{b}	1.95_{a}	1.42
Semen pH	7.50	7.40	7.80	7.5	0.07
Semen Appearance	Watery	Watery	Cream white	Cream white	
Weight of Testis	0.28_{c}	0.29_{bc}	0.30_{b}	0.35_{a}	0.09
Weight of Prostate Gland	0.28_{c}	0.26_{bc}	0.19_{ab}	0.18_{b}	2.83

$_{abc}$Means with different superscripts within the same row are significantly different (P<0.05).

MONOGASTRIC PRODUCTION / NUTRITION

Carcass characteristics and relative organs weight of Broiler Chickens Fed Maize – Yam Peels Based Diets Supplemented with Xylanase, Amylase and Protease Multi-enzymes

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Abstract: This study was conducted to investigate the effect of maize - yam peels meal based diets with and without enzyme supplementation on carcass characteristics and relative organs weight of broiler chickens. One hundred and eighty (180) day old broiler chicks were randomly assigned to six dietary treatments. Maize based diet contained 0kg, 15kg and 30kg levels of YPM without enzyme as T1, T2 T3 and Maize based diet contained 0kg, 15kg and 30kg levels of YPM with 50g/kg enzyme supplementation as T4, T5 T6 respectively. Each treatment was replicated 3 times containing 10 chicks per replicate. The experiment lasted for 8 weeks. The results of carcass characteristics and relative organs weight showed significant ($P < 0.05$) influence of yam peel meal (YPM) and enzyme supplementation on live weight, eviscerated weight, dressed weight, dressing percentage, thigh, drum stick, neck, gizzard and liver. Birds fed diets enzyme supplemented diets T4, T5, and T6 recorded highest values of 2368.00g, 2361.00g and 2433.33g respectively for live weight. Birds fed diet containing 0% YPM with enzyme (T4) and 30% YPM with enzyme (T6) revealed higher ($P < 0.05$) values of 2053.67g and 1971.33g for eviscerated weight. Birds fed diets with enzyme revealed increased values (3.06, 3.33 and 3.62) for gizzard with increased level of YPM. From the results of this study, up to 30% yam peel meal can be included with enzyme to replace maize in broiler ration for improved carcass characteristics and relative organs weight

Key words: Yam peel meal; enzyme; Carcass characteristics; organs weight; broiler chickens.

DESCRIPTION OF PROBLEM

Poultry feeds form about 90% of feed mill products. It can be observed that the amount of maize required cannot be met internally especially when viewed against the background that this commodity is in very high demand in other sectors of the economy such as for human foods and for industries. Thus, Nigeria must look inwards for her feed resources. Fortunately, the pioneering work of (1) paved the way for the understanding that agro-industrial by-products and crop residues could be economically used to supplement the erratic feed supply.

Constraints on the use of by-products and crop residues include, according to (2), bulkiness, location in areas with lower animal population density, poor nutritive value and unsuitability for direct animal use. In Nigeria today, the issue of the bulkiness and location in areas far from those where the materials are needed has been partially solved by the development of a good network of roads and the opening up of the rural areas for development. As regards the poor nutritive value and non-suitability for immediate animal use, research results have shown that grinding and enzyme treatments improve the nutritive value and intake and hence the response of animals to some of agro by-products.

However, dependence on corn grain becomes a problem in feed formulations due to its expensive and competition between human beings and poultry. This has compelled the nutritionists to explore new and non-conventional feedstuffs. Agro-industrial by-products and crop residues represent a vast animal feed resource, which is as yet largely unexploited. Yam peel meal is obtained in substantial quantities from household kitchens, commercial eateries and markets. One of the challenges of yam peel meal (YPM) is present of anti-nutritional factors such as: Oxalate, tannin, phytate and saponin (3) which could be addressed through enzyme supplementation. This research was designed to assess the effect of maize-yam peel based diet supplemented with enzyme on carcass and organs weight of broiler chickens.

MATERIALS AND METHODS

Experimental site: The study was conducted at the Poultry unit of the Teaching and Research Farm, Taraba State University Jalingo located between latitude 2^0 – 50N and longitude 11^o – 25E in Guinea savannah zone of northern Nigeria.

Experimental diets: A total of six isonitrogenous diets were formulated to meet (4) minimum nutrient requirement. Dietary treatments consist: Maize based diet contained 0kg, 15kg and 30kg levels of YPM without enzyme as T1, T2 T3 and Maize based diet contained 0kg, 15kg and 30kg levels of YPM with 50g/kg enzyme supplementation as T4, T5 T6 respectively as presented in Table 2.

Design and management of experimental birds: A total number of 180 day-old unsexed broiler chicks of commercial strain (Anak 2000) were purchased from a reputable hatchery. The chicks were weighed and allotted to six dietary treatment groups of three replicates each in a Completely Randomized Design. Each replicate consist of 10 chicks, to have a total of 30 birds per treatment group. The Birds were reared on deep litter housing system for four weeks (8 weeks). Routine vaccinations and medications were strictly followed and feed and water were provided *ad libitum*.

Data Collection

Carcass evaluation

At the end of the experiment, one bird per replicate whose live weight is a true representative of the replicate was selected. Prior to slaughtering, the birds were starved but had access to clean water for 12 hours to clear gut content. The birds were slaughtered and allowed to bleed thoroughly before being plucked. Eviscerated weight, plucked and dressed weights were taken. Cut parts and organ weights were measured using top loading scale.

Statistical Analysis

Data collected were subjected to analysis of variance using SPSS software. Where analysis of variance indicated significant treatment effects, means were compared using Duncan's New Multiple Range Test (5).

Results and Discussion

The result of carcass characteristics and relative organ weight of finisher broiler chicken fed maize-yam peel meal based diet supplemented with enzyme is presented in Table 3. Dietary inclusion of YPM with enzyme supplementation showed significant ($P < 0.05$) influence on live weight, eviscerated weight, dressed weight, dressing percentage, thigh, drum stick, neck, gizzard and liver. Birds fed diets containing enzyme supplementation T4, T5, and T6 recorded highest values of 2368.00g, 2361.00g and 2433.33g respectively for live weight. The least ($P < 0.05$) value of 1973.67g was obtained for birds fed diet containing 30% YPM without enzyme (T3). Birds fed diet containing 0% YPM with enzyme (T4) and 30% YPM with enzyme (T6) revealed higher ($P < 0.05$) values of 2053.67g and 1971.33g for eviscerated weight. Similar trend was observed for dressed weight. Statistically, birds fed diet containing 15% with enzyme supplementation (T6) recorded 73.39% for dressing percentage at comparative level across dietary treatments. Ranged values of 73.39 – 78.66% recorded in this study were higher than literature (3,6) when broiler chickens were fed diets containing YPM. Improved values obtained for carcass as observed in this study suggested adequacy of YPM with enzyme supplementation for broiler chickens. Birds fed control diet obtained least value of 9.24% for thigh at comparative level to dietary treatments. Drum stick did not follow any particular trend with birds fed T3 and T4 recorded highest ($P < 0.05$) values of 10.66% and 11.12% respectively. This values recorded for drum stick were higher than 9.91% reported (7) when broiler chickens were fed diet containing 30% yam-sweet potato peels meal. Numerically, birds fed control diet recorded highest value of 5.47% for neck. Carcass yield as well as the yields of carcass cutup parts observed in the present study were all comparable to yields reported in literature for broiler chickens (8,9).

Birds fed diets with enzyme revealed increased values (3.06, 3.33 and 3.62) for gizzard with increased level of YPM. This observation could suggest high rate of mechanical activities of the muscular stomach (gizzard) in breaking down fibre with the aid of enzyme. Increased gizzard weight is a true reflection of improved digestive or metabolic capacity of birds (10). This observation could also be attributed to increase feed intake with increase fibre level as birds consume to meet up the energy requirement (7). Ranged values of 1.48 %– 2.12 % recorded

for liver in this study were comparable to value 1.94 – 2.28% reported by (7) when broiler chickens were fed diets containing yam-sweet potato meal and it suggested that there is no nutritional stress. Dietary treatments had no significant (P > 0.05) influence on wing, breast, back, kidney and heart.

CONCLUSION

Feeding of broiler chickens with maize-yam peels meal based diets with or without enzyme improved carcass characteristic and relative organs weight. Yam peel meal as a replacement for maize up to 30% with enzyme supplementation at 50g/100kg diet improve carcass yield of broiler chickens.

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Table 2: Percentage composition of broiler finisher diets (5 - 8 weeks)

Enzyme	**0g/kg**			**50g/kg**		
YPM levels (kg)	**0**	**15**	**30**	**0**	**15**	**30**
	T1	**T2**	**T3**	**T4**	**T5**	**T6**
Ingredients:						
Maize	60.00	45.00	30.00	60.00	45.00	30.00
YPM	0.00	15.00	30.00	0.00	15.00	30.00
Palm oil	2.00	2.50	2.50	2.00	2.50	2.50
Soya bean meal	14.20	14.20	14.20	14.20	14.20	14.20
Groundnut cake	12.40	12.40	12.40	12.40	12.40	12.40
Fish meal	2.00	2.00	2.00	2.00	2.00	2.00
Rice offal	4.50	4.50	4.50	4.50	4.50	4.50
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00
Lime stone	1.50	1.50	1.50	1.50	1.50	1.50
DL-Methionine	0.30	0.30	0.30	0.30	0.30	0.30
L-Lysine	0.10	0.10	0.10	0.10	0.10	0.10

Salt	0.25	0.25	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Supplementation						
Enzymes (50g/100kg)	-	-	-	+	+	+
Calculated analysis:						
ME (kcal/kg)	3019.15	2989.61	2928.11	3019.15	2989.61	2928.11
Crude protein (%)	19.41	19.24	19.11	19.41	19.24	19.11

- No enzyme supplementation + Enzyme supplementation YPM = yam peels meal

Table 3: Effects of yam peels meal and enzyme supplementation on carcass and relative organ weight of broiler chickens (8 weeks)

Enzyme	**Without Enzyme (0g)**			**With Enzyme (50g)**			
Yam Peels Meal	**0%**	**15%**	**30%**	**0%**	**15%**	**30%**	
Parameters	**T1 (Control)**	**T2**	**T3**	**T4**	**T5**	**T6**	**S**
Live weight (g)	2251.67^{b}	2187.67^{b}	1973.67^{c}	2368.00^{a}	2361.00^{a}	233.33^{a}	3
Eviscerated weight (g)	1836.00^{b}	1774.67^{b}	1706.33^{b}	2053.67^{a}	1806.33^{b}	1971.33^{a}	3
Dressed weight (g)	1715.33^{b}	1662.33^{b}	1485.33^{c}	1863.00^{a}	1732.67^{b}	1847.67^{a}	3
Dressing percentage (%)	76.17^{ab}	75.98^{ab}	75.27^{ab}	78.66^{a}	73.39^{b}	75.93^{ab}	0
Cut parts (%):							
Wing	8.06	8.57	8.42	7.97	8.50	7.80	0
Thigh	9.24^{b}	11.83^{a}	12.23^{a}	13.30^{a}	11.70^{a}	12.11^{a}	0
Drum stick	9.34^{b}	9.92^{b}	10.66^{a}	11.12^{a}	9.54^{b}	9.54^{b}	0
Breast	17.57	17.32	17.64	18.96	18.15	18.57	0
Back	14.98	13.82	13.84	13.91	13.06	13.44	0
Neck	5.47^{a}	3.40^{b}	3.88^{ab}	4.66^{ab}	4.85^{ab}	4.32^{ab}	0
Organ Weight (%):							
Gizzard	2.57^{cd}	2.12^{d}	2.68^{bcd}	3.06^{abc}	3.33^{ab}	3.62^{a}	0
Liver	1.50^{b}	2.12^{a}	1.69^{ab}	1.48^{b}	1.57^{b}	1.66^{b}	0
Kidney	0.23	0.39	0.32	0.31	0.38	0.45	0
Heart	0.05	0.06	0.07	0.07	0.05	0.04	0

^{abcd} Mean on the same row having different superscripts were significantly ($P<0.05$) different.

Replacement value of feather meal for fishmeal on the performance of Guinea cock

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Abstract: A total of 250 guinea cocks (*Numida meleagris*) were used in a 56-day feeding trial in a completely randomized design in a deep litter house to assess the effect of feather meal (FEM) for fish meal (FM) on the performance of guinea cocks. Five replacement levels of the formulated feed: 0%, 2.5%, 5% 7.5% and 10% of FEM were used for treatments 1, 2, 3, 4 and 5 respectively with 0% FEM as control. Treatments were replicated thrice. The guinea cocks were fed the experimental diets for eight weeks after a one-week stabilization period. Results showed that final live weights 740.11g, 690.11g, 648.12g, 650.13g and 645.20g for birds fed 0%, 2.5%, 5.0%, 7.5% and 10% FEM, respectively varied significantly ($P<0.05$).

Keywords: Feather meal, fishmeal, guinea cocks, *Numida meleagris*, poultry feed.

INTRODUCTION

Feed constitutes the greatest input in animal production not only for milk, meat or eggs but also for growth and body maintenance (1). Thus, the cheaper the feed source without sacrificing its quality, the better the return to the farmer. (2) reported that Nigeria, like most other developing countries suffer greatly from shortage and high cost of livestock feeds, especially those supplying protein. This situation is as a result of the competition between man and livestock for the available conventional protein feeds. Consequently, some unconventional materials have been used to feed poultry with good results. Feather meal could be a potential source of feed for poultry (3). It has 58% crude protein and good amino acid and mineral profile, although it has low lysine, methionine and tryptophan contents (1). It is however capable of reducing the cost of poultry production. This experiment was therefore conducted to evaluate the effects of replacing feather meal which was usually thrown away as waste after processing birds for the expensive fishmeal with a view to achieving high production at reduced cost and by making animal protein available and affordable to consumers.

MATERIALS AND METHODS

Experiment Site: The experiment was carried out in Teaching and Research farm of Imo State Polytechnic, Owerri, Imo State, Nigeria. The site is situated at longitudes $7^{o}01^{1}$E and latitudes $5^{o}28^{1}$N (4).

Procurement of experimental birds and brooding: A total of 260 – day – old guinea cocks (*Numida meleagris*) procured from a local distributor were brood together for one week and fed commercial started feed "Top brand" for stabilization. After one week, 250 chicks were selected on the basis of apparent viability and good conformation and assigned to five dietary treatments of fifty birds per treatment and replicated thrice.

Processing of the feather meal: Poultry feather was collected from a commercial slaughterhouse at the Relief Market, Owerri, Imo State, Nigeria. The feathers were washed, boiled under high pressure until the resulting process of hydrolysis converted the feather into a soluble form of protein with no microbial contamination. The hydroxylation was achieved by boiling the feathers with a batch cooker (pressure pot) at internal pressure of 40-50n/m^2 for 60 minutes. After boiling, most of the feathers dissolved and on settling, the solid protein residue was dried and milled to produce feather meal. Feather meal and fishmeal were subjected to proximate analysis (Table 1) at the Animal Production Laboratory, Imo State Polytechnic Umuagwo, Nigeria, using standard methods (5). Concentrations of nutrients in the feather meal were then used in the formulation of the experimental feeds. The

mineral analysis was carried out by the method of (6), while gross energy was determined with a Gallenkamp Oxygen Adiabatic Bomb Calorimeter. Include method used in the analysis of amino acids.

Table 1: Chemical Compositions of Feather and Fish Meals

a.	Chemical Component	Feather meal%	fishmeal%
	Crude protein	58	66
	Crude fiber	1.5	1.0
	Ether extracts	2.5	4.5
	Ash	3.8	22
	Moisture	50	15
	Nitrogen free extract	6.5	8.1

Five experimental guinea cocks diets containing 0%, 2.5%, 5%, 7.5% and 10% FEM for treatments 1, 2, 3, 4 and 5 respectively were formulated in which 0% FEM, (T_1) was the control (Table 2). The ingredients were thoroughly mixed to ensure homogeneity and sent to hammer mill for grinding. The feed was fortified with vitamin premix and synthetic amino acids.

Feeding and Brooding: The experimental birds were divided according to five dietary treatments in a deep litter house made up of two hundred and fifty birds and replicated three times in a completely randomized design. All brooding facilities were available. Adequate number of feeders and drinkers were provided for the chicks to achieve and *ad libitum* access to feed and water.

Data Collection and Analysis: Initial weights of the birds were measured at the inception of the experiment (8 days old), while live weight was subsequently measured on weekly basis to evaluate growth rate. The weight at the end of the experiment (8-weeks-old) was measured as the final weight, while feed intake was measured by subtracting the feed remnant from that supplied the previous day. Data were also collected on weight gain, by subtracting the initial weight from the final weight. Feed conversion ratio was obtained by dividing the average feed intake (kg) by weight gain (kg) and the feed cost was calculated as the sum of all the items included in a diet. Data were collected from each treatment group and subjected to one way analysis of variance (7), while differences in means were separated by the Duncan Multiple Range Test as outline by (8).

Table 2: Ingredient Composition of Experimental Guinea Cock Diets

Ingredients	T_1	T_2	T_3	T_4	T_5
Feather meal (FEM)	0.00	2.50	5.00	7.50	10.00
Fish meal (FEM)	10.00	7.50	5.00	2.50	0.00
Maize grain	40.00	40.00	40.00	40.00	40.00
Groundnut cake	6.96	6.96	6.96	6.96	6.96
Soya bean cake	24.00	24.00	24.00	24.00	24.00
Wheat offal	14.00	14.00	14.00	14.00	14.00
Bone meal	4.12	4.12	4.12	4.12	4.12
Vitamin/mineral Premix	0.40	0.40	0.40	0.40	0.40
DL-Methionine-HCL	0.20	0.20	0.20	0.20	0.20
Common salt	0.32	0.32	0.32	0.32	0.32
Total	100.00	100.00	100.00	100.00	100.00
Nutrient composition					
Crude protein %	25.41	25.61	25.81	26.01	26.21
ME (Kcal/kg)	2718	2712	2705	2699	2692
Ether extract %	3.92	3.87	3.82	3.78	3.73
Crude fiber %	4.50	4.50	4.52	4.54	4.55
Moisture	1.50	2.38	3.25	4.13	5.00

NFE %	0.81	0.77	0.73	0.69	0.65
Calcium %	2.21	2.07	1.92	1.77	1.62
Phosphorus %	1.03	0.97	0.92	0.86	0.80
Lysine %	1.46	1.39	1.31	1.4	1.16
Methionine + Cystine %	0.50	0.53	0.56	0.59	0.62

2.5kg of premix/tone contain; vitamin A 10,000 I.U; Vitamin D_3 20,000 I.U; Vitamin E 12,000 I.U; Vitamin K 2.5g; Thiamine 1.5g; Riboflavin 5g; Pyroboflavin (B_6) 1.5g; Vitamin B_{12} 10mg; Biotin 2mg, Niacin 15g, Panthotenic acid 5g, Zinc 50g, Iron 15g, Copper 5g, Iodine 1.4g, Selenium 100mg, Cobalt 300g, BHT 125G.

RESULTS AND DISCUSSION

The performance characteristics of the guinea cockerel chicks (Table 3) showed that significant differences ($P<0.05$) existed between birds in various treatments for total weight and daily feed intake. Birds on the control diet (T_1) were significantly ($P<0.05$) heavier than birds on T_5. The birds on T_1 gained significantly ($P<0.05$) more weights than birds on T_2, T_3 and T_4 which had similar weight gains, while T_5 birds were the least in weight gain. Birds on the different treatment diets significantly ($P<0.05$) varied in their feed intake. Additional values of FEM resulted in additional feed intake. Feed conversion ratio varied significantly ($P<0.05$) for birds in the various treatments. Feed cost per weight gain significantly ($P<0.05$) varied between treatments as increasing amount of FEM reduced cost. It was reported (3) that anti-nutritional effects of feather meal arising from keratin fiber reduced availability, absorption and utilization of nutrients for productive purposes. Consequently, birds fed 10% FEM (T_5) consumed more feed than those on other treatments in an attempt to satisfy their body requirements (3). The trend was that increasing level of FEM reduced nutrient availability and thus reduced weight gain and final weight, which was traceable to higher dietary fiber of feeds with increasing FEM. This result agrees with (9) who observed that higher dietary fiber depressed weight gain in poultry birds.

Table 3: Performance Characteristics of Guinea Cocks Fed Feather Meal Diets

Parameters	T_1	T_2	T_3	T_4	T_5	SEM
Initial live Weight (g)	54.00	53.00	53.01	53.00	52.00	0.03^{ns}
Daily weight Gain (g)	26.22	25.98	25.18	24.56	23.68	0.19^{ns}
Daily feed Intake (g)	30.11^{a}	36.01^{b}	39.09^{b}	45.12^{c}	48.11^{c}	1.28^{*}
Feed conversion Ratio	2.23^{a}	3.30^{b}	3.50^{b}	3.54^{b}	4.18^{c}	0.13^{*}
Feed cost/kg	185.96^{c}	180.36^{b}	174.76^{d}	169.16^{e}	163.56^{a}	0.10^{ns}

A, b, c, d, e means within the same row with different superscripts are significantly different ($P<0.05$).

The feed cost per kg weight gain reduced with increasing levels of FEM, thereby reducing the cost of guinea cockerel chick production. This agrees with (9) that compared the utilization of five animal protein concentrates and obtained similar results.

CONCLUSION

The use of feather meal to replace fishmeal was achieved without any deleterious effect on the cockerel chicks. Considering the results on final weight and weight gain, it appears that the optimum replacement value of FEM for FM is 7.5% level. The cost of guinea cock production is observed to have significantly reduced following

the inclusion and increasing levels of FEM in the diet thereby reducing the cost of poultry production. It is therefore recommended that 7.5% level of feather meal for fish meal be adopted considering the cost effectiveness. However, higher levels such as 10% could be adopted if fortified with yeast or exogenous enzyme to improve fiber digestion.

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Growth Performance and Haematological Characteristics of Broiler Finisher Birds Fed High Inclusion Levels of Palm Kernel Cake (PKC)

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Abstract: High feed cost represents a major challenge in broiler production in southeast Nigeria. Feed constitutes 70% of the cost of production of broiler birds hence the replacement of unconventional feed ingredients holds the key to sustainable poultry production. The growth performance and haematological characteristics of broiler finisher birds fed high levels of inclusion of Palm Kernel Cake (PKC) were evaluated in a 28-day trial. The PKC was included at 0%, 35%, 40% and 45% per 100kg of feed as a substitute to soya bean and maize in the diet and birds were fed *ad libitum.* A total of one hundred and twenty (120). 4-week-old broiler birds were allotted to four treatment groups of 10 birds each with three replications in a randomized complete block design (RCBD). The results showed significant differences ($P<0.05$) in the final weight gain, average weight gain and feed conversion ratio with no significant difference in the feed intake. The control diet had the highest average weight gain of 919.20g and 45% PKC inclusion having the least value of 671.37g the results of the haematological parameters indicated significant differences ($P<0.05$) in the haemoglobin (Hb) concentrations, packed cell volume (PCV), total white blood cell counts (WBC). Furthermore, the mean cell volume (MCV), mean cell heamoglobin (MCH), mean cell heamoglobin concentration (MCHC) showed significant variation. However, no significant differences were observed in the red blood cell count (RBC). It could be concluded that 35% inclusion of PKC was the optimum level of inclusion for higher weight gains and productivity.

Keywords: Broiler Finisher, Growth, Performance, Haematological Characteristics, Palm Kernel Cake

INTRODUCTION

The demand for protein of animal origin has been on the increase in recent times due to high population growth, urbanization, and rising incomes (Delgado *et al*, 1999). Broiler production provides a reliable source of high-quality meat which is popular among majority of Nigeria's households. The government's ban on the importation of frozen poultry products has led to increased smuggling. However, despite the prevalence of smuggled frozen poultry in the market, consumers have preference for locally produced chicken (Anyanwu *et al*, 2015). Industry experts are however, divided on the efficacy of such a policy. In addition, recent health concerns have led to preference for white meat over red meat. The high cost of conventional feed ingredients especially maize and soy bean, has increased feeding cost to between 60-80% of the total cost of livestock production, especially for poultry and pigs (Tewe 1997). Previous studies have reported lower inclusion levels of 10 % PKC (Soltan, 2009) due to high fibre, gritty nature, lower availability levels of amino acids. Although Onwudike (1986) recommended inclusion levels of 28% and 35% whilst Okeudo et al., (2005, 2006) reported 30 % as the recommended inclusion level for finisher broilers, these reports were lacking on the haematological parameters. Given that cost reduction is *sine qua non* to the survival of the poultry industry in the region and the relatively lower cost of PKC relative to its alternatives, increasing the proportion of PKC in broiler finisher diets becomes imperative, since it could serve as protein and energy supplement due to its high metabolisable energy and protein contents. More so, Panigrahi and Powell (1991) had shown that with methionine and lysine supplementation, broilers can be fed diets containing 40% PKC.

Information obtained from haematological assay, apart from being useful for diagnostic and management purposes could equally be incorporated into breeding programmes (Elagib & Ahmed, 2011 cited by Oleforuh-Okoleh *et al*., 2015). In addition, it could also provide information regarding the meat quality given recent health concerns on consumption of healthy lipids and cholesterol profile (Oleforuh-Okoleh *et al*., 2015). Based on the fore-going reasons above, this study was initiated.

MATERIALS AND METHODS

Experimental Site and source of birds: The study was carried out at the poultry unit of the Teaching and Research Farm, Federal University of Technology Owerri, in June, 2013. A total of one hundred and twenty (120) day old unsexed and healthy commercial broiler chicks of B-knot strain brooded on a partitioned deep litter house, were randomly assigned into four dietary treatment groups of thirty birds each. Each group was sub-divided into three replicates of ten (10) birds each in a randomized complete block design. The birds were vaccinated, and fed appropriately and water was supplied *ad libitum*. The brooding house and its environments was thoroughly cleaned, washed with detergent, and disinfected. Electric bulbs and coal pots were used as source of light and heat. Black polythene was used to cover the brooding house for the first four weeks to facilitate a warm environment for the birds. A pre-weighed quantity of feed is offered each day and the left over is subtracted from the quantity fed to determine intake. The average weekly body weight per bird was determined the average weight of 10 birds.

Collection of Blood Sample: At the end of the finisher phase, blood samples were taken from the jugular vein, one bird per replicate giving a total of twelve (12) birds. The blood samples were transferred into EDTA (ethylene diamine tetra acetic) anticoagulant treated bottles. Blood samples were labeled according to the replicate and treatment. The EDTA bottles containing the blood samples were taken to a standard laboratory for hematological analysis.

Data Collection: The following haematological parameters was taken on the collected blood samples; haemoglobin concentration (Hb), red blood cells (RBC), white blood cells (WBC), Neutrophilis (Neut), basophils (Baso), lymphocytes (Lymph), eosinophils (Eos), haematocrit (haema.), Mean corpuscular volume (MCV), monocytes (Mono.), white cell differential count (WCDC), packed cell volume (PCV) and mean corpuscular haemoglobin concentration (MCHC).

Statistical Analysis: Data on each of the parameters were subjected to analysis of variance suitable for a randomized complete block design. The Duncan New Multiple Range test of the same package was used to determine significant difference between treatment means in accordance with SAS (2002).

Table 1: Percentage Composition of Experimental Diet

Ingredients	**PKC Levels %**			
	0%	35%	40%	45%
Maize	58	44	40	35
PKC	0.00	35	40	45
SBM	15	4	4	3
Blood Meal	3	3	3	3
Fish Meal	2	2	2	2
Spent Grain	8	3	3	3
Wheat offal	10	5	4	5
Bone Meal	3	3	3	3
Salt	0.25	0.25	0.25	0.25
Vitamin	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated values (min)				
Crude protein	19.02	17.14	17.02	17.03
ME Kcal kg^{-1}	2771.41	2870.31	2922.59	2896.11

Table 2: Growth Performance of Broiler Finisher birds Fed varying level of PKC

Parameter (g	T1	T2	T3	T4	SEM
Initial weight	1385.7^{a}	1094.23^{b}	1089.43^{b}	1088.30^{b}	41.11*
Final weight	2341.30^{a}	1812.97^{b}	1684.90^{b}	1813^{b}	79.77*

Weight gain	919.20[a]	718.73[b]	595.47[b]	671.37[b]	42.37*
Daily weight gain	32.83	25.67	21.27	23.97	1.51*
Daily feed intake	177.95	183.82	174.86	163.76	NS
Feed conversion ratio	1.513[a]	1.133[b]	1.173[b]	1.080[b]	0.054*

NS= No significant difference (P>0.05); *= Significant different (P<0.05) means along the horizontal column with the same superscript are not statistically significant

RESULTS AND DISCUSSION

Growth performance parameters: The results of the growth performance of the birds are shown in Table 2. The calculated chemical compositions of the experimental diets examined were within the optimal ranges reported by other authors (Anyanwu et al. 2015). This result agrees with the result obtained by Panigrahi and Powell (1991) who reported that 40% PKC in finisher broiler diet reduced the weight gain but was increased when supplemented with lysine and methionine due to increased feed intake. The growth performance of the experimental birds in terms of their mean daily weight gain, daily intake, and feed conversion ratios for the various diets are presented in Table 2. The average feed intakes for the control, 35% PKC, 40% PKC, 45% PKC diets were 177.95, 183.82, 174.86, 163.76 g/day, respectively. There were no significant (P>0.05) differences between the treatments with respect to this variable, so the inclusion of the PKC did not affect the birds feed intakes. These results is consistent with the findings of Ezieshi and Olomu (2004) who did not observe any significant (P>0.05) difference in feed intakes between broiler finishers fed 0%, 34%, and 44.95% PKC. Earlier studies by Onwudike (1986) did not record any significant (P>0.05) variation in feed intake on feeds containing 0%,11.67%, 23.33%, 35.00% and 46.67% and 58.33% PKC, also Okeudo et al (2006) did not observe any significant variation (P>0.05) at dietary inclusion of PKC at 0%, 15%, 30%, and 45% for broiler finisher birds. This result indicates that inclusion of PKC in compounded broiler finisher rations have little or no effect on feed intake. The daily weight gain as observed in the data presented indicate a significant (P<0.05) variation between the treatment with 0% PKC having the highest value of 32.83g than the other treatments indicating no significant effect on their daily weight gain. The reduction in weight gain correlated strongly with the findings of Soltan (2009). Reduction of body weight with increasing inclusion levels of P.K.C in broiler diets may be attributed to lower nutrient digestibility with PKC inclusion (Soltan, 2009), it could be due to the high fiber content of PKC in the diet. Also, Sundu and Dingle (2003) reported that during the processing. PKC may undergo Maillard reaction (the reaction of mannose with amino groups leading to a formation of a brown complex) due to heat applied in the processing before and during oil extraction and this adversely affect digestibility. Also, Okeudo et al (2006) reported that the final live weights of broilers fed the 0.0%, 15% and 30% PKC diets were similar (approximately 1.9 – 2.0 kg) and were significantly (P<0.05) higher than the live weights of broilers fed 45% PKC diet (1.5 kg). These results are inconsistent with those presented by Okeudo et al. (2005).

There were significant differences between treatments (P<0.05 in feed conversion ration (Table 2) which suggests that increasing the proportion of PKC could reduce the feed conversion ratios of finisher broilers. There were significant (P<0.05) differences between the treatment's groups in haematological indices (Table 3), although all the values were within the range identified as optimal by Lindsay (1977). Mitruka and Rawnsley (1977) identified Hb contents of 7-18g/dL as being normal in chickens. The range of values of PCV, Hb, and RBC contents of the blood of birds fed the various treatments is an indication of improved oxygen carrying capacity of the cells which translates to a better availability of nutrients growth and productivity of the birds. It is also an indication of absence of any deleterious effect by consumption of high levels of PKC.

Table 3: Haematological Indices of Broiler Finisher birds Fed varying levels of PKC

Parameter	T1	T2	T3	T4	SEM
HB	9.30[a]	8.78[a]	8.73[a]	7.53[b]	0.225*
PCV	28.75[a]	27.00[ab]	26.18[b]	24.00[c]	0.648*
WBC	1452.75[b]	1612.75[a]	1350[bc]	1253[c]	35.69*
RBC	2.58	2.68	2.53	2.13	0.277NS
LYMP.	80.50[b]	90.00[a]	80.25[b]	86.75[a]	1.154*
NEUTRO.	18.25[a]	7.75[c]	10.50[bc]	12.25[b]	1.058*

EOSIN	1.25[b]	1.75[a]	1.25[b]	1.00[b]	0.151*
MONO	0.00	0.00	0.00	0.00	0.00
BASO	0.00	0.00	0.00	0.00	0.00
MCV	115.93[a]	92.20[c]	104.30[b]	103.23[b]	2.382*
MCH	35.30[a]	31.28[b]	34.73[a]	30.48[b]	0.667*
MCHC	33.00[a]	33.13[a]	33.33[a]	30.00[b]	0.638*

NS= No significant difference (P>0.05); *= Significant different (P<0.05) (P<0.05). means along the horizontal column with the same superscript are not statistically significant HB- Heamoglobin, PCV – Packed cell volume, WBC – White blood count, RBC – Red blood count, LYMP – Lymphocyte, NEUTRO – Neutrophil, EOSIN- Eosinophil, MONO – Monophil, BASO- Basophil, MCV – Mean cell volume, MCH - Mean cell heamoglobin, MCHC - Mean cell heamoglobin concentration.

CONCLUSION AND RECOMMENDATION

It could be concluded that 35% inclusion of PKC was the optimum level for raising broiler finisher birds. The haematological indices showed that increasing the PKC beyond 35% resulted in a reduction in the WBC showing that the PKC can increase the bird's immune system at moderate amount of inclusion.

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Productive Performance and Carcass Characteristics of Rabbits Fed Graded Levels of Moringa (*Moringa Oleifera*) Leaf Meal

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Abstract: A total of forty-five (45) cross-bred rabbits (New Zealand x Dutch) were fed for ten weeks with graded levels of Moringa oleifera leaf meal (MOLM) to determine their productive performance and carcass characteristics. The rabbits were between six and seven weeks of age with initial body weight of 511.11g. They were caged individually and allotted to five different dietary treatments in a Randomized Complete Block Design (RCBD) in groups of nine rabbits per treatment. Each treatment had three replicates having three rabbits each. The treatments consisted diets 1 (control), 2, 3, 4 and 5 having graded levels of MOLM at 0, 5, 10, 15 and 20% respectively. Results obtained showed that, there were no significant ($P>0.05$) differences in initial body weight and daily weight gain, but significant differences ($P<0.05$) were observed in final body weight, daily feed intake and feed conversion ratio. Similarly, carcass characteristics showed no significant ($P>0.05$) differences for most of the parameters measured, except for shoulder, loin, lungs and tail weight which were different ($P<0.05$) among treatment groups. Results obtained indicated that feeding MOLM up to 20% had positive effect on the performance especially feed intake and final live weight.

Keywords: Performance, carcass characteristics, Rabbits, graded levels and Moringa leaves

DESCRIPTION OF THE PROBLEM

There is global awareness of the shortage of animal protein supply in the tropics (1). There has been rising awareness on the virtues of rabbit production in developing countries as a means of alleviating world's animal protein shortage and (2) attributed this to several advantages of rabbits over other livestock species and advocated its increased production in Nigeria. However, (3) showed that feed accounted for 65 to75% of the total cost of rabbit production and recommended research into alternative and cheaper feeds for rabbits in Nigeria. There is the need therefore, to explore the use of non-conventional fed resources in rabbit production. One of such feed is the moringa leaf. *Moringa oleifera* leaf are good sources of proteins, vitamins A, B and C and minerals such as calcium and iron (4).

Rabbit grow rapid and their growth rate is comparable to that of broiler chicken (5). Rabbits are highly prolific and have short generation intervals and the meat has high biological value and contains crude protein (21%), fat (10%), low cholesterol, low sodium (0.25mg/g) and high proportion of linoleic and linolenic fatty acids (6).

MATERIALS AND METHODS

Experimental Site: The study was conducted at the Livestock Teaching and Research Farm, Department of Agricultural Education, College of Education Waka-Biu. Biu is located between latitude 10º and 40' North and longitude 12º 42' East. The minimum relative humidity is 16% in March and the maximum is 74% in August (7).

Experimental Stock and Experimental Diets: A total of 45 cross-bred rabbits (Dutch and New Zealand) of mixed sex aged between 6 to 7 weeks were purchased and used for the experiment. They were randomly allotted to five experimental diets in groups of nine per treatment and three rabbits per replicate in a Randomized Complete Block Design (RCBD). The experimental diets and clean drinking water were provided *ad libitum*

throughout the experimental period. The experimental diets had diet 1 (control) contained 0%, 2 (5%), 3 (10%), 4 (15%) and 5 (20%) levels of moringa leaves inclusion. The experiment lasted for ten weeks. The ingredient composition and calculated analysis of the experimental diets is presented in Table 1.

Table 1: Ingredient composition and calculated analysis of the experimental diets

Ingredient (%)	**T1 (0)**	**T2 (5)**	**T3 (10)**	**T4 (15)**	**T5 (20)**
Maize	40.00	36.91	31.72	27.35	23.72
Soyabean	23.00	21.28	21.09	20.65	19.28
MOLM	0.00	5.00	10.00	15.00	20.00
Groundnut haulms	15.95	15.95	15.95	15.95	15.95
Fish meal	3.00	3.00	3.00	3.00	3.00
Wheat bran	15.00	15.00	15.00	15.00	15.00
Salt (NaCl	0.30	0.30	0.30	0.30	0.30
Bone meal	2.50	2.50	2.50	2.50	2.50
Premix	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis					
Crude protein (%)	18.81	18.82	18.80	18.89	18.81
Crude fibre (%)	9.15	9.37	9.60	9.78	9.98
Ash (%)	3.98	4.20	4.51	4.81	5.10
ME (kcal/kg)	2763.00	2700.00	2576.00	2481.00	2392.00

MOLM = *Moringa oleifera* leaf meal
ME = Metabolizable energy, calculated according to the formula of (8) as ME = 37 x % CP + 81 x % EE + 35.5 x % NFE

Premix Supplied the following = Vit. A = 5000iu, Vit D3= 800,000iu Vit. E =- 12,000mg, Vit. K = 1,500mg, Vit. B1 = 1000mg, Vit. B2 = 2000mg, Vit. B6 = 1,500mg, niacin = 12000mg, Panthotenbic acid = 20.00mg, biotin = 10.00mg, Vit. B12 = 300.00mg, folic acid = 150,000mg choline = 60,000mg, manganese 10,000mg, iron = 15,000, zinc = 800.00, Copper = 400.00mg, Iodine = 80.00mg, selenium = 8,000mg.

Data Collection: Performance data collected, were initial body weight, final body weight, daily feed intake, daily weight gain and feed conversion ratio. Carcass parameters were also measured.
Chemical Analysis: All feed samples collected were analyzed using (9) methods
Statistical Analysis: All data collected were subjected to analysis of variance (ANOVA) using the software statistix 9.0 version and significant means were separated by Least Significant Difference (LSD) (20).

RESULTS AND DISCUSSION

The performance of rabbits fed graded levels of *Moringa oleifera* leaf meal (MOLM) is presented in Table 2. The final weight, daily feed intake and feed conversion ratio (FCR) were significantly ($p<0.05$) different among treatments. Rabbits fed 10%, 15% and 20% MOLM diets consumed more feed than those on the control and 5% MOLM diets. Rabbits fed on 0% MOLM diet consumed the lowest quantity of feed. The daily weight gain were not significantly ($p>0.05$) affected by the inclusion of MOLM. The values for daily weight gain (10.20 to 13.41g) obtained in the this study were similar to the values (10.07 to 12.65g) reported by (11) who fed diets containing *Moringa oleifera* leaf to growing rabbits. Similarly, the values for FCR (4.68 to 5.44) were similar to the values (4.54 to 5.71) reported by (12) when MOLM were fed to growing rabbits of similar age. Values for the final body weights and the daily weights gain which showed significant ($p<0.05$) differences were similar to the values reported by (11).

Table 2: Productive performance of Rabbits Fed graded levels of *Moringa oleifera* leaf meal (MOLM)

Parameters	Levels of MOLM (%) in the diets					
	T1 (0)	T2 (5)	T3 (10)	T4 (15)	T5 (20)	SEM
Initial weight (g)	511.11	544.44	533.33	521.11	555.56	51.60^{NS}
Final weight (g)	1154.30^{b}	1239.70^{ab}	1378.30^{a}	1332.10^{a}	1330.00^{a}	46.75*
Daily feed intake (g)	59.19^{c}	60.01^{b}	65.84^{a}	62.27^{ab}	63.59^{ab}	1.24*
Daily weight gain (g)	10.20	11.03	13.41	12.68	12.29	1.17^{NS}
Feed Conversion Ratio (FCR)	5.80^{c}	5.44^{ab}	4.68^{a}	5.31^{ab}	5.17^{b}	0.16*
Mortality	00	00	00	00	00	-

a,b,c = Means on the same row with different superscripts differ significantly ($p<0.05$)
SEM = Standard Error of Means
NS = Not significant ($p>0.05$)
* = Significant ($p<0.05$)

The carcass characteristics and organ weights of rabbits fed graded levels of MOLM is presented in Table 3. Most of the values for carcass components and the organ weights obtained in this study did not differ significantly ($p>0.05$) among treatment groups, except for the shoulder, loin, lungs and tail which differ ($p<0.05$) significantly. All the values can be favourably compared to the values reported by (13) when MOLM was fed to growing rabbits.

Table 3: Carcass Characteristics of Rabbits Fed Graded Levels of *Moringa oleifera* leaf meal

Parameters	Levels of MOLM (%) in the diets					
	T1 (0)	T2 (5)	T3 (10)	T4 (15)	T5 (20)	SEM
Slaughter weight (g)	1154.30	1239.70	1378.30	1332.10	1330.00	51.29^{NS}
Dressed weight (g)	700.00	700.00	733.33	700.00	66.73	37.03^{NS}
Dressing percentage (%)	42.74	42.29	43.40	41.03	39.40	4.71^{NS}
Weight of organs expressed as percentage of slaughter weight						
Head	8.91	7.28	8.49	9.25	8.68	0.99^{NS}
Shoulder	18.13^{a}	15.09^{c}	17.95^{b}	17.35^{a}	18.30	1.13*
Back	50.19	5.39	5.98	6.62	5.93	0.89^{NS}
Loin	14.96^{a}	12.81^{ab}	12.82^{ab}	12.15^{b}	11.95^{b}	1.81*
Thigh	13.49	11.42	12.39	13.44	12.70	1.46^{NS}
Heart	0.24	0.20	0.29	0.25	0.18	0.02^{NS}
Liver	3.62	3.17	3.52	3.21	2.76	0.31^{NS}
Kidney	0.75	0.79	0.78	0.80	0.69	0.10^{NS}
Lungs	0.56^{b}	0.73^{a}	0.57^{ab}	0.72^{ab}	0.45^{b}	0.12*
Abdominal fat	2.64	1.76	1.45	2.12	1.49	0.62^{NS}
Tail	0.24	0.20	0.23	0.29	0.34	0.03*
Skin	6.49	7.19	6.46	6.85	7.04	0.80^{NS}
Feet	1.92	2.11	1.98	1.97	2.13	0.36^{NS}

a,b,c = Means on the same row with different superscripts differ significantly ($p<0.05$)
SEM = Standard Error of Mans., NS = Not significant ($p>0.05$), * = significant ($p<0.05$)

CONCLUSION and APPLICATION

Results obtained in this study revealed that *Moringa oleifera* leaf meal could be included in rabbit diets upto 20% level without deleterious effects on performance and carcass components. More research should be carried out with different classes of rabbits to perfect the feeding of moringa leaves to rabbits in the tropics.

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Comparative Effect of *Morinda lucida* Leaf Meal and Antibiotic Growth Promoter on Growth Performance and Serum of Broiler Chicken

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Abstract: This experiment was carried out to compare the effects of *Morinda lucida* leaf meal and antibiotics growth promoter on growth performance and serum biochemical indices of broiler chickens. One hundred and twenty unsexed 7 days old broiler chicks with mean weight of 143.5g were used in a completely randomized design for 56days of the experiment. The birds were assigned into four dietary treatments consisting of 30birds per treatment, replicated thrice with 10 birds per replicate. The treatments included treatment 1 (control) with no Morinda lucida leaf meal and oxytetracycline inclusion, treatment 2 contained 0.20% oxytetracycline, treatment 3 contained 0.50% inclusion of Morinda lucida leaf meal, and treatment 4 contained 0.75% inclusion of Morinda lucida leaf meal. Result obtained showed that the values obtained for daily feed intake was significantly ($P<0.05$) affected with the lowest values at T3 (99.33g) and the highest values at T2 (107.00g), while the initial weight, final body weight, weight gain, daily weight, total weight gain and feed conversion ratio were not significantly ($P>0.05$) affected. The result obtained for serum biochemical indices showed that the glucose, cholesterol, albumin, globulin and creatinine values were significantly different ($P<0.05$) across the treatments, the values obtained for Aspartate amino transferase, Alanine amino transferase, total protein and the urea were not significantly ($P>0.05$) different. In conclusion, 0.75% of Morinda lucida leaf meal can be included in the broiler diet to improve the performance and health status of broiler chicken without any adverse effects.

KEYWORDS: *Morinda lucida*, growth performance, growth promoter, oxytetracycline and broiler chickens.

INTRODUCTION

The health of alimentary tract is an important factor in performance of poultry production due to its crucial role in absorption of nutrients and a barrier against attack of pathogenic microbes. Intensive and industrial farming has provided a good condition for residing of harmful microflora in alimentary tract because of gradual colonization of natural microflora in intestine of newly hatched chicks (Fuller, 1989). Therefore, antibiotics as growth stimulants in poultry production have been commonly used. However, application of antibiotics has been declining because of their harmful effects, residues in carcass, rising of resistance to microorganisms and causing hypersensitivity (Smith *et al.*, 2003). On the other hand, due to breakthrough in genetics and nutritional sciences, improvement in vaccines, bio-security and vaccination programs application of antibiotics as prophylactic and growth promoters have been decreased (Baurhoo *et al.*, 2007). Moreover, in some countries antibiotic application is prohibited (Cervantes, 2006; Michard, 2008). Nowadays, efforts for finding proper alternatives, such as phytobiotics, probiotic, prebiotic and organic acid to replace antibiotics have been extensively increased (Hertrampf, 2001; Langhout, 2000). Herbal medicines are rich in the active ingredients and are safe with body chemistry of man (Odutuga *et al.*, 1973). The presence of these ingredient leads to the claim of the use of plant for treatment of disease by trado-medical doctor (Obih, 1986). In other to stop the trend of increased emerging and resistance infectious disease, it will require an approach that includes the development of new drug, using plant such as *Morinda lucida.* *Morinda lucida* family of Rubiacea is an indigenous plant found in most Africa countries. *Morinda lucida* leaves contain saponin, alkaloid, tannin and flavonoids (Cowan, 1999).

MATERIALS AND METHODS

The experiment was carried out at the poultry experimental unit of Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan. A total number of one hundred and twenty day old broiler chicks (Arbor Acres) were purchased at Federal College of Animal Health and Production Hatchery Farm in Ibadan. One hundred and twenty birds were allotted into four dietary treatments. Thirty birds per treatment with three replicate of ten birds each for eight week trial (56 days). The four treatments were designated, T1, T2, T3, T4 following a completely randomized design. T1 serves as control with no inclusion of *Morinda lucida* leaf meal nor antibiotics, T2 contains 0.2% inclusion of antibiotics (oxytetracycline), T3 contains 0.5% inclusion of *Morinda lucida* leaf meal, T4 contains 0.75% inclusion of *Morinda lucids* leaf meal. *Morinda lucida* leaves were harvested within the premises of Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan. The leaves were air-dried for 7days after which the leaves were separated from the twigs. The leaves were milled and stored in white polythene bag and sealed until it is needed for use. Daily feed consumption taken and weight gain measured weekly. At the end of the experiment the birds were weighed and four birds per treatment were selected to collect 5ml of blood through the jugular vein and 3ml of the blood were put into sterile sample bottle for serum biochemical analysis. Data collected were subjected to analysis of variance (ANOVA) using SAS software (2008) and significant means were separated with Duncan Multiple range test.

Table 1: Gross composition of the experimental diet

Ingredients	**T1**	**T2 (0.20% OXYTET)**	**T3 (0.50% MLLM)**	**T4 (0.75% MLLM)**
Maize	60.00	60.00	60.00	60.00
Soya bean meal	30.00	30.00	30.00	30.00
Wheat offal	3.25	3.25	3.25	3.25
Fish meal (72%)	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00
Limestone	2.00	2.00	2.00	2.00
Premix (broiler)	0.30	0.30	0.30	0.30
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**

Calculated Analysis
Crude protein (%) = 22.50
Metabolizable energy (Kcal/kg) = 2988.38
MLLM - *Morinda lucida* leaf meal
OXYTET - Oxytetracycline

Table 3: Effect of *Morinda lucida* leaf meal and Antibiotics growth promoter on the growth performance of broiler chicken

Parameters	**T1(0%)**	**T2 (0.20%) OXYTET**	**T3 (0.5%) MLLM**	**T4 (0.75%)**	**SEM**
Initial weight (g)	144.67	144.67	142.00	142.00	0.89
Final weight (g)	1932.67	1866.33	1825.00	2040.67	50.46
Weight gain (g)	1788.00	1721.67	1683.00	1898.67	50.63
Daily weight gain (g/d)	118.00	117.00	112.00	120.33	1.92

Total feed intake	6591.33	6966.00	6455.67	6900.00	112.30
Daily feed intake (g/d/b)	106.33[a]	107.00[a]	99.33[b]	106.33[a]	1.23
FCR	3.70	4.05	3.84	3.63	0.14
Mortality (%)	10	10	Nil	6.67	

[abc] means values on the same row with different superscript differ significantly (P<0.05)

Table 4: Effect of *Morinda lucida* leaf meal and Antibiotics growth promoter on the serum biochemical indices of broiler chickens

Parameters	**T1(0%)**	**T2 (0.20%) OXYTET**	**T3 (0.5%) MLLM**	**T4 (0.75%) MLLM**	**SEM**
GLU (mg/dl)	180.97[a]	135.68[b]	127.23[c]	123.22[c]	10.96
AST (i.u/l)	68.17	71.74	69.45	59.93	3.82
ALT (i.u/l)	17.92	18.57	20.38	19.82	0.61
CHOL (mg/dl)	130.11[a]	98.39[ab]	75.71[b]	68.29[b]	9.32
TP (g/dl)	3.77	2.97	3.20	2.86	0.19
ALB (g/dl)	1.50[b]	1.60[ab]	1.66[ab]	2.11[a]	0.10
GLO (g/dl)	2.27[a]	1.37[ab]	1.54[ab]	0.75[b]	0.22
CRT (mg/dl)	1.11[ab]	1.44[ab]	1.04[b]	1.71[a]	0.11
UR (mg/dl)	1.46	2.05	2.13	2.75	0.14

[abc] mean values on the same row with different superscript differ significantly (P<0.05)
Glucose (GLU), Aspartate aminotransferase (AST), Alanine aminotransferase (ALT), Cholesterol (CHOL), Total protein (TP), Albumin (ALB), Globulin (GLO), Creatinine (CRT), Urea (UR), *Morinda lucida* leaf meal (MLLM), Oxytetracycline (OXYTET).

RESULT AND DISCUSSION

The result of the comparative effect of *Morinda lucida* leaf meal and antibiotic growth promoter on the growth performance shows that there was significant effect in the daily feed intake. The values obtained for the feed intake (106.33, 107.00, 106.33g) for T1 (0%), T2 (0.20%) and T4 (0.75%) was higher than the value (99.33g) for T3 (0.5%). For the daily weight gain, the values were 118,117,112 and 120.33g/d for treatments 1, 2, 3 and 4. Numerically, T4 (0.75% MLLM) had the highest daily weight gain compared to T2 (0.2% oxytet). The value for T4 (120.33g/d) is higher than the value reported by Nwaogu (2011) (43.4g/d) for broiler fed scent leaf meal and also the result is better than that of Odoemelam *et al.*, (2015) (42.00g/d) who fed broiler with *Occimum gratissimum*. For the feed conversion ratio, the values obtained are 3.7, 4.05, 3.84 and 3.63 for treatment 1, 2, 3 and 4. Numerically, T4 (0.75% MLLM) had a better FCR compared to T2 (0.20% Oxylet) because the lower the FCR the better the feed. The values obtained for the FCR (3.63-4.05) in this study is higher than the values (1.96-2.15) reported by Nwaogu (2011) for broiler fed scent leaf meal and also the FCR obtained in this is in line with the work reported by Onyimonyi *et al.*, (2011) who fed garlic to broiler. For the weight gain, the values are 1788, 1721, 1683 and 1898g for treatment 1, 2, 3 and 4. Numerically, T4 (0.75%MLLM) had the highest weight gain compared to T2 (0.20%Oxytet). The result of the weight gain is compared with the result of Obun (2013) who fed Neem leaf to broiler birds and reported highest value of 1800g as the body weight gain. The trend of the MLLM in the diet of broiler show a better performance in terms of feed intake, weight gain and feed conversion ratio than the synthetic antibiotic (Oxytetracycline) which may be attributed to the presence of bioactive substances such as alkaloids, anthraquinione, tanins, flavonoids and glycosides (Kemabonta and Okogbue 2000). It is probable that at 0.75% MLLM inclusion, these active compounds of *Morinda lucida* leaf

meal were able to create a harmonious gut environment suitable for the release and assimilation of digestive nutrients necessary to enhance growth. The values for T3 and T4 of MLLM had a reduced glucose level compared to T1 and T2 which showed that MLLM has hypoglycemic effect on the birds, also Elujoba *et al.,* (1990) reported that MLLM has triterpenoids which is effective in hypoglycemic. This is in agreement with the work of Oleforuh-Okoleh *et al.,* (2015) who reported a reduced glucose level on broiler birds when aqueous extract of bitter leaf was fed. T4 had the lowest cholesterol value compared to other treatments and also the cholesterol decreases across the treatment which indicated that MLLM has the ability to reduce the cholesterol value in broiler birds as reported by Elujoba *et al.,* (1990) that MLLM has hypocholesterolamic effects. This result is in line with Owen *et al.,* (2011a) who reported serum cholesterol and LDL lowering potential of bitter leaf meal.

CONCLUSION AND APPLICATION

It can be concluded that *Morinda lucida* leaf meal contain valuable phytochemicals that can be utilized in the diets of broiler birds as feed additives. The inclusion of 0.75% *Morinda lucida* leaf meal in the diets of broiler chicken improved the growth performance and gave a better result in term of broiler health. *Morinda lucida* leaf meal at this level of inclusion has beneficial effects on the health status of broiler. Based on this study, *Morinda lucida* leaf meal inclusion level at 0.75% can be used as growth promoter feed additives to improve growth performance in broiler chicken and could be used instead of prophylactic phytobiotic since the whole world is criticizing the use of synthetic antibiotics in livestock production.

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A Biochemical Assay of Selected Varieties of Kidney Bean Seeds in Nigeria for Monogastric Animal Feed Production

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Abstract: A study was conducted to determine the biochemical composition of selected varieties of kidney bean seeds grown in Nigeria for possible use as a feedstuff for monogastric animals. Four samples were taken from each of five most cultivated varieties on the Jos Plateau in Nigeria, and analyzed to determine their proximate compositions and contents of anti-nutritional factors. The varieties studied were white, brown, red, gray and black varieties. The anti-nutritional factors investigated were trypsin inhibitor, hydrocyanic acid (HCN), tannins, phytic acid, oxalate and haemagglutinins. Thus there were five treatments replicated four times in a completely randomized design. From the results of the studies, the red and black varieties had a significantly ($P<0.05$) higher dry matter content than all other varieties. The white variety had the least dry matter content. There were no significant differences in the crude protein and ether extract contents of the kidney bean varieties studied. The white variety had a significantly ($P<0.05$) higher crude fibre content than all other varieties, and the red variety had the least fibre. The five varieties did not differ significantly in their contents of hydrocyanic acid, phytic acid, oxalate and haemagglutinin. The red and black varieties had significantly ($P<0.01$) higher contents of trypsin inhibitor than other varieties. The black variety had significantly ($P<0.01$) higher content of tannin than other varieties. Due to the presence of anti-nutritional factors in the kidney beans, there is a need to subject the seeds to some processing to facilitate the efficient utilization of its nutrients by monogastric animals.

Keywords: Biochemical, Kidney Beans, Animal Feeds

INTRODUCTION

The high cost of feed and feed ingredients, particularly the protein concentrates such as groundnut cake and soyabeans, has been the major problem in monogastric animal production in developing countries today, apart from the incidence of disease (Adeniyi and Balogun, 2002; Amaefule *et al*., 2004). The ultimate goal of livestock production is the attainment of sustainable production with minimum cost and maximum returns. This has, however, been difficult to achieve due to the prohibitive cost of these feed ingredients. The urgent need to arrest the escalating cost of feed ingredients has prompted animal nutritionists, farmers and other players in the livestock industry to shift research focus to alternative feedstuffs which are locally available and affordable to farmers and feedmillers. The availability of alternative sources of nutrients will encourage a shift to the sources for which there is less competition from humans as food. Efforts have been made to use other vegetable protein sources such as pigeon pea (Iorgyer *et al*, 2009, Amaefule and Obioha, 2001, Iorgyer, 2010); *Mucuna pruriens* seeds (Emenalom and Udedibie, 1998) and Jackbean (Esonu *et al*., 1998) in monogastric diets with encouraging results. There are, however, many other legumes whose seeds can be explored for their nutritional value for monogastric animals. One of such legumes is the kidney beans (*Phaseolus vulgaris* L.).

Kidney bean is a leguminous crop grown in different parts of the world. Several varieties of this crop are currently cultivated in fairly large quantities in Mangu and Bokkos areas on the Jos Plateau, Nigeria. The varieties cultivated have crude protein contents ranging from 17 to 28% (Olomu, 2011), and are worth investigating for possible use as a protein ingredient in monogastric animal feed production.

However, like other grain legumes, its usefulness as a feed ingredient for monogastric animals may be limited due to the presence of some anti-nutritional factors (Kingsley, 1995). The presence of these anti-nutritional substances has been associated with growth depression and pancreatic hypertrophy in many species (Birk, 1988). There is therefore the need to investigate the biochemical compositions of the kidney bean varieties commonly cultivated on the Jos Plateau in Nigeria for possible use for monogastric animal feed production.

Objectives

The objectives of this study are:

To determine the proximate composition of selected varieties of kidney beans cultivated on the Jos Plateau, Nigeria.

To determine the major anti-nutritional factors present in the kidney bean varieties and their concentrations.

MATERIALS AND METHIODS

Data on the cultivation and yields of different varieties of kidney beans on the Jos Plateau, Nigeria, were obtained from Plateau Agricultural Development Programme (PADP), Jos, from where five most widely cultivated varieties were selected for the study. The most widely cultivated kidney bean varieties on the Jos Plateau were the white, brown, red, gray and black varieties. A sample (1kg) of each variety obtained from four different locations was taken to the laboratory to analyze for its proximate composition and anti-nutritional factors. Thus, this study comprised of five kidney bean varieties replicated four times in a completely randomized design.

Proximate Analyses of the Kidney Bean Seeds

The dry matter (DM) content was determined based on the weight loss after 24 hours in an oven set at 100^0C. The nitrogen content was determined by Kjeldhal method of AOAC (1995) and crude protein calculated as N x 6.25. The ash content was determined as the residue remaining after incinerating the sample at 600^0C for 3 hours in a muffle furnace. The AOAC (1995) method was also employed for ether extract and crude fibre determinations. The nitrogen free extract (NFE) was obtained as the difference between the weight of the sample dry matter and the sum of the weights of the crude protein, ether extract, crude fibre and ash contents.

Determination of Anti-nutritional Factors

The anti-nutritional factors determined were trypsin inhibitor, hydrogen cyanide, tannins, phytic acid, oxalate and haemagglutinins.

Estimation of trypsin inhibitor

Ground samples of each kidney bean variety were extracted for 3 hours with petroleum ether (b.p. 60-80^0C) at room temperature. The defatted materials were sieved through a 40 mesh screen. One gramme of each sample was suspended in 20ml of 0.5N HCl and kept overnight at 4^0C in a refrigerator. The insoluble matter was removed by centrifugation at 800 rpm for 20 minutes in a Unipan Centrifuge Model No. 310. The supernatant was used as trypsin inhibitor (TI) extract and diluted at 1:1000 with water before use. The trypsin inhibitor activity (TIA) of sample extracts was determined according to the method of Kakade *et al*., (1974) with the modification described by Liu and Markakis (1989).

Estimation of hydrogen cyanide (HCN)

The hydrocyanic acid content of the different kidney bean varieties was determined using the procedure of Cooke and Maduagwu (1978) as modified by Ikediobi and Fashagba (1985). Two grammes of each sample was extracted with 15ml 0.1M of sodium phosphate buffer pH 6.8 for 30 minutes using a shaker. The mixture was centrifuged at 100 rpm and the supernatant obtained was decanted into a 50ml volumetric flask. Exactly 0.2ml of the supernatant was pipetted into a test tube and the volume made up to 2ml with 0.1M sodium phosphate buffer pH 6.8. Four millilitres (ml) of alkaline picrate was added and mixed thoroughly. The mixture was

incubated at 95^{0}C in a water bath for 10 minutes. It was allowed to cool and absorbance was read at 490nm. The total cyanic content was obtained by extrapolation from a standard curve of potassium cyanide.

Estimation of tannins

The kidney bean sample was defatted and extracted with 5% ethyl ether and ethanol respectively. Tannic acid was estimated using the method of Earp *et al*., (1981). The method employed the vanillin-HCl procedure based on acid catalyzed addition of vanillin to flavonols and their polymers as well as other phenolic compounds such as dihydrocalcone and flavones. These reactions were determined colorimetrically at 500nm using a spectrophotometer (Spectronic 20).

Estimation of phytic acid

Eight grammes of defatted, finely ground kidney bean samples were soaked in 200ml of 2% HCl solution for 3 hours and then filtered through two layers of hardened filter paper. In a 400ml beaker, 50ml of the filtrate was placed and 107ml distilled water was added to give it proper acidity and thereafter titrated with standard ferric chloride solution containing 19.5mg iron per millilitre until a brownish yellow colour persisted for 5 minutes. Phytic acid was thereafter determined using the method of Sutardi and Buckle (1985).

Estimation of oxalate

One gramme of each kidney bean sample was placed in 250 cm^3 conical flask. One hundred and ninety centimetre cube (190cm^3) distilled water and 10ml 6M hydrochloric acid (HCl) were added. The mixture was warmed on a water bath at 90^{0}C for four hours and the digested sample was centrifuged at a speed of 2000 rpm for 5 minutes. The supernatant was diluted to 250 cm^3. Three aliquots of 50 cm^3 each of the supernatant was evaporated to 25 cm^3, the brown precipitate was filtered off and washed. The combined solution and washings was titrated with concentrated ammonia (NH_3) solution in drops until salmon pink colour of methyl orange changed to faint yellow. The solution was heated on a water bath at 90^{0}C and the oxalate was precipitated with 10 cm^3 of 5% calcium chloride solution. The solution was allowed to stand overnight and then centrifuged. The precipitate was washed into a beaker with hot 25% H_2SO_4 diluted to 125 cm^3 with distilled water and warmed to 90^{0}C. It was then titrated against 0.05M $KMnO_4$ according to the procedure of AOAC (2006).

Estimation of haemagglutinins (lectins)

The haemagglutinin content of each kidney bean variety was determined using spectrophotometric method. A weighed sample (0.5g) of the ground kidney bean seeds was dispersed in a 10ml normal saline buffered at pH 6.4 with a 0.01M phosphate buffer solution. It was allowed to stand at room temperature for 30 minutes and then centrifuged to obtain the extract. A volume of 1ml trypsinized rabbit blood was added to 0.1ml of the extract diluent in a test tube. A control was mounted with the test tube containing only the blood cells, and both tubes were allowed to stand for 4 hours at room temperature. Normal saline (1 ml) was added to all the test tubes and allowed to stand for 10 minutes after which the absorbance was read at 620nm. The haemagglutinin was determined using the method of Lees (1971).

The data generated from these studies were subjected to analysis of variance using the SAS (1995) procedure, and treatment means were separated using Duncan's Multiple Range Test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Proximate composition of selected varieties of kidney bean seeds

The results of the proximate analysis of the five selected varieties of kidney beans were shown in Table 1. The results showed that the dry matter contents of the red and black varieties did not differ significantly, but were significantly ($P<0.05$) higher than the values for the brown and gray varieties, which also did not differ significantly from each other. The white variety had the least dry matter content. The dry matter content, which ranged from 91.35 – 93.90%, was comparable to 89.0% given by Olomu (2011). There were no significant

differences in the crude protein and ether extract contents of the varieties. The crude protein contents of the different varieties, which ranged from 24.93 – 27.38%, were higher than 23.90% and 24.0% given by Olomu (2011) and Anon. (2012) respectively, for the crop. The crude protein content of kidney beans is comparable to those of cowpea and pigeon pea seeds given as 24.67% and 23.77% respectively, by Aduku (2005). The ether extract contents of the varieties, which ranged from 12.18 – 13.73%, were much higher than 1.5% and 7.8% reported by Olomu (2011) and Banerjee (2009) respectively. These differences may be due to varietal differences. This agrees with an observation by Olomu (2011) that there are wide variations in the chemical compositions of kidney bean varieties. These ether extract values are lower than 38.0% and 46.5% for full-fat soyabeans and groundnut respectively, (Aduku, 2005; Olomu, 2011). This implies that kidney beans may not be regarded as an oilseed. The kidney bean varieties differed significantly in their crude fibre, ash content and nitrogen free extract. The white variety had a significantly ($P<0.01$) higher crude fibre content than all the other varieties. This was followed by the gray and black varieties which did not differ significantly. The red variety had the least, with a crude fibre content of 5.65%, which is lower than 6.50% for soyabean meal (Aduku, 2005). The generally low crude fibre content of kidney beans makes the crop suitable as a feedstuff for monogastric animals. The ash content of the gray variety was significantly ($P<0.05$) higher than that of the white variety. The brown and red varieties did not differ significantly in their ash contents but had significantly ($P<0.05$) lower values than that of the white variety, and higher values than the black variety. The black variety had the least ash content of all the five varieties. The red variety had a significantly ($P<0.01$) higher content of nitrogen free extract than all the other varieties. This was followed by the brown and black varieties, which did not differ significantly from each other. The red variety had a significantly ($P<0.01$) higher content of nitrogen free extract than all other varieties. The white variety had the least nitrogen free extract.

Anti-nutritional factors of selected varieties of kidney bean seeds

The contents of anti-nutritional factors of the five kidney bean varieties were as presented in Table 2. The varieties differed significantly ($P<0.01$) in their contents of trypsin inhibitor and tannin. There were no significant differences in the hydrocyanic acid (HCN), phytic acid, oxalate and haemagglutinins among the varieties. The red and black varieties did not differ significantly in their contents of trypsin inhibitor, but had significantly ($P<0.01$) higher values than the other varieties. The white, brown and gray varieties did not also differ significantly in their trypsin inhibitor. The tannin content of the black variety was significantly ($P<0.01$) higher than the values for the other four varieties, which did not differ significantly ($P<0.05$) from one another.

Table 1: Proximate Composition of Five Selected Varieties of Kidney Bean Seeds

Proximate Composition (%)	Kidney Bean Varieties					
	White	Brown	Red	Gray	Black	SEM
Dry matter (DM)	91.35^{c}	92.96^{b}	93.79^{a}	92.96^{b}	93.90^{a}	0.22*
Crude protein (CP)	27.38	26.38	24.93	26.44	27.15	0.66^{NS}
Ether extract (EE)	13.73	13.30	12.28	14.74	12.18	0.29^{NS}
Crude fibre (CF)	9.46^{a}	7.23^{c}	5.65^{d}	8.44^{b}	8.12^{b}	0.20**
Total ash	4.72^{b}	4.30^{c}	4.40^{c}	5.15^{a}	4.17^{d}	0.06*
Nitrogen free extract (NFE)	35.06^{c}	41.76^{b}	46.53^{a}	30.17^{d}	42.28^{b}	0.72**

^{abcd} Means within the same row bearing different superscripts are significantly different

SEM = Standard error of mean; NS = Not significant; * = $P<0.05$; ** = $P<0.01$

Table 2: Anti-nutritional Factors of Five Selected Varieties of Kidney Bean Seeds

Anti-nutritional Factors (mg/100g)	Kidney Bean Varieties					
	White	Brown	Red	Gray	Black	SEM
Trypsin inhibitor	3.40^{b}	3.12^{b}	3.83^{a}	3.10^{b}	4.12^{a}	0.06**
Hydrogen cyanide	21.96	19.39	23.96	18.83	19.60	1.66^{NS}
Phytic acid	29.00	25.40	29.30	27.80	27.10	0.08^{NS}
Tannin	143.95^{b}	149.15^{b}	176.66^{b}	166.27^{b}	263.96^{a}	8.35**
Oxalate	16.40	18.30	17.80	19.70	16.00	0.11^{NS}

Haemagglutinin	3.88	3.65	3.91	3.96	3.96	0.10^{NS}

[a,b] Means within the same row bearing different superscripts are significantly different;
SEM = Standard error of mean; NS = Not significant; ** = P<0.01

CONCLUSION

From the result of the study on the proximate composition of the white, brown, red, gray and black varieties of kidney beans cultivated on the Jos Plateau in Nigeria, each variety had a potential for use as a protein feedstuff in the diets of monogastric animals since they had relatively high crude protein contents which did not differ significantly. The varieties also had a relatively low crude fibre contents. The five varieties also did not differ significantly in their contents of hydrocyanic acid, phytic acid, oxalate and haemmaglutinins. They differed significantly in their contents of trypsin inhibitor and tannins. It is recommended that for kidney beans to be used for monogastric animal feed production, it will need to be subjected to some form of processing in order to destroy the anti-nutritional factors for proper utilization of its nutrients by such animals.

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Performance and Cost benefits of Broiler Chickens fed Maize bran/Maize-Soya based broiler diets Supplemented Commercial Enzymes

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Abstract: Eight weeks broiler trial was conducted to evaluate the performance and economics of production of broiler chickens fed maize bran/maize-soya based diets supplemented with commercial enzymes. Five iso-nitrogenous and caloric diets were formulated, with diet E, serving as control without commercial enzyme. Diets A, B, C and D were supplemented with different commercial enzymes at proprietary advised inclusion levels. A total of 420 unsexed Arbor Acer day old chicks was randomly allocated to five treatments, replicated three times with twenty-eight birds each following a completely randomized design. Data were collected on daily feed intake and weekly weights of birds, while feed conversion ratio was calculated on pen weight basis. Results revealed that average final body weight and weight gain of birds fed diet A, B, and C were significantly ($p>0.05$) higher than diet E but were similar to diet D. Moreover, FCR of diet A, B, C and D were significantly ($p>0.05$) lower than diet E, though there were non-significant difference in feed intake. However, cost of feed consumed and cost of feed per weight gain were significantly ($p>0.05$) reduced in diet A & B, and increased in diet C, D and E. Moreover, revenue was significantly ($p>0.05$) higher with diet A, B and C compared to diet E but similar with diet D. Therefore, it can be concluded that maize bran/maize-soya based broiler diet supplemented with enzyme "B" will improved the growth performance of broiler chickens and profitability of farmer, and reverse is the case of enzyme D.

Keywords: performance, cost, broilers, maize bran, enzymes

INTRODUCTION

In Nigeria, broiler feed is based primarily on cereal grains and vegetable protein meal, which is supplied for meeting most of energy and protein requirements in the poultry diet. Soya Bean Cake and Soya Bean Meal are all by-products obtained after the extraction of oil from decorticated soya beans. Both Soya bean and Maize are competitive products. The reason is because; it is consumed by both human beings and animals as either in processed form or otherwise. Thus, the experimental diets are maize bran/maize-soya based diet. However, high level of inclusion of maize bran in poultry diet poses certain problems like increased viscosity of gut contents, poor digestibility and poor chick performance due to its high fibre content of 14-18% Crude Fibre, (Rad and Keshavarz, 1976). Then, to move away from competitive cereal grains to its by-products become more imperative for the use of enzymes. The testa of soya bean meal and cereal grains is rich in non-starch polysaccharides (NSP) which reduce the digestibility of the Soya bean meal/cereal grains. These NSP are polymeric carbohydrates which differ in composition and structure from starch (Annison, 1992) and possess chemical cross linking among them and therefore are not well digested by poultry (Annison, 1993). A part of these NSP is water soluble which is notorious for forming a gel like viscous consistency in the intestinal tract (Pettersson, 1987). Predominantly water soluble and viscous arabinoxylans (belonging to pentosane group) are assumed to be the factor responsible for the low metabolizable energy (ME) in cereal grains (Choct and Annison, 1990), resulting in relatively poor chick performance (Friesen *et al.*, 1992).

These pentosanes, which are the main constituents of the endosperm cell wall of cereal grains, greatly increase the water intake by the bird which leads to unmanageable litter problems caused by wet and sticky droppings (Dunn, 1996). Similarly, β-glucans also adversely affect all nutrients, especially protein and starch utilization and are known to give rise to highly viscous conditions in the small intestine of the chicks (Hesselman and Aman, 1986). Research work has suggested that these negative effects of NSP can be overcome by supplementation of diets with suitable exogenous enzyme preparations (Zanella *et al.*, 1999; Gracia *et al.*, 2003).

These enzymes are assumed to degrade high amount of NSP in high fibre maize bran/maize-soya based broiler diet, resulting in increased nutrient availability to poultry birds. The trial therefore, aimed at evaluating the effects of commercial enzymes on growth performance, nutrients utilization and its economic efficiency.

MATERIALS AND METHODS

Experimental site: The broiler trial was conducted at National Veterinary Research Institute, Vom Plateau State, Nigeria.

Experimental animal and management: A total of four hundred and twenty-twoArbor Acer breed day old broiler chicks were obtained from a commercial hatchery was used for the trial. An average (33±0.12g body weight) were weighted individually and randomly divided into fifteen (15) pens of twenty-eight birds each. Moreover, each broiler diet was allocated three pens (replicates) and was exposed to same condition. The brooding temperature was kept at an average of 26.5^0C from the first to second week of age. Thereafter, the temperature was lowered to 22^0C for the rest of experimental period. Wood shaving was used as litter material. At DOC, antibiotic and anti-stress were given to the birds for three days. From week two to three, first and second Infectious Bursal Disease Vaccine (IBDV) was administered. Then, at week four and five Anticoceidial drug and Newcastle Disease Vaccine Lasota were given to the birds respectively. The design was simple CRD and commercial enzymes used as main effect. That's, a maize bran/maize-soya based diet (negative control) were supplemented with enzymes A, B, C, and D. The experiment was conducted for the period of eight weeks. The daily feed consumption, weekly body weights, weight gain and feed conversion ratio were properly recorded.

Table: 1 Composition of Broiler Experimental Diets

	Diets %				
Ingredients	A	B	C	D	E
Lysine	0.17	0.17	0.17	0.17	0.17
Salt	0.39	0.39	0.39	0.39	0.39
Premix Broiler	0.25	0.25	0.25	0.25	0.25
Maize	35.3	35.3	35.3	35.3	35.3
GNC	5.00	5.00	5.00	5.00	5.00
Maize Bran	33.4	33.4	33.4	33.4	33.4
Bone Meal	2.10	2.10	2.10	2.10	2.10
Soya Bean Oil	2.50	2.50	2.50	2.50	2.50
MHA Methionine	0.12	0.12	0.12	0.12	0.12
Limestone	0.40	0.40	0.40	0.40	0.40
Toxin Blinder	0.02	0.02	0.02	0.02	0.02
Soya Bean Meal	20.4	20.4	20.4	20.4	20.4
Enzyme	0.05	0.03	0.03	0.08	-
Total Percentage (%)	100	100	100	100	100
Nutrients Composition of Diets					
Metabolizeable energy (Kcal/Kg)	3,055	3,055	3,055	3,055	3,055
Crude Protein %	17.65	17.65	17.65	17.65	17.65
Crude Fat %	7.63	7.63	7.63	7.63	7.63
Crude Fibre %	7.95	7.95	7.95	7.95	7.95
Ash %	5.68	5.68	5.68	5.68	5.68
Calcium %	1.0	1.0	1.0	1.0	1.0
Available Phosphorus %	0.35	0.35	0.35	0.35	0.35
Methionine %	0.41	0.41	0.41	0.41	0.41
Lysine %	0.9	0.9	0.9	0.9	0.9

Methionine + Cystine %	0.69	0.69	0.69	0.69	0.69

*Diet E is without Enzyme (Negative control)

RESULTS AND DISCUSSION

Table 2: Effect of broiler diet supplemented with commercial enzymes on growth performance of broilers.

Parameters	Diet A	Diet B	Diet C	Diet D	Diet E	S.E.M
Initial weight (g/bird)	32.68	32.84	32.87	33.55	33.45	0.27
Final weight (g/bird)	3899.64^{a}	3804.55^{a}	3990.89^{a}	3640.56^{ab}	3494.25^{b}	2.60
A.D.W.G(g/bird)	69.06^{a}	67.35^{a}	70.68^{a}	64.41^{ab}	61.80^{b}	1.33
A.D.F.I(g/bird)	137.51^{a}	132.65^{ab}	139.82^{a}	134.48^{a}	141.24^{a}	2.26
F.C.R	1.99^{b}	1.97^{b}	1.98^{b}	2.09^{b}	2.29^{a}	0.04
P.E.R	2.85^{a}	2.88^{a}	2.87^{a}	2.71^{ab}	2.49^{b}	0.05

[a,b,c] Means across rows with different superscripts differ significantly at P<0.05; S.E.M: Standard Error of the Mean; A.D.W.G: Average Daily Weight Gained; A.D.F.I: Average Daily Feed Intake; F.C.R: Feed Conversion Ratio; P.E.R: Protein Efficiency Ratio.

Table 2 showed the performance of broiler chickens fed diets containing different commercial enzymes. The results showed that all the parameters measured showed significance within the treatments. The final weight and average daily weight gained showed that broiler chickens fed diet containing enzymes were not significantly (P>0.05) different from each other, but were significantly (P<0.05) higher than those fed with the negative control diet. The average daily feed intake showed that broiler chickens fed diets containing enzymes and those fed with negative control diet were not significantly (P>0.05) different from each other, while those fed negative control diet had the highest mean, those fed diet B had the lowest mean while the remaining treatment groups had intermediate values. The F.C.R showed that broiler chickens fed diet containing enzymes were not significantly (P>0.05) different from each other, but they were significantly (P<0.05) lower than those fed negative control diet while P.E.R showed that broiler chickens fed diet containing enzymes were not significantly (P>0.05) different from each other, but those fed negative control diet were significantly (P<0.05) lower than them, whereas those fed diet D were not significantly different from the negative control group.

Table 3: Effect of broiler diet supplemented with commercial enzymes on economics of production of broilers.

Parameters (N)	Diet A	Diet B	Diet C	Diet D	Diet E	S.E.M
Cost of feed consumed	584.46^{b}	556.73^{b}	685.48^{a}	594.15^{b}	588.44^{b}	17.07
Cost/Kg weight gained	151.17^{b}	147.60^{b}	173.18^{a}	164.81^{a}	169.92^{a}	3.65
Cost of production	584.46^{b}	555.46^{b}	685.49^{a}	594.14^{b}	588.43^{b}	17.12
Cost/Kg feed	75.90^{b}	74.95^{b}	87.55^{a}	78.90^{b}	74.40^{b}	1.62
Revenue	3509.68^{a}	3424.09^{a}	3591.80^{a}	3276.51^{ab}	3144.84^{b}	67.14
Gross margin	2925.22^{a}	2868.63^{a}	2906.32^{a}	2682.37^{b}	2556.42b	58.56

[a,b,c] Means across rows with different superscripts differ significantly at P<0.05; S.E.M: Standard Error of the Mean.

Table 3 showed the economics of production of broiler chickens fed diet containing different commercial enzymes. The cost of feed consumed showed that broiler chickens fed diet C were significantly (P<0.05) higher than the remaining treatment groups, while the cost/Kg of weight gained showed that broiler chickens fed diet A and B were not significantly (P>0.05) different from each other, which were significantly (P<0.05) lower to those fed diet C, D and the negative control. The cost of production and cost/Kg of feed showed that broiler chickens fed diet A,B, D and negative control were not significantly (P>0.05) different from each other, but were significantly (P<0.05) lower to those fed diet C. The revenue showed that there was no significant (P>0.05) difference between broiler chickens fed diet A, B, C and D, but were significantly (P<0.05) higher than those fed negative control diet with the exception of those fed diet D, while the gross margin showed that there was no significant (P>0.05) difference between broiler chickens fed diet A, B and C, but they were significantly (P<0.05) higher than those fed diet D and the negative control. Based on the non-significant difference between the negative control diet and diet D as regards to the revenue generation and gross margin, it could easily be pointed out that the commercial enzyme supplemented in diet D had no significant effect on the revenue generation of broiler production.

CONCLUSION

In Nigeria today, there is insufficient raw materials and rapid increase in the price of major feed ingredients (like maize and soya bean), which is as a result of the competitive nature of these major feed ingredients and poor mechanized farming system. So, to harness the nutritive potentials of some by-products, the commercial enzyme becomes very imperative in the feed formulation. The commercial enzyme apparently serves as a key to unlock the nutrient components, enable the chickens have access to the available nutrients, aid in digestion, nutrient utilization and efficient growth performance especially in the broiler chickens. The commercial enzymes are targeted to drive the agribusiness walls of livestock sector by enhancing the revenue generation, efficient feed conversion and cost effectiveness. Hence, the additional cost of commercial enzyme supplemented in diet D has no significant effect on the growth performance of the broiler chickens fed with the diet and the returns in investment. The commercial enzyme supplemented in diet "B" could be regarded as more economical. This is as a result of the non-significant difference in gross margin and revenue between diets A, B and C; whereas diet "B" has the least cost and significantly different from diet C but similar to diet A, D and E. The result equally affirmed with the recent trend about phytase enzyme.

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Effects of Microbial Culture from Fermented Maize Mash Steep on Performance and Blood Parameters of Broiler Chickens

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Abstract: The effects of microbial culture isolated from maize steep on broiler performance, biochemical and haematological parameters were assessed in a 42-day trial. 192 - day old broiler chicks of a commercial strain were administered drinking water with none or any of *Lactobacillus fermentum*, *Bacillus substilis* and *Saccharomyces cerevisiae* included singly or in combinations to give eight treatment groups. Performance parameters of birds were determined and at the end of the trial, blood samples were collected from the birds for biochemical and haematological analyses. Data collected were subjected to one-way analysis of variance using the SAS software. Performance of birds was not significantly influenced by any of the experimental treatments. Amongst the biochemical indices assessed only total protein was significantly ($p<0.05$) influenced with the highest value (36.00g/l) observed in birds on drinking water with combination of *Lactobacillus fermentum* and *Bacillus substilis*. For haematology, the experimental treatments had significant ($p<0.05$) influence only on RBC, MCH and MCV. The RBC values of broilers on the experimental treatments were significantly ($p<0.05$) higher compared to those on the control treatment. The values of MCH and MCV for birds on drinking water with *Saccharomyces cerevisiae* alone were significantly ($p<0.05$) lowest compared to others. In conclusion, although there was no significant improvement in growth performance of birds, maize steep had no adverse effect on broiler chickens.

Keywords: Performance, maize steep, microbial culture, biochemical, haematological.

INTRODUCTION

The long term and extensive use of antibiotics for veterinary purpose in poultry production may eventually result in selection for the survival of resistant bacteria species or strain (Ohimain and Ofongo, 2012) and the major concerns are related to the presence of antibiotic residues in poultry products that can cause adverse effects on human health and the possible development of antibiotic resistant bacteria (Kalsum *et al*., 2012). One key strategy to replace the use of antibiotics in poultry diets is to feed microorganisms directly to the bird. Previous reports have shown that direct feeding of Lactobacillus strain culture isolated directly from the gut of healthy bird and screened for probiotic properties improved the growth performance of broilers at 1 – 21days of age (Zhu *et al*., 2009). Blood parameters are indicators of an organism's wellbeing and a difference in the constituent compounds of blood when measured against normal values could be used to explain the metabolic status of an animal as well as quality of feed (Babatunde *et al*., 1992) administered to the animals. At present, information on the effect of microbial culture isolated from steep of fermented grain mash on broilers is limited. This study was therefore designed to evaluate the effect of direct inclusion of probiotic microbial culture isolated from maize steep on the performance, biochemical and haematological parameters of broiler chickens.

MATERIALS AND METHODS

The bacterial and fungal isolates possessing probiotic properties according to previous report (Ohimain and Ofongo, 2012) and were isolated and characterized from fermented maize mash steep in this experiment include: *Bacillus substilis, Lactobacillus fermentum* and *Saccharomyces cereviseae.* They were each applied singly and in various combinations directly into drinking water for broilers as a source of probiotic. This resulted into 8 experimental treatments designated thus: O; Ordinary drinking water (Control), L; water with *Lactobacillus fermentum*, B; water with *Bacillus substilis*, S; water with *Saccharomyces cereviseae*, LB; water with mixture of *Lactobacillus fermentum* and *Bacillus substilis*, LS; water with mixture of *Lactobacillus fermentum* and *Saccharomyces cereviseae*, BS; water with mixture of *Bacillus substilis* and *Saccharomyces cereviseae*, LBS; water with mixture of *Lactobacillus fermentum*, *Bacillus substilis*, and *Saccharomyces cerevisiae*. The quantity of microbial organisms per ml of drinking water is presented in Table 1.

The experiment was laid out in a completely randomized design with 192-day-old broiler chicks (mixed sex) of Arbor Acre strain randomly divided into eight experimental treatments consisting of three replicates. Water and feed were administered *ad-libitum* for 42 days and the composition of diet was presented in Table 2.

Performance parameters were measured and at the end of the trial blood samples were collected from two randomly selected birds per replicate through the jugular vein into properlylabeled and sterilized tubes without anticoagulant for blood biochemistry and with Ethylene Diamine Tetra Acetic acid for blood haematology. The biochemical parameters were determined as previously described by Adeyemo *et al*. (2010). The haematological parameters were determined as previously described by Adeyemo *et al*. (2010) and Madubuike and Ekenyem (2006). The MCV, MCHC and MCH were estimated by calculation using a standard formula (Jaime and Howlett, 2008). All data collected were subjected to one-way analysis of variance (ANOVA) using the General Linear Model of SAS (2003) at 5% level of significance. All significantly different means were separated using the Duncan's Multiple Range Test of the same software package.

RESULTS AND DISCUSSION

The results of the effects of direct inclusion in drinking water of isolated microbial cultures from maize steep on the performance, blood biochemistry and haematology of broilers are as shown in Table 3 and 4.

The lack of significant ($p<0.05$) effect of experimental treatments on the performance parameters supports previous reports by Ergun *et al* (2000) that probiotics have no effect on the performance of broilers. For blood biochemistry, there was a significant ($p<0.05$) effect only on blood total protein of broilers with the highest value (36.00g/l) observed in birds on treatment LB. It was however comparable with the birds on control treatment. According to Hewida *et al*. (2011), blood biochemistry parameters in broiler chickens were not significantly affected by microbial culture with probiotic properties. The effect on blood haematology in broiler chickens resulted in a significant ($p<0.05$) influence on RBC, MCH and MCV. While Dimcho *et al*. (2005) reported that probiotic supplementation did not affect blood constituents comprising of haemoglobin concentrations in ducklings, Cetin *et al.,* (2005) observed that probiotic supplementation caused statistically significant increase in the erythrocyte count, haemoglobin concentration and haematocrit values of Turkeys. The RBC values of broilers on the control treatment was significantly ($p<0.05$) lowest compared to values for all other experimental treatments. Therefore, the oxygen carrying capacity of the experimental birds would be reduced since the major function of the red blood cells is to transport haemoglobin, which in turn carries oxygen from the lungs to the tissues (Raji *et al*., 2014). The values of MCH and MCV for birds on drinking water with *Saccharomyces cerevisiae* (S) alone were significantly ($p<0.05$) lowest compared to other experimental treatments. Muhammad and Oloyede (2009) reported that reduction in MCV occurs when iron deficiency becomes severe thus the presence of *Saccharomyces cereviseae* in this study was probably not adequate enough to alleviate the deficiency of iron in the broiler red blood cells.

Table 1: Quantity of microbial organisms per ml of drinking Water

Age (weeks)	Cfu/ml of drinking water		
	Lactobacillus fermentum	*Bacillus substilis*	*Saccharomyces cerevisiae*
1	2.90×10^6	2.70×10^6	2.20×10^3
2	2.80×10^6	2.60×10^6	2.90×10^3
3	4.00×10^6	2.60×10^6	2.80×10^3
4	4.20×10^6	2.20×10^6	2.10×10^3
5	2.00×10^6	3.80×10^6	1.90×10^3
6	3.30×10^6	3.20×10^6	2.50×10^3

Cfu- colony forming units

Table 2: Composition of broiler's diets (%)

Ingredients	Starter	Finisher
Maize	48.00	53.00

Soyabean meal	18.50	16.50
Groundnut cake	17.50	13.50
Fish meal	2.00	1.00
Wheat offal	10.00	12.00
Bone meal	2.00	2.00
Oyster shell	1.00	1.00
Methionine	0.25	0.25
Lysine	0.25	0.25
Salt	0.25	0.25
Vit/Min Premix*	0.25	0.25
Total	100.00	100.00
Analyzed nutrient composition (%)		
Energy (Kcal/Kg ME)	2721.05	2739.35
Crude Protein	22.86	20.18
Crude Fibre	3.81	4.02

*Vitamin/ mineral premix contained the following: (Univit. 15 Roche) 1500 I.U Vit A; 1500 I.U Vit D; 3000 I.U Vit E; 3.0g Vit K; Vit. B_2 0.3g Vit.B_6; 8.0mg Vit.B_{12}; 8.0g Nicotinic Acid; 3.0g Ca-Pantothenate; 50mg Fe; 10.00g Al; 0.2g Cu; 3.5mg Zn; 0.15mg I; 0.02g CO_2; 0.01g Se.

Table 3: Effect of direct inclusion of isolated microbial culture from maize steep on performance in broilers

Parameters	O	L	B	S	LB	LS	BS	LBS	±SEM
Average daily feed intake (g/ bird/day)	70.80	70.68	70.48	70.49	72.23	73.14	72.02	72.40	0.88
Average daily weight gain (g/bird/day)	31.99	35.50	33.55	34.56	35.08	36.04	32.82	34.27	2.24
Feed conversion ratio	2.23	1.99	2.11	2.04	2.06	2.03	2.22	2.13	0.15
Cost of feed/weight gain (₦)	190.71	170.57	180.29	175.50	177.11	174.33	189.65	182.36	2.90
Mortality (%)	0	0	0	0	0	0	0	0	0

Table 4: Effect of direct inclusion of isolated microbial culture from maize steep on blood biochemistry and haematology in broilers

Treatments Parameters	O	L	B	S	LB	LS	BS	LBS	±SEM
Total protein (g/l)	31.00^{ab}	30.50^{ab}	23.00^{c}	28.00^{bc}	36.00^{a}	23.50^{c}	31.00^{ab}	24.50^{c}	2.38
Albumin (g/l)	19.00	19.00	15.00	19.50	21.00	16.00	20.00	16.00	2.51
Globulin (g/l)	12.00	11.50	8.00	8.50	15.00	7.50	11.00	8.50	3.43
Urea (mmol/l)	1.80	2.30	1.75	2.10	1.60	1.60	2.40	2.45	0.29
Cholesterol (mmol/l)	2.35	2.00	2.05	1.60	2.30	2.15	2.03	2.20	0.48
PCV (%)	23.50	31.00	23.50	30.00	28.50	24.00	24.00	27.00	2.53
Hb(g/dl)	7.85	10.35	7.80	10.50	9.50	8.00	8.00	9.00	0.85
RBC ($x10^6$/ µl)	1.75^{b}	2.75^{ab}	2.25^{ab}	4.05^{a}	2.85^{ab}	3.00^{ab}	2.75^{ab}	3.20^{ab}	0.55
WBC ($x10^6$/ µl)	1.95	3.00	2.90	2.45	3.65	2.00	3.30	2.10	0.52
MCHC (g/dl)	33.39	33.38	33.19	33.33	33.33	33.32	33.36	33.34	0.05
MCH (pg)	44.28^{a}	37.48^{ab}	35.14^{ab}	24.70^{b}	34.76^{ab}	29.82^{ab}	29.32^{ab}	28.29^{ab}	5.07

MCV (fl)	132.57[a]	112.27[ab]	105.88[ab]	74.09[b]	104.22[ab]	89.60[ab]	87.88[ab]	84.90[ab]	15.15
Neutrophil (%)	49.00	52.00	51.00	51.00	55.00	42.00	52.00	58.00	3.80
Lymphocyte (%)	47.00	47.00	48.00	48.00	48.00	56.00	45.00	41.00	3.41
Eosonophil (%)	2.00	0	1.00	0	1.00	1.00	1.00	2.00	0.62

[a, b] means within column followed by different superscripts are significantly different (P <0.05), O; Ordinary drinking water, L; water with Lactobacillus fermentum, B; water with Bacillus substilis, S; water with Saccharomyces cereviseae,LB; water with mixture of Lactobacillus fermentum and Bacillus substilis, LS; water with mixture of Lactobacillus fermentum and Saccharomyces cereviseae, BS; water with mixture of Bacillus substilisand Saccharomyces cereviseae, LBS; water with mixture of Lactobacillus fermentum, Bacillus substilis, and Saccharomyces cereviseae , SEM: Standard Error of Mean

In conclusion, inclusion of probiotic microbial culture isolated from fermented maize mash in drinking water of broilers had no adverse effects on their blood biochemistry and haematology. More trials are however required in order to further offer satisfactory explanations concerning the effects of probiotic microbial culture isolated from fermented maize mash.

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The Performance and Serum Biochemical Indices of Weaner Pigs fed Diets Containing Varying Levels of *Morinda lucida* Leaf Meal as Growth Promoter

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Abstract: This experiment was carried out on the effect of diets containing graded levels of Morinda lucida leaf meal as growth promoter on the performance and serum biochemical indices of weaner pigs. Sixteen weaner pigs with mean weight of 10.00± 0.5kg were used in a Completely Randomized Design (CRD) for 56 days of the experiment. The pigs were assigned into four treatments, four pig per treatment. Treatment 1 serving as (control) has no Morinda lucida leaf meal, treatment 2 contained 500g/100kg inclusion of Morinda lucida leaf meal, treatment 3 contained 750g/100kg inclusion of Morinda lucida leaf meal, while treatment 4 contained 1000g/100kg inclusion level of Morinda lucida leaf meal respectively. The daily feed intake was not significantly ($P>0.05$) affected, but numerically increased progressively with the highest value at T2 (1.52kg) and lowest value at T4 (1.40kg), while the initial weight, final body weight, weight gain, daily weight gain, total weight gain and feed conversion ratio were not significantly different ($P>0.05$). The serum parameters glucose, albumin, globulin, creatinine, alanine, total protein, amino transferase and aspartate amino transferase were not significantly different ($P>0.05$) across treatment, but recorded a significant difference ($P<0.05$) on the cholesterol level across the treatment. In conclusion 0.5% inclusion level of Morinda lucida leaf meal can be included in the diets of weaner pigs to improve performance and health status of the weaner pigs without adverse effects.

Keywords: *Morinda lucida*, performance, weaner pigs, serum biochemistry, growth promoter.

DESCRIPTION OF PROBLEM

Monogastrics has made a very important contribution to the production of animal protein in many countries around the world. As a result, pig's rapid developments are based on the fecundity and growth potentials. Intensive pig production has played a significant role in meat production and income generation in the tropics (1). Pork is a very important source of animal protein in the human diets and the largest source of meat at the world level. According to (2) report, there is a greater output of meat from pigs than the combined output of meat from cattle, buffalo, sheep and goat, even considering the fact that, due to religious beliefs, pork is not produced and consumed in many countries, its relative importance is even greater in the rest of the world (3). The best indicator of animal's well being and its potential for production is its health status. Antibiotics used as growth promoters in animal feeds have been criticized and banned in many nations due to possible development of drugs resistance by the consumer (4). Numerous additives are now being used or proposed as means to reduce or eliminate pathogens and to improve growth which include probiotics, organic acid, enzymes and phytogenics (5). The high dosage of antibiotics, hormones and chemical derivatives for increase and sustain livestock production has increased the problem of its residual effects in their products thus causing a serious health concern (6). A large number of medicinal plants with known medicinal properties are available and is being used by the farmers (7). According to (8) feed additives are products used in animal nutrition for purpose of improving the palatability and quality of feed and to improve the animal's performance and health, that is providing enhanced digestibility of feed materials. Some feed additives can be in the form of medicinal plants. (9) said that medicinal plants have contributed immensely to the health care of livestock animals. According to this statement, this has added to the recognition of the value of traditional medicinal systems, and the identification of medicinal plant from indigenous pharmacopoeias, which has significant healing power. The development of drug resistance by

some microbes in livestock is a reality on farms and has necessitated chemotherapeutic control alternatives and thus plants with bio-activity are one of these potential alternatives (10). *Morinda lucida*a medicinal plant has been in use for their anti-microbial, antioxidant and their medicinal properties (11).

MATERIALS AND METHODS

The experiment was conducted at the Institute of Agricultural Research and Training (IAR&T) Piggery Research Unit, Moor Plantation, Ibadan, Nigeria. The experiment lasted for 12 weeks, the experimental materials used for the study includes 16 weaner pigs which are allotted into four dietary treatments consisting of four weaner pigs per treatment in a completely randomized design. *Morinda lucida* leaf which is the test ingredients was collectedfrom National Center for Genetic Resources and Biotechnology (NACGRAB) and Bora environment. It was air dried for seven days and was milled into powder form and stored in a polythene bag at room temperature. Experimental diets were formulated and designated into four treatments one, two, three and four. Treatment one serves as the control diet while treatment two, three and four were having graded levels of *Morinda lucida* leaf meal at 500g/100kg. 750g/100kg and 1000g/100kg inclusion rate respectively. Blood samples were collected from two weaner pigs from each treatment through the anterior vena cava for haematological analysis. All data collected were subjected to analysis of variance (Anova) of (12) and where significance occurred, they were separated using Duncan Multiple Range test.

Table 1: Gross Composition of experimental diets showing graded levels of *Morinda lucida* leaf meal inclusions

Parameter	**T1(0.00%)**	**T2 (500g/100kg)**	**T3 (750g/100kg)**	**T4 (1000g/100kg)**
Maize	20.00	20.00	20.00	20.00
PKC	32.50	32.50	32.50	32.50
GNC	5.00	5.00	5.00	5.00
BDG	37.00	37.00	37.00	37.00
Blood meal	3.00	3.00	3.00	3.00
Bone meal	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated Analysis (%)				
Crude protein	19.16	19.16	19.16	19.16
Metabolizable Energy (kcal/kg)	2375.86	2375.86	2375.86	2375.86

MLLM: *Morinda lucida* leaf meal

Table 2: Effect of diets containing graded level of *Morinda lucida* leaf meal as growth promoter on performance of weaner pigs

Parameter	**T1(0.00%)**	**T2 (500g/100kg)**	**T3 (750g/100kg)**	**T4 (1000g/100kg)**	**SEM(±)**
Initial weight (kg)	10.23	10.00	10.00	10.25	0.53
Final weight (kg)	38.75	39.75	37.50	37.50	1.51
Weight gain (kg)	28.50	29.75	27.75	27.25	1.15
ADWG (kg/day)	0.51	0.53	0.50	0.49	0.02
Total feed intake (kg)	85.75	85.25	80.00	78.50	1.51
Average daily intake (kg)	1.53	1.52	1.42	1.40	0.15
F.C. R	3.01	2.86	2.88	2.88	0.13

MLLM: *Morinda lucida* leaf meal FCR: Feed conversion ratio

Table 3: Serum biochemical indices of pigs fed diets containing graded levels of *Morinda lucida* leaf meal.

Parameter	**T1(0.00%)**	**T2 (500g/100kg)**	**T3 (750g/100kg)**	**T4 (1000g/100kg)**	**SEM(±)**
GLU (mg/dl)	62.96	69.14	72.88	62.97	6.05
AST (LU/L)	43.42	55.83	43.82	67.48	2.56

ALT (LU/L)	16.32	16.72	29.28	20.72	8.37
CHOL (mg/dl)	136.55	132.44	123.50	120.50	6.09
TP (g/dl)	7.79	8.50	9.81	11.19	0.72
ALB (g/dl)	3.52	3.71	3.58	3.12	0.10
GLO (g/dl)	4.27	4.79	6.23	8.07	0.62
CRT (mg/dl)	1.05	0.70	0.79	0.85	0.07

[ab] mean values on the same row with different superscript differ significantly (P<0.05)
GLU (mg/dl): glucose, AST (LU/L): aspartate amino transferase, ALT (LU/L): alanine amino transferase, CHOL (mg/dl): cholesterol, ALB (g/dl): TP (g/dl): total protein, CRT (mg/dl): creatinine, GLO (g/dl): globulin.

RESULT AND DISCUSSION

The result of diets containing varying levels of *Morinda lucida* leaf meal reveals that there was no significant effect (P>0.05) of *Morinda lucida* leaf meal on growth performance of the weaner pig. However, weaner pigs fed 0.5% *Morinda lucida* recorded highest values for final weight (39.75 ± 1.51kg) weight gained (29.75 ± 1.15kg), average daily weight gain (0.53 ± 0.02). For the serum biochemical indices, the result shows that there were significant differences on the cholesterol level of animal after feeding *Morinda lucida* leaf meal but no significant difference were recorded on their glucose, aspartate amino transferase, alanine amino transferase, total protein, albumin and creatinine of the animals. For the average daily weight gain, the values were 0.51, 0.53, 0.50 and 0.49kg/d for treatments 1, 2, 3 and 4. Numerically, pigs fed (0.50% inclusion level of MLLM). The values obtained for the FCR (2.89-3.00) in this study is better than the values (3.59-3.92) reported by (13) who concluded that dietary curcumin had no influence on performance, FCR or immune status and serum immunoglobin of post weaned pigs. The result of the weight gain compared with the result of (14) who fed weaner with cassava leaves as supplement. The result of the present study agrees with the report of (13), who concluded that dietary curcumin had no influence on performance, FCR or immune status and serum immunoglobin of post weaned pigs.

CONCLUSION AND APPLICATION

From the result of the study, it can be concluded that the use of *Morinda lucida* leaf meal have no significant influence on the performance and serum biochemistry of weaner pigs. Although it can be seen in treatment two that animals fed (0.5%) diets containing inclusion level of *Morinda lucida* leaf meal recorded the highest value for final weight, weight gain and average daily weight gain. Based on the result of this experiment it can therefore be recommended that farmers can include 0.5% inclusion of *Morinda lucida* leaf meal in the diet of weaner pigs.

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Evaluation of The Growth Performance, Carcass Characteristics and Cost of Broiler Chickens Fed Commercial and on-Farm Formulated Diets

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Abstract: The study compared the growth performance, carcass yield and cost benefits of broilers fed two commercial feeds against two on-farm feeds for a period of eight weeks. 180, day-old broiler chicks were assigned to the four experimental diets with 30 birds per treatment and 10 birds per replicate in a completely randomized design. Feed and water was provided *ad libitum* and the birds were managed under the deep litter system. Data were collected on the growth rate, carcass and economics of production; these were subjected to the one-way ANOVA. Results showed that final body weight, weekly feed intake and weekly weight gain were higher ($P<0.05$) in birds fed C1 diet compared to those on other dietary treatments. However, value for FCR did not differ ($P>0.05$) between treatments. Birds on the on-farm formulated diets recorded better feed cost per kg gain ($P<0.05$) and cost of feed consumed per bird ($P<0.01$). Results for carcass characteristics indicated significant ($P< 0.05$) effects of treatment on the dressed weight, wings, shank and head weight. Relative organ weights of the full gizzard, empty gizzard, spleen, lungs, oesophagus and trachea were also significantly ($P< 0.05$) different between treatments. From these results, it can be concluded that though commercial feeds resulted in higher live weight, on-farm feeds especially sorghum-based was cheaper and resulted in better cost/kg gain and cost of feed consumed per bird. It is therefore recommended that; poultry farmers should consult animal nutritionist for feed formulation to enable them produce least cost feed for profit maximization.

Keywords: Performance, Commercial diets and Compounded diets

INTRODUCTION

Sustainable poultry production is seen as one of the fastest means of ameliorating the incessant animal protein intake shortage in many developing countries (Oyewole *et al*., 2015; Oko *et al*., 2017). Therefore, there is increasing number of people venturing into poultry business and the consequent high demand for commercial feeds could result in feed manufacturers producing substandard feeds more so with less supervision from quality control agencies in Nigeria.

In Nigeria, feed alone accounts for 70 - 80% of total variable cost of intensive broiler production (Afolayan *et al*., 2014; Oyewole *et al*., 2015), depending on the region and season of production (Amir *et al*., 2001) leading to high cost of production (Afolayan *et al*., 2014). These had resulted to the collapse of many commercial poultry farms while some others experienced slow growth as a result of fluctuation or sudden rise in the cost of poultry feeds (Onimisi, 2004). Reports by Sanusi *et al*. (2015) indicated that some commercial feeds were of low quality and have resulted to poor broiler performances. Many farmers change from one commercial feed to another in search of a better feed (Ogundipe *et al*., 1986) while some have resulted to producing their feeds. Many farmers also believe that self-made feeds are cheaper than the commercial feeds (Oyewole *et al*., 2015)**.** To increase profitability in the poultry industry, there is the need to formulate practical rations that will help in reducing the cost of production and still maintain high broiler performance (Oko *et al*., 2017).

The poultry nutritionist is therefore challenged to formulate diets at least cost for profit maximization. Therefore, this study compared the growth performance, carcass yield as well as cost benefits of broilers when fed on-farm versus commercial feeds.

MATERIALS AND METHODS

This experiment was conducted at the poultry unit of the Teaching and Research farm, University of Calabar, Calabar, Nigeria. Calabar is located in South south region of Nigeria at Latitude $4^{0}57^{1}$N and Longitude $8^{0}19^{1}$E with annual rainfall ranged from 1260mm to 1280mm, average temperature of 27.5^{0}C with a relative humidity of 55 - 99% and an elevation above sea level of 99 meters (NMA, 2016).

To compare the growth performance and profitability of broilers, two popular commercial diets (C1 – Vital Feeds and C2 - Top Feed) marketed in Cross River were compared to two on-farm formulated (F1-Maize based and F2 - Sorghum-based) diets (Table 1). Therefore, a total of four experimental diets were studied.

TABLE 1: Gross composition of on-farm formulated diets (%)

	Maize diet		**Sorghum diet**	
Ingredients	**Starter**	**Finisher**	**Starter**	**Finisher**
Maize	41.50	47.50	0.00	0.00
Sorghum	0.00	0.00	41.50	47.50
Soybean meal	32.75	22.25	32.75	22.25
Palm kernel cake	4.00	4.45	4.00	4.45
Wheat offal	5.00	7.00	5.00	7.00
Crayfish dust	2.00	2.00	2.00	2.00
Brewers' Dried Grain	10.00	12.00	10.00	12.00
Bone meal	3.50	3.00	3.50	3.00
Methionine	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Palm oil	0.50	0.50	0.50	0.50
Salt	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated nutrient				
% Crude protein	23.07	19.93	23.90	20.88
% Crude fibre	5.25	5.21	3.18	2.84
ME (Kcal/kg)	2959.25	2914.15	2917.75	2866.65

A total of 180, day-old broiler chicks were assigned to the four dietary treatments in a completely randomized design throughout the eight weeks of experiment. Each treatment had 30 birds which were further subdivided into three replicates of 10 birds each. Each replicate was housed in individual pen under the deep litter system in line with the approved animal care guidelines of the Ethical Committee of the Department of Animal Science, University of Calabar. Feed and water were provided *ad libitum* throughout the experiment.

Data were collected on the growth performance; carcass characteristics and cost benefit ratio of birds fed the different diets.

At the end of the feeding trial (day 56), two birds were randomly selected per replicate (that is a total of 24 birds), starved overnight and weighed individually before slaughter. The dressed weights were determined. The dressing percentages were calculated; prime cut parts (back, breast, drum stick, thigh, wing, neck, shank and head) and organ weights (crop, proventriculus, gizzard, gall bladder, heart, liver, spleen, lung and pancreas and kidney) were individually measured and expressed as percentages of the live weights.

Data collected were subjected to the one-way analysis of variance in a completely randomized design according to the methods of Steel and Torrie (1980). Significant means were separated using Duncan's multiple range test of GENSTAT Release 8.1 (GENSTAT, 2011) software package.

RESULTS AND DISCUSSION

The performance of broilers fed the experimental diets is presented in Table 2. Live weight was significantly ($P<0.05$) influenced by dietary treatments. Birds fed C1 had significantly ($P<0.05$) higher value but statistically similar ($P>0.05$) with the value obtained for C2 which was not different ($P>0.05$) from on-farm formulated diets. Birds fed on-farm feed recorded higher live weights (2441.73 and 2454.57 g) than the value of 2155 g reported by Dafwang (2006) but comparable to the report of Doma *et al*. (2001) for broilers fed different commercial diets. The present findings are consistent with the reports of Sanusi *et al*. (2015) and Oyewole *et al*. (2015a) that birds on commercial diet had better performance than those on on-farm diet but contrary to the report of Doma *et al*. (2001) that significantly ($P < 0.01$) higher final live weight was observed in broilers fed self-formulated

diet compared to those on commercial diets. Birds on commercial diets consumed significantly (P<0.05) higher feed than those produced on the farm.

The higher feed intake observed for commercial diets, may be that, they were more palatable and acceptable to the birds or the birds consumed more to be able to satisfy their nutrient requirement. Feed conversion ratio was not significantly (P>0.05) different between dietary treatments. The appreciable performance of birds fed on-farm feed may be because the feed was fresher than the commercial feeds. Therefore, it is expected to possess more potent nutrients particularly vitamins and amino acids, as against commercial feeds whose nutrient potency may have deteriorated due to long period of storage before reaching the end users. The better performance (live weight and weight gain) observed for birds fed commercial diets may be attributed to inclusion of other performance enhancers for which information was not provided by the manufacturers. Abeke *et al*. (2008) earlier reported that the current trend in feed manufacturing involves the use of bio-acids, enzymes, coccidiostats, toxin binders and anti-oxidants among others to enhance better nutrient utilization and therefore promote better performance of birds. Birds fed sorghum-base on-farm feed had numerically better feed cost per kg. Feed cost/kg gain was also better (P<0.05) for sorghum base on-farm feeds. F2 also resulted in lower but better (P<0.05) cost of feed consumed per bird. The lower cost per kg gain (P<0.05) observed with on-farm formulated diets is in line with the report of Adebayo *et al*. (2002) and Oyewole *et al*. (2015) who had lower feed cost per kg gain when compared with commercial diets.

The carcass and organ characteristics of the experimental birds are shown in Tables 3 and 4, respectively. There were significant (P<0.05) effects of treatment on the live weight, dressed weight and the relative weights of wings, shank, head gizzard, spleen, lungs, oesophagus and trachea whereas, dressing percent, back, breast, drum stick, thigh and neck were not significantly (P>0.05) different. This may suggest that the on-farm and commercial feeds promoted similar carcass characteristics. Thus, identical carcass and muscle developments are attainable by feeding all the diets.

CONCLUSION

From these results, it was concluded that though commercial feeds resulted in higher live weight, on-farm feeds especially sorghum-based (F2) was cheaper and resulted in better cost/kg gain and cost of feed consumed per bird. It is therefore recommended that for sustainable production, poultry farmers should consult animal nutritionist for feed formulation to enable them produce least cost feed for profit maximization.

Table 2: Growth performance of broilers fed on-farm and commercial diets

	Treatments						
Parameters	**C1**	**C2**	**F1**	**F2**	**SEM**	**P-value**	**Sig. level**
Initial weight (g)	48.83	48.83	48.83	48.83	1.17	1.00	NS
Final weight (g)	2617.07^{a}	2561.83^{ab}	2441.73^{b}	2454.57^{b}	40.46	0.04	*
Av. weekly wt gain (g)	327.13^{a}	320.23^{ab}	305.22^{b}	306.82^{b}	5.06	0.04	*
Av. weekly feed intake	662.08^{a}	657.00^{a}	610.00^{b}	609.17^{b}	9.47	0.01	*
FCR	2.02	2.05	2.00	1.99	0.04	0.61	NS
Cost/kg feed (N)	148.00	152.00	149.57	140.67	0.00	-	NS
Cost/kg gain (N)	299.58^{a}	312.35^{a}	298.85^{a}	279.31^{b}	5.84	0.03	*
Cost of feed consumed/bird (N)	783.91^{a}	798.91^{a}	729.90^{b}	685.53^{c}	11.28	<0.001	**

SEM= standard error of mean *=significant at P<0.05 **=significant at P<0.01 NS= not significant

Table 3: Carcass cuts of broiler chickens fed on-farm formulated and commercial diets

	Treatments						
Parameters	**C1**	**C2**	**F1**	**F2**	**SEM**	**P-value**	**Sig. level**
Live weight (g)	2333.33^{a}	2140.00^{b}	2150.00^{b}	2200.00^{b}	44.97	0.01	*
Dressed weight (g)	1816.67^{a}	1593.33^{b}	1650.00^{b}	1650.00^{b}	37.35	0.01	*

Dressing %	77.82	74.48	76.74	74.99	0.98	0.14	NS
Prime cuts (relative weight) %							
Back	14.15	14.27	14.28	14.07	0.19	0.85	NS
Breast	18.71	19.86	19.48	19.36	0.42	0.34	NS
Drumstick	11.43	10.64	10.56	10.26	0.59	0.57	NS
Thigh	13.52	12.17	12.57	11.99	0.47	0.18	NS
Wings	8.68[a]	7.65[b]	8.30[ab]	8.47[a]	0.24	0.05	NS
Neck	4.48	4.18	4.75	4.51	0.17	0.22	NS
Shank	4.58[a]	3.70[c]	4.49[ab]	4.00[b]	0.09	<0.001	**
Head	2.27[a]	2.00[b]	2.31[b]	2.32[b]	0.07	0.04	*

SEM= standard error of mean *=significant at P<0.05 **=significant at P<0.01 NS= not significant

Table 4: Relative organ weight of broilers fed on-farm formulated and commercial diets

Parameters (%)	**Treatments**				**SEM**	**P-value**	**Sig. level**
	C1	**C2**	**F1**	**F2**			
Heart	0.46	0.46	0.47	0.45	0.04	1.00	NS
Liver	1.79	1.84	1.89	1.91	0.06	0.52	NS
Full gizzard	2.55[a]	2.40[a]	1.91[b]	1.88[b]	0.10	0.002	**
Empty gizzard	2.25[a]	2.01[a]	1.65[b]	1.54[b]	0.09	0.002	**
Spleen	0.09[a]	0.07[b]	0.06[b]	0.08[a]	0.003	0.01	*
Lungs	0.57[a]	0.47[b]	0.48[b]	0.56[a]	0.02	0.02	*
Proventriculus	0.45	0.42	0.50	0.53	0.03	0.24	NS
Pancreas	0.38	0.37	0.35	0.43	0.02	0.16	NS
Abdominal fat	1.00	0.98	0.84	1.13	0.08	0.17	NS
Oesophagus	0.14[a]	0.10[b]	0.13[a]	0.10[b]	0.01	0.001	**
Crop	0.27	0.32	0.27	0.31	0.02	0.26	NS
Gall bladder	0.14	0.15	0.13	0.14	0.01	0.86	NS
Trachea	0.11[ab]	0.10[ab]	0.12[a]	0.09[b]	0.01	0.04	*

SEM= standard error of mean *=significant at P<0.05 **=significant at P<0.01 NS= not significant

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Effect of Graded Levels of Soymilk Residue on Growth and Meat Yield of Rabbits

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Abstract: A feeding trial was conducted to investigate the effect of graded levels of soymilk residue on growth and meat yield of rabbits. A total of 30 cross-bred 5-6-week old weaner rabbits were used. The rabbits were randomly assigned to five treatments with six rabbits per treatment in a Completely Randomized Design (CRD). Soymilk residue was included at 0, 5, 10, 15 and 20% designated as diet T_0, T_5, T_{10}, T_{15} and T_{20}, respectively. Feed and water were provided *ad-libitum* and other routine management practices were observed. The feeding trial lasted for 12 weeks. Results showed that weight gain and meat yield were not affectedby the treatment, despite the reduction in feed intake, rabbits on diet 15 and 20% had better feed conversion ratio than the control. It was concluded that the inclusion of soymilk residue up to 20% do not cause adverse effect on the growth of grower-finisher rabbits but rather increased profitability.

Keywords: Soymilk residue, Rabbits, Growth performance

DESCRIPTION OF PROBLEM

The challenge of sub optimal animal protein intake is a serious problem in most developing countries of the world including Nigeria. This is partly due to rapid population growth in these regions of the world, results in serious pressure on world food resources and supplies [1]. With the recommend minimum of 70g protein intake per caput with at least 35g is expected to come from animal source [2], Nigerian consumes less than 6g of protein with 3.2g coming from animal source. Rabbit production has potential of alleviating the problem of animal protein supply in developing countries [3]. Rabbits are highly prolific animals that are efficient converters of feed to flesh, have short generation interval, low cost of investment and small body size which make it suitable for backyard rearing [4].

Feed is one of the major challenges in rabbit production in Nigeria due to competition between human and animal for the conventional feed ingredients which has resulted to high cost of conventional feed ingredientsand in turn made feed cost to account for 70 –80% of cost production [5]. Soymilk residue is a non-conventional feed resource, which is a by-product of soymilk processing not consumed by man and presently regarded as waste and therefore very cheap and readily available. The objective of this study is to investigate the feed value of soymilk residue for growing rabbit.

MATERIALS AND METHODS

The study was conducted at the Rabbit Unit of the Livestock Teaching and Research Farm, Federal University of Agriculture Makurdi, Benue state, Nigeria. Thirty, 5 - 6 week old, crossbred rabbits were used for the experiment. The animals were weighedand housed individually in cages using a completely Randomized Design. Five experimental treatments designated T_0, T_5, T_{10}, T_{15} and T_{20} and were fed diet containing 0%, 5%, 10%, 15% and 20% SMR, respectively. All diets were formulated to contain 18% crude protein and 2700kcal/kg metabolizable energy.

Table 1: Composition of experimental diets containing soymilk residue

Ingredients	T_0	T_5	T_{10}	T_{15}	T_{20}
Maize	32.57	31.05	26.85	21.51	14.35
Full fat soybeans	37.05	26.70	25.94	26.67	23.30
Rice offal	25.86	20.28	18.82	17.20	10.87
Brewer dried grain	0.00	10.00	10.00	10.00	20.00
Soybean milk Residue	0.00	5.00	10.00	15.00	20.00
Palm oil	0.00	2.35	3.67	4.90	6.92
Bone meal	3.66	3.75	3.80	3.80	3.65
Salt	0.25	0.25	0.25	0.25	0.25
Synthetic Methionine	0.36	0.38	0.39	0.40	0.39
Synthetic Lysine	0.00	0.00	0.02	0.02	0.03
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**

RESULTS AND DISCUSSION

The result (Table 2) showed that there was no significant difference in feed intake and weight gain. This is similar to the work reported by [6] who fed soymilk residue, cowpea testa and cornstarch residue to rabbits and [7] who fed graded levels of soymilk residue to rabbitbut different from [8] when soymilk residue replaced groundnut cake in rabbit diets. Feed conversion ratio tended to improve with increment in the content of soymilk residue in the feed. The conversion for rabbit fed 5 and 10% soymilk residue was not different from control, but rabbit fed 15 and 20% converted feed better than control. The trend in dressing percentage was the same as for feed conversion ratio.

The result of feed conversion ratio disagreed with the report of [6] but is comparable to the report of [9] and [10], when soybean residue was fed to broiler. This difference may be attributed to difference in processing of soymilk residue and soybean varieties used. The reduction in the cost of feed increased profitability.

Table 2: The Effect of Feeding Soymilk residue on Growth Performance of Grower Rabbits

	T_0	T_5	T_{10}	T_{15}	T_{20}	SEM	P
Feed intake (g/rabbit)	48.26	48.16	48.77	47.72	44.68	2.33	0.43^{ns}
Weight gain (g/rabbit)	15.00	14.96	16.97	15.85	16.27	1.03	0.29^{ns}
FCR	3.49^{a}	3.49^{a}	3.26^{ab}	3.32^{b}	3.09^{b}	0.12	0.01*
Dressing (%)	52.61^{b}	55.30^{ab}	57.30^{ab}	59.36^{a}	59.53^{a}	1.91	0.03*
Feed cost/(₦/kg) gain	277.80	261.05	245.48	253.65	231.13		
Total cost (₦/rabbit)	1226.2	1200.0	1211.00	1205.00	1179.33		
Revenue	1800	1850	1900	1950	2000		
Gross margin	573.80	650.00	689.00	745.00	820.67		

CONCLUSION AND APPLICATION

It may be concluded from the result that the inclusion of soybean milk residue up to 20% in the diet of grower-finisher rabbits does not cause adverse effect on the growth performance.

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Proximate and Phytochemical Analysis of Moringa oleifera Leaf Meal

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Abstract: This study was aimed at determining the nutritional properties of *Moringa oleifera* leaf meal (MOLM) as a cheaper alternative source of nutrients to be incorporated into animals feed. Proximate analysis of MOLM in (mg/100g) revealed; Moisture- 4.45%, Crude Protein- 28.34%, Crude Fibre-10.60%, Crude Fat-6.10%, Ash-8.80%, Nitrogen Free Extract-41.71, MetabolizableEnergy-335.10, Calcium-1.62%, Phosphorus- 0.08%. The phytochemical analysis showed that MOLM contained; glycoside, Saponin, Steroid, Flavonoid, Triterpernoids, Resin, Carbohydrate, and Reducing sugar while Alkaloid and Tannin were absent. It can therefore be concluded that *Moringa oleifera* leaf meal at its dry level will be a valuable feed ingredient for raising animals in the tropics.

Keywords: Feedstuff, Utilization, Medicinal, Nutrients, and Food

INTRODUCTION

Moringa oleifera otherwise regarded as a miracle tree" is reported to have many medicinal properties (1) and (2). *Moringa oleifera* has appreciable crude protein levels (3) and could substitute conventional feed stuffs as it possesses useful characteristics (4). *Moringa oleifera* is the most widely cultivated species of a monogenetic family the *Moringacea*, which is native to the sub- Himalayan tracts of India, Pakistan, Bangladesh and Afghanistan. This rapidly growing tree (also known as the horseradish tree, drumstick tree, benzoline tree or Ben oil tree) was utilized by the ancient Romans, Greeks and Egyptians, it is now widely cultivated and has become naturalized in many locations in the tropics. *Moringa oleifera* is already an important crop in India, Ethiopia, the Philippines and the Sudan, and is being grown in west, East and South Africa, tropical Asia, Latin America, Florida and Pacific Islands. All parts of the *Moringa oleifera* tree are edible and they have long been consumed by humans (5). *Moringa oleifera* tree have been used to combat malnutrition, especially among infant and nursing mothers. (6) reported that *Moringa oleifera* leaves contain more vitamin A than carrot, more calcium than milk, more iron than spinach, more vitamin C than oranges more potassium than banana, and that the protein quality of *Moringa oleifera* leaves rivals that of milk and egg. (7) also reported that *Moringa oleifera* leaf meal is very rich in carotene, ascorbic acid, iron and in two amino acids generally deficient in other feeds i.e. methionine and cystine. In Nigeria this plant is widely grown especially in the northern and middle belt parts of the country. Its use in these areas ranges from making soup, as snack or local salad enjoyed by various classes and group of people. This work was therefore aimed at determining the nutritive value and the phytochemical composition of *Moringa oleifera* leaves.

MATERIALS AND METHODS

Source and processing of *Moringa oleifera* leaf meal: The *Moringa oleifera* leaf meal used for this study was collected from Vom and environments in Jos South Local Government area, Plateau State, Nigeria. The harvested leaves were air dried under the shade until they were dried and crispy, while retaining their greenish colouration. The dried leaves were then milled using a hammer mill to produce *Moringa oleifera* leaf meal (MOLM).

Laboratory Analysis: The proximate analysis of *Moringa oleifera* leaf meal was carried out according to the method of (8). The phytochemical analysis was carried out according to the methods of (9) and (10), all at the Biochemistry Division of National Veterinary Research Institute, Vom, Plateau State.

RESULTS AND DISCUSSION

Moringa oleifera leaf can be used in feeding animals; this is because it has complete nutrients needed by the animals. MOLM has crude protein of 28.34% which is good enough to provide animals with the protein content that is needed to make them grow normally. It has an appreciable level of protein that can to keep animals healthy as indicated by (3). This quantity of protein falls within the range (20-35% on dry basis) as indicated in the findings of (11). The differences may be due to location, climate and time of harvesting of the *Moringa oleifera* leaf. The fibre found in MOLM is not too much to cause problems to animals especially monogastrics; this is because for non-ruminant's high fibrous feeds can depress feed digestion. (12) and (13) reported that high fibre content was found to interfere with nutrient availability for growth and maintenance. Both (14) ;(15) observed that high fibre in the diet could be the cause of decrease in the availability of nutrients which is as a result of reduction in the period of exposure of the feed to digestive enzymes which in turn impairs absorption of nutrients. The quantity of fat available can go a long way in complementing the amount of energy needed in the feed by animals. The amounts of energy couple with other nutrients present in the Moringa plant are available to sustain animals and give them adequate growth rate. Animals need energy to grow and perform their productive roles which can be found in *Moringa oleifera* leaf. (16) stated that minerals facilitate digestion, absorption, metabolism, oxidation of feed, elimination of waste product, bone formation, hydrogen regulation, regulation of blood, somatic pressure etc.

Table 1: Proximate Analysis of *Moringa oleifera* Leaf Meal (mg/100g)

Parameter	Values
Moisture (%)	4.45
Crude protein (%)	28.34
Crude fibre (%)	10.60
Crude fat (%)	6.10
Ash (%)	8.80
NFE (%)	41.71
ME (Kcal/kg (%)	2535.10
Calcium (%)	1.62
Phosphorus (%)	0.08

In the phytochemical analysis of *Moringa oleifera* leaf meal it was shown to contain glycosides, saponins, steroids, flavonoids, triterpenoids, resins, carbohydrate and reducing sugar while alkaloids and tannins are absent. This could be due to location, climate and time of harvesting of the *Moringa oleifera* leaf meal. Tannin has been reported to interfere with the biological utilization of protein, to a lesser extent available carbohydrate and lipids (17). This also means that there may not be any interference with protein utilization, carbohydrate and lipids would be available in the feed for the animals to use. Saponins are known to possess both beneficial cholesterols lowering properties and deleterious to intestinal cell toxicity and permeability (18). Saponins are also known to cause some harmful effects to non-ruminants such as retardation of growth rate, which is due primarily to reduction in feed intake (19).

Table 2: Phytochemical Analysis of *Moringa oleifera* Leave Meal

Parameter	Result
Alkaloids	-ve
Tannins	-ve
Glycosides	+ve
Saponins	+ve
Steroids	+ve
Flavonoids	+ve

Triterpenoids	+ve
Resins	+ve
Carbohydrate	+ve
Reducing sugar	+ve

CONCLUSION

It can be concluded that *Moringa oleifera* leaf meal is a plant to be reckoned with. This is because it contains most of the nutrients that are needed in feed ingredients by feed millers to compound feed and the livestock rearers to feed their animals which will pave way to provide the society with enough and rich proteins. It may not contain high amounts of antinutritional factors that may be harmful to animals or humans as no report has indicated such.

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NOGASTRIC PRODUCTION/ NUTRITION

Haematology and Serum Biochemistry of Broilers fed Diet containing Jackfruit Juice Extract as Mineral/vitamins supplement

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Abstract: This study was designed to evaluate blood characteristics of broiler chickens fed diets containing jackfruit juice extract as vitamins/minerals supplement. Jackfruits were harvested, juice extracted and fortified with formic acid. Five (5) levels of the jackfruit juice vitamins/minerals supplements (200, 400g, 600g, 800g and 1000g of the jackfruit juice extract/1kg of ash) were mixed, using the formic acid fortified fruit juice extract. The samples were labeled, air dried, packed in polyethylene bags and stored in a refrigerator at 2^0C. Broiler starter and finisher feeds were formulated and replicated into seven (7) portions. Conventional vitamin/mineral premix was added to the first portion of the feed, while second to the seventh portion were supplemented with each of the jackfruit juice extract /wood ash preparation. One hundred and forty-seven (147) day-old chicks were weighed and assigned to each group of the seven diets on weight equalization basis, in a completely randomized design and fed for 56 days. Blood samples were collected per replicate for haematological and serum biochemical analysis. Result of blood characteristics showed that dietary treatments had no significant (P>0.05) effects on haematological profile of broilers. The serum biochemical indices showed significant (P< 0.05) differences between dietary treatments in chloride and urea. It was concluded that jackfruit Juice extract has high potential as vitamins/minerals supplement in broiler chickens' diet. 0.5% of 200 mg jackfruit juice extract/1kg wood ash preparation was therefore recommended for inclusion in the diets of broiler chickens, where the conventional vitamin/mineral premix is scarce or expensive.

Keywords: jackfruits, serum, carcass characteristics, Vitamins and wood ash.

DESCRIPTION OF PROBLEM

An adequate supply of vitamins and minerals is key factor for good poultry nutrition, it also strengthens the bird's defenses against harmful pathogens. Nutrition becomes increasingly important after periods of disease or stress when the immune system is weakened and energy levels are at their lowest (5).

Vitamins are required for optimal poultry health and can be classified as either fat soluble vitamins (Vitamin A, D, E and K) or water-soluble vitamins (Vitamins B- complex and C). Utilization of nutrients in adequate amounts can both improve animal's health and the producer's bottom line (10). Vitamin D plays a vital role in optimal function of a hen's skeletal system, strengthening the bones, claws and beak. It also has a positive impact on the quality of the eggshells produced by layers. Indeed, the vitamin D requirements of hens are increased by inadequate levels of calcium and phosphorous.

In poultry, dietary deficiency of vitamin A results in poor feathering and stunt growth. Vitamin A has been reported to have a relatively short shelf life, and as a result, dry feeds stored for extended periods of time may not contain adequate amounts of the vitamins (5). Vitamin E is vital for growth and good egg production. It also contributes to a healthy immune system by increasing the activity of "microbe-eating" phagocytes. Birds with deficiency in Vitamin E are susceptible to harmful bacteria and diseases including avian encephalomalacia. Vitamins and mineral are usually supplied by feedstuffs, but the quantities are usually below the requirement of animals. The deficiency is breached by supplementing diets with the synthetic vitamins and minerals, which is difficult to obtain due to high cost of importation. The situation has negative impact on poultry industry and the entire livestock sector at large owing to the importance vitamins and minerals play in the performance of animals. There is need therefore to utilize the abundant vitamins and minerals, found in jackfruit juice in preparing vitamins and mineral supplements. The objective of the study was to evaluate the haematological, blood

biochemical indices and carcass characteristics of broiler chicken fed diet containing jackfruit juice extracts supplements.

MATERIALS AND METHODS

Location of study: The experiment was carried out at the Poultry unit of the Teaching and Research Farm, Department of Animal Science, University of Calabar, Calabar, Cross River State, Nigeria.

Collection and preparation of test materials: Bunches of jack fruit were harvested from home garden at Unical Satellite Town, Calabar. Jackfruits were open using a sharp knife and pulp separated from the seeds. The juice was extracted from the pulp using fruit juice extractor, concentrated formic acid added to it at the rate of 10mls per litre and stored in a bottle. Wood ash (without charcoal) was obtained from the open kitchen, after cooking.

Preparation of the jack fruit vitamins/minerals supplements: Five (5) levels of the jackfruit juice vitamins/minerals supplements were constituted, using the formic acid fortified fruit juice extract. In the first level, 200g of the jackfruit juice extract was weighed out using an analogue weighing balance and absorbed in 1kg of wood ash. In the second level, 400g of the jackfruit juice extract was absorbed in 1kg of wood ash while the third, fourth and fifth levels were prepared by absorbing each of 600g, 800g and 1000g of the jackfruit juice extract in 1kg of wood ash. The samples were properly labeled, air dried in a dark corner of the laboratory, packed in polyethylene bags and stored in a refrigerator at 2^0C.

Experimental diets: Broiler starter and finisher feeds were formulated to supply both crude protein and metabolizable energy and replicated in seven (7) portions. Conventional vitamin/mineral premix was added as supplement to the first portion of the feed while second to the seventh portion of feeds were supplemented with each of the jackfruit juice extract /wood ash preparation described earlier.

Management of experimental animals and experimental designs: One hundred and forty-seven (147) day-old chicks were weighed and distributed on weight equalization basis into seven groups of twenty-one (21) birds, which were further divided into three replicates

Blood collection and evaluation of blood parameters: At the end of the feeding trial, two birds per replicate (6 per treatment) were randomly selected, for blood collection. About 2ml of blood was collected per treatment. Blood samples were collected with Ethylene diamine tetra acetic acid (EDTA) coated bottles for haematological analysis while bottles without EDTA (none anti-coagulant) were used to collect blood samples for serum biochemistry tests. Haematological procedures were carried out according to (14) in determining the total red blood cell count and PCV. Total serum protein was determined using burette method as described by (14). Albumin (Ab) with BCG to form a green compound. The concentration of albumin is directly proportional to the intensity of the green colour formed. The globulin concentration was obtained by subtracting albumin value of total protein. ALT and AST were determined manually by spectrophometric method as described by (4) and (16).

Statistical analysis: The data obtained in this study were subjected to one-way analysis of variance for CRD (17). Significant mean was separated using the Duncan multiple range test (9).

RESULTS AND DISCUSSION

Haematological characteristics of broiler chickens: Table 2 shows the effect of feeding diets containing jackfruit juice extract on the haematological indices of broiler chickens. The concentrations of Hb, PCV, RBC, WBC, platelet, lymphocyte, MCV, MCH and MCHC were not significantly ($P>0.05$) influenced by dietary treatments. This indicates that the health status of the birds was not adversely compromised. The Hb range of 6.10-7.50 obtained in this study were within the normal range for chickens (7-13g/l) in the report of (3) and the range of (6.3-7.8g/l) reported by (12), but lower than the range (8.7 – 9.3 g/l) reported by (11) for indigenous chickens. Lower levels of haemoglobin and PCV, according to (11) causes' acute inflammation from most pathogenic micro-organisms which results in haemolysis. PCV values obtain in this study were within the range of (18.50-22.75%). they were lower than the values reported by (6) for caged birds which have a value of (35-55%) and a PCV of less than 35% indicates anaemia, while value greater than 55% suggests dehydration.

However, (15) gave a range of 25 to 45% as been normal which is different from the values obtain from this study. This signifies that there were symptoms of physiological anaemia in the experimental birds. MCHC, MCH

and MCV values were not significantly different; these suggest that there were no difference in the mean corpuscular sizes, this may be due to similar haemoglobin content. The MCV obtained in this study were lower than the range of (92.44-122.09) reported by (1). MCV measures the average volume of individual red blood cells (7). The values obtained for MCV and MCHC in this study indicated that there was a negative interaction between energy and protein levels in the diets. The lymphocyte showed no significant (P>0.05) differences. The reduction in values of WBC and lymphocytes would predispose the animals to reduced immunological responses to infections. The value of platelets counts in this study showed that clot retraction is not deficient. This is an indication that they may be able to cope with blood coagulation.

Serum biochemical profile of broiler chickens fed diet containing jackfruit juice extract: The serum biochemical indices of broiler chicken fed diet supplemented with Jackfruit Juice is presented in Table 3. The results showed that glucose, cholesterol, total protein, albumin, globulin, calcium and TBL were not significantly (P>0.05) influenced by dietary treatments. However, the concentrations of chloride and urea were significantly (P<0.05) influenced by dietary treatments. Urea recorded the highest value of (4.82) among birds fed diet 2 while birds fed diet 5 had the least value (3.88). Glucose levels recorded in this work were within the range of (6.65-7.76), they were lower than the reported range of (9.9-11.1mol/l) and 8.17-9.77mol/l) as reported by (3) and (1) respectively. Cholesterol values reported were higher than the reported range of 3.10 - 3.64 mg/dl reported by (8). High levels of blood cholesterol may result in fat deposition on the walls of the blood vessels and these deposits may eventually harden to form the atheroschlerotic plague, these may block important blood vessels and result in a myocardial infarction (8). The values obtained in this study for protein was within the normal range of serum protein (5.00 - 7.00g/dl) as reported by (2) and (4.55 - 6.46g/dl) by (18). Higher values suggest that there was enzyme hydrolysis of dietary proteins and this explains why the blood pool serves as a major source of amino acids needed for the synthesis of protein (13). This observation showed that the protein level in the diet was sufficient to sustain the normal protein levels in the blood. The albumins concentration (3.24 – 3.50) from this study were comparable to the range of 2.32 - 4.07g/dl reported by (8), but was at variance with the range (2.4 - 5.35g/dl) reported by (8). The lower values obtained for globulin could be attributed to non-proper utilization of feed (protein in diets). Calcium showed no significant (P>0.05) difference. The values obtained in this study were however far lower than the range of 9.55 - 10.55mmol/l reported by (8) but higher than the range of 1.87 - 2.53mmol/l reported by (1) except the positive control diet with the value of 2.50mmol/l and diet 6 with 2.27 mmol/l. According to (8), calcium is the major factor in the formation and maintenance of the bones.

CONCLUSION AND APPLICATIONS

The results showed that jackfruit juice extract have a high potential as feed supplement in broiler chicken diet. From this study, it was recommended that 200 mg jackfruit juice extract/1kg wood ash preparation should be added at 0.5% in the diets of broiler chickens, where the conventional vitamin/mineral premix is scarce or expensive.

Table 2: Haematological profile of broiler chickens fed diets containing jackfruit juice extract.

Treatment Parameters	+ve (1)	-ve (2)	3	4	5	6	7	±SEM
Hb(g/100ml)	7.50	6.50	6.10	6.10	6.80	6.65	6.30	0.51
Pcv (%)	22.75	19.75	18.50	19.25	20.50	20.00	19.00	1.51
Rbc(10^6ul)	3.62	3.15	2.93	3.05	3.25	3.17	3.00	0.24
Wbc(10^3ul)	3.68	3.12	2.75	2.92	3.15	3.16	3.15	0.32
Plt (10^3/1)	189.00	160.00	202.00	200.00	188.00	210.00	196.00	30.6
Lym (%)	69.00	66.50	67.00	72.00	73.00	69.00	73.00	2.01
McV(f)	62.80	62.82	63.13	33.11	63.08	63.04	63.34	0.33
McH(pg)	20.99	20.99	21.14	21.14	21.00	21.01	23.00	0.08
McHc (%)	33.43	33.41	33.25	33.25	33.30	33.24	33.16	0.15

[abc] = Mean with different superscripts on the same row differ significantly (P<0.05)

SEM = Standard error of mean, Hb = Haemoglobin, Pcv = Packed cell volume, Rbc = Red blood cell, Wbc = White blood cell, Plt = Platelets, Lym = Lymphocytes, McV = Mean cell volume, McH = Mean corpuscular haemoglobin, McHc = Mean corpuscular haemoglobin concentration.

Table 3: Serum biochemical profile of broiler chickens fed diets containing jackfruit juice extract

Treatment Parameters	(1) +ve	(2) –ve	3	4	5	6	7	SEM
Glu(mmol)	6.88	6.98	7.31	6.65	6.68	7.76	7.31	0.25
Chol(mg/dl)	4.89	6.81	5.36	5.63	5.12	6.51	5.36	0.76
Tp(g/Dl)	5.24	5.67	5.46	5.33	5.62	5.38	5.46	0.27
Alb(g/dl)	3.24	3.4	3.5	3.41	3.48	3.33	3.50	0.13
Glob(g/dl)	2.00	2.66	1.97	1.92	2.14	2.06	1.97	0.16
Cal (mmol I.)	2.5	3.05	3.28	3.33	3.35	2.27	3.25	0.40
Ast (IU/L)	16.9	31.5	37.5	34.0	36.0	19.4	27.5	10.12
Alt (IU/L)	19.00	25.00	25.00	23.00	21.00	21.00	25.00	2.83
HDL (mg/Dl)	2.47	3.01	2.53	2.92	2.49	2.97	2.53	0.31
Tbl(µmol.I)	1.10	0.99	0.93	0.84	0.94	1.12	0.93	0.10
Chloride (mmol I.)	101.75^{ab}	99.10^{b}	103.85^{a}	103.60^{a}	102.70^{a}	101.60^{ab}	103.85^{a}	1.00
Urea(mg/dl)	4.15^{ab}	4.82^{a}	4.07^{ab}	4.16^{ab}	3.88^{b}	4.60^{ab}	4.07^{ab}	0.23
LdL(mg/dL)	2.92	3.60	1.81	2.54	3.20	3.29	1.81	0.96

abc = Mean with different superscripts on the same row differ significantly

SEM = Standard error of mean

Glu=Glucose, Chol=Cholesterol, Tp=Total protein, Glob= Globulin, Cal= Calcium, Ast = Aspartate amino transferase, Alt = Alanino aminotransferase, Hdl = High density lipoprotein, Tbl =Total Bilirubin , LdL = Low density lipoprotein

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Effect of Processing Methods on Proximate Composition of Sweet Orange Peel Meal: A Potential Livestock Feed Resource

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Abstract: Four methods were used to process fresh sweet orange (Citrus sinensis) fruit peel meal samples obtained from the same batch. Sample T1 (Sun-drying alone), T2 (Fermentation for 24 hours prior to Sun-drying), T3 (Soaked in water and dried) and T4 (Soaked in boiled water for 30minutes). The samples were later sundried, milled, and analyzed for proximate composition according to the procedure of AOAC. The proximate composition of the samples was all significantly ($p<0.05$) different in the parameters measured. Dry matter of T4, 95.21% (boiled and dried SOPM) was significantly ($p<0.05$) higher than others. Ash value obtained showed sundried 5.42% significantly different ($p<0.05$) from boiled 3.46%, which was the least. Ash content of sundried SOPM was higher than others, while the least was obtained with boiled and dried SOPM. The trend of crude fat was sundried 5.84%, soaked 4.32%, boiled 4.00% and fermented 3.55%. Crude fibre values differed significantly ($p<0.05$), and ranged from 7.56 to 9.56%. Crude protein values differed significantly ($p<0.05$), and ranged from 5.87 to 8.42%. There were significant ($p<0.05$) differences in NFE content of the samples. Boiled sample had the highest NFE (73.42%), while sundried (62.61%) was the lowest. Sundried SOPM sample had higher values for ash, crude fat, crude fibre and crude protein while boiled SOPM sample had better options for dry matter, nitrogen free extract and energy. All samples had long shelf life, good mineral composition, and is good sources of energy (carbohydrate). All may be included as feed resource in animal diet.

Keywords: Processing, Proximate, Peel Meal, Feed Resource, Fermentation

INTRODUCTION

Domestic animals make important contribution to the global food security, accounting for about 30% of the global value of food production, and produce 34% of the protein and 16% of the energy consumed in human diets (FAO, 2002). In Nigeria, the high cost of animal products has made animal protein intake fall below normal requirement for good health. Joseph *et al*. (2000) said seasonal effect on the availability of energy and protein feed ingredients which are basic requirements in commercial feed preparation contributes to the high cost of animal protein. Hence the need to search for, identify and develop alternative feed resources which are cheap and readily available. This is with the view of replacing the more expensive ones (Bashar and Abubakar, 2001). Sweet orange (*Citrus sinensis*) peel, an agro-industrial by-product is abundant in Nigeria for a greater part of the dry season when the fruits are harvested. Oluremi *et al.* (2006) reported that sweet orange peel is comparable in energy and protein with maize and Agu (2006) reported that maize can be replaced by sun dried sweet orange peel meal (SOPM) in broiler starter diet at 20% for optimal performance and nutrient utilization. Several processing methods have been reported to improve the nutritive quality and utilization of some agro-allied by-products; among which are fermentation (Adejinmi *et al*., 2007; Oyewole *et al*., 2012) and ensiling (Obikaonu and Udedibie, 2007). There is need for information on the nutrients of SOPM especially when processed using different methods, with a view to utilization in the livestock diets.

OBJECTIVES OF THE STUDY

The objectives of the study were to determine the proximate composition of sweet orange fruit peel meal fermented for 24 hours, sundried alone, soaked in boiled water for 30minutes or sweet orange fruit peel meal soaked in water for 24 hours.

MATERIALS AND METHODS

This study was carried out at the Department of Animal Production, Kogi State University, Anyigba. The area lies between Latitude 7^0 15' and 7^0 29'N of the equator and Longitudes 7^0 11^1 and 7^0 32^1 East of the Greenwich Meridean (Ifatimehin *et al*., 2009). Fresh peels of sweet orange (*Citrus sinensis*) fruit were collected from retail orange sellers in Anyigba and environs. The peels were divided into four parts for four different methods of processing and designated T1 (Sun-drying alone), T2 (Fermenting for 24 hours prior to Sun-drying), T3 (Soaked in water and dried) and T4 (Soaked in boiled water for 30minutes).

Laboratory Analysis: The samples were analyzed for their proximate composition according to the procedure of (AOAC, 2000).

Statistical Analysis: All obtained data were subjected to one-way analysis of variance (ANOVA) using SPSS version 20. Least significant difference (LSD) was used to separate means that were significantly different.

RESULTS AND DISCUSSION

Results: The proximate composition of the four sweet orange peel meal (SOPM) samples is shown in Table 1. The proximate composition of the samples was all significantly ($p<0.05$) different in the parameters measured. Dry matter of T4 (boiled and dried SOPM) was 95.21%, and significantly ($p<0.05$) higher than others. Observed ash for sundried SOPM was 5.42%, and significantly different ($p<0.05$) from boiled water soaked SOPM (3.46%), which was the least. Ash value obtained from sundried SOPM was higher than others, while the least was obtained with boiled and dried SOPM. The trend of crude fat was sundried 5.84%, soaked 4.32%, boiled water soaked 4.00% and fermented 3.55%. The crude fibre values differed significantly ($p<0.05$). It ranged from 7.56 to 9.56%. The crude protein values differed significantly ($p<0.05$). The range was from 5.87 to 8.42%. Boiled water soaked SOPM had the least (5.87%). There were significant ($p<0.05$) differences in NFE content of the samples. The boiled water soaked sample had the highest NFE (73.42%). The sundried (62.61%) was the lowest. The energy values differed significantly ($p<0.05$). It ranged from 3007.05Kcal/Kg to 3147.61Kcal. The sundried (3007.05Kcal/Kg) had the least energy than those of fermented, soaked and boiled water soaked which were 3091.10Kcal/Kg, 3108.84Kcal/Kg and 3147.61Kcal/Kg respectively.

Table 1: Proximate and Energy Composition of Four SOPM Samples

Parameters	T1 (Sundried)	T2 (Fermented)	T3 (Soaked)	T4 (Boiled)	SEM	LOS
Dry matter (%)	93.34^{d}	94.44^{c}	94.78^{b}	95.21^{a}	0.26	*
Ash (%)	5.42^{a}	4.67^{b}	3.78^{c}	3.46^{d}	0.29	*
Crude Fat (%)	5.84^{a}	3.55^{d}	4.32^{b}	4.00^{c}	0.33	*
Crude Fibre (%)	9.56^{a}	7.56^{d}	8.24^{c}	8.46^{b}	0.27	*
Crude Protein (%)	8.42^{a}	7.56^{b}	6.41^{c}	5.87^{d}	0.37	*
NFE (%)	62.61^{c}	71.11^{b}	71.04^{b}	73.42^{a}	1.59	*
ME (Kcal/Kg)	3007.05^{d}	3091.10^{c}	3108.84^{b}	3147.61^{a}	22.95	*

^{abcd} Means on the same row with different superscripts are significantly different ($p<0.05$) SEM = Standard error of mean, LOS = Level of significance. NFE = Nitrogen Free Extract ME = Metabolizable Energy: 37% CP + 81 EE + 35.5NFE (Pauzenga, 1985)

Discussion: The dry matter of SOPM obtained ranged from 93.34% - 95.21%, and is higher than 89.63 % (Ipinjolu, 2000), 85.9% Agu *et al*. (2010) for unfermented SOPM and 87.6% for 24 hours fermented SOPM

(24SOPM) and89.2% for 48 hours fermented SOPM (48SOPM) by Agu *et al*. (2010). Observed values indicate that the feedstuffs are likely to store for a long time without becoming mouldy. Sundried SOPM had 8.42% CP differed from 10.73% CP reported by Agu *et al*. (2010). Agu *et al*. (2010) and Oluremi *et al.* (2008) observed lower CP of 7.44% and 7.73% for unfermented SOPM. Observed CP value of 7.56% for fermented SOPM is lower than 8.29% (24SOFPM) and 10.0% (48 SOFPM) observed by Agu *et al*. (2010). Considerable variations in the crude protein content in the four SOPM samples maybe due to processing and handling coupled with the activities of enzymes by unidentified microbes (Odekunle, 2000). It is likely that some of the protein dissolved in water used to soak SOPM, while some of the unidentified microbes utilized some of the protein in the fermented sample. Ash content ranged from 3.46% to 5.42% lower than 6.28 % (Oluremi *et al*., 2008) and 11.90% (Agu *et al*., 2010) for sweet orange fruit peel. The crude fat, 3.55% to 5.84% observed for SOPM differed from 12.60% reported by Agu *et al*. (2010) but higher than 2.24% for unfermented SOPM reported by Agu *et al*. (2010). Agu *et al*. (2010) observed 2.50% and 2.95% crude fat for 24SOPM and 48SOPM. Observed crude fat is similar to 4.0% for maize reported by Ipinjolu (2000). The observed crude fibre 7.56% to 9.56% for SOPM is similar to 7.86% (Agu *et al*., 2010) and 7.73% (Oluremi *et al.*, 2008). Ojokoh (2007) reported decrease in CF content of ripe mango peel fermented with fungi and bacteria. The observed trend may be due to the activities of some micro-organism which led to the breakdown of Non-Starch Polysaccharides (NSPs) in the SOPM, while water soaking may also have dissolved part of the fibre in addition to ash. The ability of fungi to degrade cellulose has been reported (Iyayi and Losel, 2001). The observed NFE content (%) was higher in boiled SOPM (73.42%), fermented SOPM (71.11%) and soaked SOPM (71.06%) than in sundried SOPM (62.61%) but comparably similar to what was reported by Oyewole (2011) for maize (73.46%). By implication, the SOPM could serve as alternative carbohydrate source.

CONCLUSION AND APPLICATION

The high variability in the nutrient content of SOPM encountered in this research may be attributed to within species variability, more so the different processing methods employed. The sundried SOPM sample studied had higher values for moisture content, crude ash, crude fat, crude fibre and crude protein while boiled SOPM samples had better options for dry matter, nitrogen free extract and energy. Information from the proximate analysis revealed that all have long shelf life, good mineral composition (ash level) and a good source of energy (carbohydrate). Therefore, this work provides some information on the nutritional value of SOPM using various means of processing the feedstuffs, which can be included as feed resource in animal diet.

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Growth Performance and Linear Body Measurements of Broilers Fed Diets Containing *Gongronema latifolium* Leaf Meal

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Abstract: An eight-week study was carried out to evaluate the growth performance and linear body measurements of broilers fed varying levels of *Gongronema Latifolium* leaf meal (GLLM). Eighty (80) day old birds were weighed and randomly allocated into four (4) treatment groups of twenty (20) birds per treatment. Each treatment was replicated four (4) times with five (5) birds per replicate. Treatment 1 served as the control and did not contain GLLM supplement, while treatments 2, 3 and 4 contained 0.25, 0.50 and 0.75%, respectively of GLLM supplement. Results showed that there were significant ($p < 0.05$) differences among treatments in average daily feed intake and average daily weight gain while there was no significant ($p > 0.05$) differences among treatments in feed conversion ratio. It was found that there were no significant ($p > 0.05$) differences among treatments in body length, breast girth, shank length and thigh length. Based on the results obtained in this study T2 (diet containing 0.25% GLLM) was recommended as the most favorable diet.

Keywords: supplement; thigh length; vitamins and minerals; weight gain.

DESCRIPTION OF PROBLEM

Animal protein requirement in developing countries has become critical due to a disproportionate growth in human population relative to livestock production. Poultry production has been described as the most economic means of reducing the animal protein shortfall in developing countries (1). Sub-therapeutic doses of antibiotics have been used in animal feed to promote growth and improve feed efficiency in contemporary intensive animal farming (2). The emergence of antibiotic resistance by pathogenic bacteria has led to international restriction on the use of antibiotics in animal feeds. It is therefore imperative to find safe alternative feed additive to the use of antibiotics such as *Gongronema Latifolium* leaf meal. In addition, the high cost of supplementary sources of vitamins in broiler feed motivated this research.

Vegetables and other leafy plants are known to be rich in protein, essential fatty acids and most especially in vitamins and minerals which make them to be good potential sources of these nutrients to livestock and human population (3). However, their incorporation is still at a relatively low rate in view of the huge dependent on vitamin/mineral premixes which are the well adapted sources of these micronutrients for the livestock (3). *Gongronema latifolium* (utazi), are commonly grown in Nigeria and their integration into normal poultry nutrition could promote growth and the well-being of birds as well as save scarce resources spent on commercial antimicrobial, vitamin and mineral additives. The main aim of this experiment was to determine the growth performance and linear body measurements of broilers fed varying dietary levels of *Gongronema latifolium* leaf meal.

MATERIALS AND METHOD

The experiment was carried out at the Department of Animal Science Teaching and Research Farm University of Nigeria, Nsukka. It lasted for eight (8) weeks. Eighty (80) day old broiler chicks were purchased from a reliable source. The birds were weighed and randomly allocated into four (4) treatment groups of twenty (20) birds per treatment in a completely randomized design. Each treatment was replicated four (4) times with five (5) birds per replicate. Treatment 1 served as the control and did not contain any *Gongronema latifolium* leaf meal (GLLM) supplement, while treatments 2, 3 and 4, contained 0.25, 0.50 and 0.75 %, respectively of GLLM supplement. Clean water and feed were provided *ad libitum*. The required drugs and vaccinations were administered appropriately according to the vaccination routine for broilers. The *Gongronema latifolium* was

procured from Ogige market in Nsukka town, Enugu state, Nigeria. The leaves were detached from the stems and were spread out evenly in an environment having sufficient air flow so that they could be well air dried. Afterward, the dried leaves were milled to fine powder using a milling machine. The percentage compositions of the diets are shown in Tables I.

Table I Percentage compositions of experimental diets

	Broiler starter diets				Broiler finisher diets			
SLM	0	0.25	0.50	0.75	0	0.25	0.50	0.75
Maize	14.32	14.3	14.3	14.26	28.63	28.6	28.58	28.51
Wheat offal	3.58	3.58	14.38	3.56	7.16	7.15	7.14	7.13
PKC	13.38	13.32	13.26	13.22	26.74	26.64	26.58	26.45
SBM	14.48	14.44	14.38	14.34	28.97	28.86	28.75	28.66
Fish meal	4	4	4	4	4	4	4	4
Lysine	0.125	0.125	0.125	0.125	0.25	0.25	0.25	0.25
Methionine	0.125	0.125	0.125	0.125	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.5	0.5	0.5	0.5
Salt	0.25	0.25	0.25	0.25	0.5	0.5	0.5	0.5
Oyster shell	3	3	3	3	3	3	3	3
Total	100	100	100	100	100	100	100	100
Calculated composition:								
Crude protein%	23.88	23.89	23.88	23.90	19.76	19.87	19.78	19.79
Energy (Mcal/kgME)	2.82	2.79	2.81	2.83	2.89	2.90	2.88	2.91
Crude fibre %	6.27	6.26	6.27	6.26	6.40	6.30	6.42	6.43

Body weights of the birds were taken on a weekly basis. Daily feed intake was obtained from the difference between the quantity of feed offered and that of the left over from the previous day divided by the number of birds per replicate. Feed conversion ratio was then calculated as quantity (gram) of feed consumed per unit (gram) weight gained over the same period. Body length, shank length, breast girth and thigh length were measured using measuring tape.

Data collected were subjected to analysis of variance in a completely randomized design. Significant differences between treatment means were separated using Duncan's New Multiple Range Test [(4)].

RESULTS AND DISCUSSION

The results of the effect of varying dietary levels of *Gongronema latifolium* leaf meal on growth performance of broilers is shown on table II

Table II: The effect of dietary inclusion of *Gongronema latifolium* leaf meal on growth performance and linear body measurements of broiler birds.

	Parameter	T1	T2	T3	T4	SEM
Growth	Average daily feed intake (g)	57.27^{c}	85.16^{a}	78.57^{b}	73.37^{b}	71.1
Performance	Average daily weight(g)	26.48^{c}	42.86^{a}	35.86^{b}	34.60^{b}	33.7
	Feed conversion ratio(g)	2.16	2.00	2.19	2.12	2.13
Linear Body Measurement	Body length(cm)	38.75	36.62	35.12	35.00	35.4
	Breast girth (cm)	16.75	16.38	17.63	17.75	17.13
	Shank length (cm)	15.75	17.38	17.50	17.62	17.1
	Thigh length (cm)	16.75	16.00	15.88	16.00	16.2

T1 = 0 % GLLM (control); T2 = 0.25 % GLLM; T3 = 0.50 % GLLM; T4 = 0.75 % GLLM GLLM: *Gongronema Latifolium* leaf Meal

a, b, c means on the same row with different superscript are significantly different ($p < 0.05$).

There were significant ($p < 0.05$) differences among treatments in average daily feed intake (ADFI) and average daily weight gain (ADWG) while there was no significant ($p > 0.05$) differences among treatments in feed conversion ratio (FCR). The ADFI value (85.16g) of birds on T2 was significantly higher than those (52.27g, 78.57g and 73.37g) of birds on T1, T3 and T4 respectively. The ADWG value (42.86g) of birds on T2 was significantly higher than those (26.48g, 35.86g and 34.60g) of birds on T1, T3 and T4 respectively. The decrease in the efficacy of *Gonronema latifolium* when supplemented beyond 0.25% could be attributed to high anti nutrient (alkaloids, flavonoids, saponins, steroids and tannins) content in the diet at high levels of inclusion. The positive effect of *G. Latifolium* on growth performance of the test groups suggested that the inclusion of *G. Latifolium* in the diet was beneficial. (5) and (6) had reported that *G. latifolium is* one of the cheapest and most available sources of important proteins, vitamins, minerals and essential amino acids that can boost the physiological status of birds and promote their growth. The inclusion of *G. latifolium* in the broiler diet might have resulted in better gut and overall health status, more efficient nutrient utilization, normal development and better growth response of the treated birds. According to (7), daily feed intake of birds on *G. Latifolium* was markedly better than those without *G. Latifolium*. The different responses of birds to *G. Latifolium* with respect to feed intake may be as a result of the availability of useful vitamins and minerals inherent in *G. Latifolium.*

The effect varying dietary inclusion of *Gongronema latifolium* leaf meal on linear body measurement of broiler birds is presented in Table II. There were no significant ($p > 0.05$) differences among treatments in body length, breast girth, shank length and thigh length.

CONCLUSIONS AND APPLICATIONS

Based on the results obtained in this study T2 (diet containing 0.25% GLLM) is recommended as the most favorable diet. The better performance of birds on GLLM suggests that GLLM stands the chance of possibly replacing the use of costly synthetic commercial vitamins and mineral premixes as a major source of these nutrients in poultry production.

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Performance Characteristics and Haematological Indices of Broiler Chicken fed Diets Containing Fermented Kenaf (*Hibiscus cannabinus* L.) Seed Meal

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Abstract: A 7 weeks experiment was conducted with 180 unsexed day old broilers of Cobbs strains to evaluate the performance characteristics and haematological indices of broilers fed diets containing fermented kenaf seed meal at starter phase. The birds were randomly distributed into 3 dietary treatments of 60 birds per treatment which were further distributed into 4 replicates of 15 birds per replicate in a completely randomized design (CRD). Three experimental diets were formulated such that fermented kenaf seed meal (FKSM) were made to replaced full fat soybean meal at 0%, 10% and 20% (T1, T2 and T3) respectively. Data were collected on weight gain and feed intake while blood sample were collected for haematological indices assay. The results of growth response revealed significant differences ($P<0.05$) in the values obtained for final weight, weight gain, feed conversion ratio (FCR), cost of feed consumed per bird and cost of feed consumed per weight gain, while all other parameters were not significant ($P>0.05$). Final weight ranged (687.40 – 833.20 g/bird)), weight gain (550.00 – 695.90g/bird), FCR (2.5 – 3.08), cost of feed consumed per bird (₦162.21 – 169.95) and cost of feed consumed per weight gain (₦214.02 - 295.83). The result of haematological indices revealed significant difference ($p<0.5$) in the value obtained for Packed cell volume (PCV), Haemoglobin concentration (Hb), Mean cell volume (MCV), Mean cell haemoglobin (MCH) and white blood cell (WBC). It can therefore be concluded that FKSM in the diets of started broiler will not have produce any deleterious effect on their performance haematological indices.

Keywords: Performance, haematology, kenaf, broilers, fermentation

DESCRIPTION OF PROBLEM

The problem of protein shortage especially that of animal origin, is a perennial one. But when a quick means of significantly increasing farm income and improving animal protein in the human diet is the objective, poultry becomes the animal of choice (1). The rising demand for poultry products has led to a tremendous increase in the number of poultry farmers in Nigeria. However, the progress made so far in the poultry sector in Nigeria and many other African Countries is being currently undermined by the escalating cost of feeds.

Therefore, in order to reduce feed cost, which accounts for about 60 to 70% of total cost, research efforts are being geared towards evaluating alternative feed ingredients for poultry (2). However, (3) observed that such alternative and emerging crops should not only have comparative nutritive value but should be cheaper than the conventional sources, and should also be available in large quantities. One of such emerging crops is Kenaf (*Hibiscus cannabinus L*). Kenaf, (*Hibiscus cannabinus L)* has been, primarily used as a fibre crop and secondarily as a livestock feed (4). It's leaves have an acidic flower and are used for the production of local soups. Kenaf seed have a crude protein content of 30.88%, with an organic matter content of 95.15% and ether extract content of 18.55% on a dry matter basis. The fatty acid content includes palmitic acid (33.21%), stearic acid (50.02%), -Oleic acid (31.26%), and linoleic (30.51%) (5). It has a high potential as feedstuff. Despite the rich nutritional composition of kenaf seed, there are reports of the presence of a number of antinutritional (toxic) factors. (6) Reported low levels of tannin, amylase inhibitors, protease inhibitors, phytic acid and gossypol in kenaf seed. With the above in mind, this study was designed to evaluate the performance, haematological indices of starter broilers fed fermented kenaf seeds meal

MATERIALS AND PROBLEMS

Experimental site: The experiment was carried out at the Teaching and Research Farm of the Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan. The site is located in the rain forest zone of South- western Nigeria on longitude 7^0 23^1 and latitude 4^0 53^1 E and 76m above sea level. The climate is humid with a mean annual rainfall of 1037mm and mean temperature of 34.7^0C, respectively. (7).

Source and preparation of kenaf seeds: The raw kenaf seed was obtained from the Institute of Agriculture Research and Training, Ibadan. The seeds were cleaned by hand picking and winnowing to remove all the foreign materials. After cleaning the kenaf seeds were fermented for three days in an air-tight plastic drum at the rate of 1kg to 5 litres of water, the seeds were allowed to ferment for 72 hrs as outlined by (8). Water was drained off

and fermented seeds sun-dried at a temperature of 27ºC for 4 days before being milled into Fermented kenaf seed meal (FKS) and bagged.

Experimental Diets and Design: A total of three diets were formulated such that full fat soyabean was replaced with graded levels of FKSM. The replacement was in order of 0, 10 and 20% of FKSM. The birds were brooded together for 1 week, during which time they were fed with the control diet. They were fed with broiler starter for 3 weeks. The gross composition of the starter diets is as shown in Table 1. One hundred and eighty (180) day old Hubbard chicks sourced from a commercial hatchery Ibadan were used for this experiment. The chicks were randomly assigned to 3 dietary treatments of 60 birds per treatment which was further divided into 4 replicates of 20 birds per replicate after adjustment for weight in a completely randomized design (CRD),

Table 1: Gross composition (g/100gDM) of Broiler starter diets using Fermented kenaf seed meal

Ingredients (%)	T1	T2	T3
Maize	50.00	50.00	50.00
Groundnut cake	6.40	6.40	6.40
Soyabean meal	30.00	20.00	10.00
Kenaf seed meal	-	10.00	20.00
Fish meal (72% CP)	2.00	2.00	2.00
Wheat offals	7.30	7.30	7.30
Bone meal	2.00	2.00	2.00
Limestone	1.50	1.50	1.50
Salt	0.25	0.25	0.25
Vitamin/mineral premix*	0.25	0.25	0.25
Lysine	0.20	0.20	0.20
Methionine	0.10	0.10	0.10
Total	**100.00**	**100.00**	**100.00**
**M.E	2831.25	2828.25	2821.30
Determined analysis %			
Dry matter (%)	91.43	91.67	91.67
Crude protein (%)	23.03	22.98	22.91

RESULTS AND DISCUSSION

The results of Performance characteristics and haematological indices of starter broilers fed diets containing graded levels of fermented kenaf seed meal is as presented in Tables 2 and 3. Significant difference ($p<0.05$) were recorded in mean values obtained for final weight, weight gain, feed conversion ratio (FCR), cost of feed consumed per bird and cost of feed consumed per weight gain. While all other parameters were not significantly ($p>0.05$) influenced. Final live weight and weight gain of starting broilers fed the control diet (0% FKSM) was highest with value higher than those obtained for 10% and 20% FKSM. This implies that inclusion of FKSM in the diets added no positive improvement on the final live weight and weight gain of broiler starter. This agreed with the work of (9) who reported that feeding differently processed Roselle seeds to broiler chicken did not produce any effect on the weight gain. It also corroborates the work of (10) who found out that feeding Roselle seeds with or without enzyme to broiler chicken has no significant ($p>0.05$) effect on final weight, weight gain and feed conversion ratio. Higher final weight and weight gain recorded for the control diet in this study could be as a result of the relatively low crude fibre of control compared to the FKSM based diets, since increasing the fibre content in diets has negative linear effects on the body weight (11, 12). Previous literatures also confirm that processing of oil seeds resulted in improved growth performance (13, 6 and 14). The findings of this current study confirmed the fact that processing of FKSM and its inclusion in the diets of young chicks poses no deleterious effects on their performance. The highest haemoglobin (Hb) and packed cell volume (PCV) counts obtained for broiler starter on 10% and 20% for FKSM is indicative of improved health status of the birds on the FKSM based diets. This indicated that the diets were nutritionally adequate to meet the nutrient needs of the birds. Haematological indices reflect the effect of dietary treatments on the animals in term of quality, type and amount of feed ingested and were available for the animals to meet its physiological, biochemical and metabolic necessities (15).

Table 2: Performance Characteristics of Broiler Starter fed Fermented Kenaf Seed Meal

Parameter	**T1**	**T2**	**T3**	**SEM**
Initial weight (g/bird)	135.00	132.50	135.00	5.20
Final weight (g/bird)	833.20^{a}	729.20^{ab}	687.40^{ab}	113.00
Weight gain (g/bird)	695.90^{a}	593.80^{ab}	550.00^{ab}	110.80
Feed consumed (kg/bird)	1674.79	1677.29	1673.33	8.65
FCR	2.50^{ab}	2.84^{a}	3.08^{a}	0.46
Price/kg of feed(₦)	101.50	97.50	97.00	2.10
Cost of feed consumed/bird(₦)	169.95^{a}	163.44^{b}	162.21^{b}	3.63
Cost of feed consumed/wgt gain(₦)	214.02^{b}	276.39^{a}	295.83^{a}	44.09

[abc]: Means on the same row with different superscripts differ significantly(P<0.05).

Table 3: Haematological indices of Broilers Starter fed Fermented Seed Meal

Parameter	Ti	T2	T3	SEM
Packed cell volume (%)	32.33[ab]	39.33[a]	38.00[a]	2.28
Haemoglobin (g/dl)	10.90[b]	13.33[a]	13.10[ab]	0.81
Red blood cell ($x10^6/mm^3$)	2.81	3.33	3.10	0.17
Mean cell volume (μ^3)	114.78[b]	117.78[b]	121.25[ab]	4.02
Mean cell haemoglobin (fl)	38.70[b]	39.91[ab]	42.31[a]	0.93
MCHC (%)	33.72	34.51	34.54	0.40
WBC ($x10^3$)	2.95[a]	2.25[b]	2.82[a]	0.13
Lymphocytes (%)	63.67	66.33	69.00	6.65
Eosinophils (%)	0.67	0.67	1.33	1.01
Monocytes (%)	0.67	0.00	0.00	0.89
Basophil (%)	2.33	0.33	1.67	1.27
Heterophil (%)	32.67	32.67	28.00	6.50

[abc]: Means on the same row with different superscripts differ significantly(P<0.05).

CONCLUSION AND APPLICATION

It can therefore be concluded that FKSM in the diets of started broiler will not have produce any deleterious effect on their performance haematological indices.

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Response of Weaner Rabbits to Dietary Levels of Desert Date (*Balanites aegyptiaca*) and Sweet Potato (*Ipomoea batatas*) Leaf Meals

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Abstract: A 56-day study was carried out to evaluate the effects of feeding graded levels of desert date leaf meal (DDLM) and sweet potato leaf meal (SPLM) on growth performance and nutrient digestibility of weaner rabbits. Thirty (30) weaner rabbits were allotted to five dietary treatments of six rabbits per treatment and replicated three times with 2 rabbits per replicate in a completely randomized design (CRD). The dietary treatments were: D1 (0% Leaf meals), D2 (5% DDLM), D3 (10% DDLM), D4 (5% SPLM), D5 (10% SPLM), respectively. The result of growth performance showed that final body weight (FBW), total body weight gain (TBW), total feed intake (TFI) and feed conversion ratio (FCR) were significantly ($P<0.05$) influenced by the dietary treatments. Rabbits fed D1, D2, D3 and D4 diets had significantly higher ($P<0.05$) FBW, TBW and average daily weight gain (ADWG) and better feed conversion ratio (FCR) while those fed D5 diets recorded significant lower ($P<0.05$) values. From the result of this study, it could be concluded that diet having inclusion levels of 5% DDLM, 10% DDLM and 5%SPLM could be fed to weaner rabbits for optimum growth performance.

Keywords: Growth performance, Desert date leaves, Sweet potato leaves

DESCRIPTION OF PROBLEM

There has been an increasing pressure on the livestock sector to meet the growing demand for high-value animal protein in developing countries. Isikwenu, (2013) advocated the useof intensive animal systems with a short generation interval as a way to minimize animal protein deficit in developing countries. In this sense, rabbit production stands out as a promising venture (Iyeghe- Erakpotobor and Esieyo, 2010). The high cost associated with production of rabbit has been a setback. However, growing interest in rabbit production has stimulated the search for high-quality alternative protein sources which is expected not to compete with human food (Adedeji *et al.,* 2013, Yakubu and Wafar, 2014).

In recent years, tropical forages have been highlighted as a less expensive and locally available source in the tropics. Moreover, potential of these forages in diet is determined by its excellent nutritional composition and digestive utilization ability ofanimals (Medugu *et al.,* 2012). Therefore, the aim of this study was to evaluate the response of weaner rabbits fed desert date *(Balanites aegyptiaca)* and sweet potato *(Ipomoea batatas)* leaf meals

MATERIALS AND METHODS

Thirty (30) weaner rabbits with an initial average weight of 590.45g were used for the experiment. The animals were housed in 3 tier rabbit hutches measuring 60cm × 60cm ×30cm. The hutches were fitted with feeders and drinkers. Animals were allowed to acclimatize for a period of one week and were given prophylactic treatment against ecto and endo parasites and assigned to five dietary treatmentshaving three replicates of two rabbits per replicate in completely randomized design. Fresh leaves of desert date and sweet potato were shade dried until crispy to touch and milled using traditional pestle and mortar and incorporated into the diet. Five experimental diets were compounded using desert date leaf meal (DDLM) and sweet potato leave meal (SPLM). D1 (0%), D2 (5% DDLM), D3 (10% DDLM), D4 (5% SPLM), D5 (10% SPLM) as shown in Table 1.The rabbits were offered

experimental diets and water *ad libitum* for the period of 56 days. The animals were weighed at the beginning of the experiment to determine the initial weights and subsequently on a weekly basis using an electronic weighing balance Parameters evaluated include total weight gain, daily feed intake and feed conversion ratio (FCR) feed conversion ratio and daily weight gain were computed. Data collected were subjected to one-way analysis of variance completely randomized design (Steel and Torrie, 1980) and means were separated using Duncan's Multiple Range Test (Duncan, 1985).

Table 1: Ingredients and Percentage Composition of Experimental Diets

	Inclusion levels of leaf meals				
Ingredient	**D1 (0%)**	**D2 (5%DDLM)**	**D3 (10%DDLM)**	**D4 (5%SPLM)**	**D5 (10%SPLM)**
Maize	49.00	49.00	49.00	49.00	49.00
Maize offal	20.00	19.00	17.00	19.00	17.00
Soybean meal	25.00	21.00	18.00	21.00	18.00
SPLM	0.00	0.00	0.00	5.00	10.00
DDLM	0.00	5.00	10.00	0.00	0.00
Fishmeal	2.00	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.5
Premix	0.25	0.25	0.25	0.25	0.5
Total	100	100	100	100	100
Determinedanalysis					
Dry matter	96.67	95.78	96.78	96.34	96.67
Crude protein	16.11	16.04	16.08	16.09	16.12
Ether extracts	6.04	6.03	6.61	6.09	6.08
Crude fibre	5.9	6.34	7.45	8.67	13.89
Ash	5.33	6.62	6.91	7.67	7.49
NFE	63.29	61.64	59.62	58.15	53.09
**ME Kcal/kg	3332.105	3270.13	3246.88	3152.945	2973.615

*Vitamin-mineral premix provider per kg the following: Vit. A 1500 IU; Vit.D_3 3000 IU; Vit.E 30 IU; Vit. K 2.5mg; Thiamine3mg; Riboflavin 6mg; Pyrodoxin 4mg; Niacin 40 mg; Vit. B_{12} 0.02mg; Pantothenic acid 10mg; Folic acid 1mg; Biotin 0.08mg; Chloride 0.125mg; Mn 0.0956g; Antioxidant 0.125g; Fe 0.024g; Cu 0.006g; Se 0.24g; Co 0.24

**ME (Kcal/kg) was calculated using the formula of Pauzenga, (1985). ME = 37 × %CP + 81 ×%EE + 35.5 × NFE.

RESULTS AND DISCUSION

The result of the growth performance of weaner rabbits is presented in Table 2. The result showed that final body weight (FBW), total body weight gain (TBW), total feed intake (TFI) and feed conversion ratio (FCR) were significantly ($P<0.05$) influenced by the dietary treatments. Rabbits on D1, D2, D3 and D4 diets had significantly higher ($P<0.05$) FBW, TBW and average daily weight gain (ADWG) while those fed D5 diets recorded significant lower ($P<0.05$) value. Decreased in FBW, TBW and ADWG of rabbit fed D5 diet. This result agreed with the reports of (Abonyi *et al.,* 2012 and Makinde *et al.,* 2015) who in their separate studies reported decreased in FBW, TBW and ADWG when they fed higher inclusion of sweet potatoes and *Leucaena Leucocephala*leaves meals to weaner rabbits respectively.Higher FBW, TWB and ADWG of rabbits fed D1, D2, D3 and D4 diets could be attributed to better utilization of diets which did not cause disproportionate growth in weaner rabbits.The feed intake of rabbits on D5 diet (10%SPLM) was significantly highercompared than those on D1 (0%), D2 (5% DDLM), D3 (10%DDLM)and (5%SPLM) diets. Higher feed intake recorded by rabbits fed D5 (10%SPLM) diet could be attributed to the higher crude fibre content and decrease in Metabolizable energy as the level of SPLM increasedto 10% (Table 1). Therefore, the rabbits on diet D5 (10%SPLM) consumed more feed to meet their energy requirement. Similarly, the poor growth performance of rabbits fed D5 (10%SPLM) dietdespite the higher feed intake could be attributed to accumulation of protease inhibitor in the

diet as the level of SPLM increases. Protease inhibitor have reported to decrease proteolytic enzyme activity, thereby leading to reduction in nutrient absorption and utilization (Eusebio and Mamaug, 2004).The finding from this study confirmed the earlier report of (10) when they fed weaner rabbit with sweet potato leaf meal and reported reduction in nutrient absorption and utilization as a result of protease inhibitor in diet.Better FCR was observed in rabbit fed D1 (0%), D2 (5% DDLM), D3 (10%DDLM) and (5%SPLM) diets indicating better utilization of the feed but rabbits on D5 (10%SPLM) recorded the poorest. Generally, the values recorded in this study for the parameters measured were within ranges reported by other authors (Yakubu and Wafar, 2014; Abdullahi *et al.,* 2017) for rabbits raised under tropical condition.

Table 2: Growth Performance of Weaner Rabbits Fed varying of DDLM AND SPLM

Parameters	Inclusion levels of leaf meals					
	D1 (0%)	D2 (5%DDLM)	D3 (10%DDLM)	D4 (5%SPLM)	D5 (10%SPLM)	SEM
Initial body weight (g)	562.00	560.10	561.34	562.03	561.35	5.61^{ns}
Final body weight (g)	1572.18^{a}	1575.32^{a}	1589.56^{a}	1565.30^{a}	1419.60^{b}	15.44^{*}
TBWG (g)	1010.18^{a}	1015.22^{a}	1028.22^{a}	1003.27^{a}	858.20^{b}	9.81^{*}
ADWG (g)	18.03^{a}	18.12^{a}	18.36^{a}	17.91^{ab}	15.32^{c}	0.17^{*}
Total feed intake (g)	3414.16^{b}	3481.92^{b}	3593.36^{b}	3520.00^{b}	4696.96^{a}	37.96^{*}
ADFI (g)	60.96^{b}	62.17^{b}	64.16^{b}	62.85^{b}	83.87^{a}	0.67^{*}
FCR	3.37^{b}	3.42^{b}	3.49^{b}	3.50^{b}	5.47^{a}	0.19^{*}

Means in the same row bearing different superscripts differ significantly (P<0.05), NS= not significant different (P>0.05) *= significantly different (P<0.05) SEM = Standard error mean. TBWG =Total Body weight gain, ADWG= Average daily weight gain, ADFI=Average daily feed intake, FCR= Feed conversion ratio

CONCLUSION AND APPLICATION

From the result, the authors recommend 5- 10% desert date leaf meal and 5% sweet potato leaf meal incorporation into weaner rabbit diet.

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Haematological Indices of Young and Adult Japanese quail raised in a Semi-Arid Environment of Borno State, Nigeria

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Abstract: This study examined the effects of sex and weight on haematological parameters of young and adult Japanese quails reared under semi-arid condition. Parameters considered were eosinophils, haemoglobin, lymphocytes, monocytes, neutrophils, packed cell volume and white blood cells. The respective range values for eosinophils, haemoglobin, packed cell volume and white blood cells were: 1.67-1.88 (young), 1.50-2.00 (adult); 12.69-14.31 (young), 9.87-11.17(adult); 0.30-0.43(young), 0.29-0.34(adult) and 13.25-15.17(young), 9.73-13.83(adult). Except for the heamoglobin and PCV in yound birds, the haematological counts (eosinophils, heamoglobin, PCV and white blood cells) were higher in the males than their female counterparts in young and adult quails. Light adult quails had highest concentrations for haemoglobin and PCV while heavy young and adult quails had highest counts for WBC. These facts are essential in pathology studies, management and in breeding programmes to produce quails that are fit and more productive.

INTRODUCTION

The common quail, *Coturnix coturnix* originated from Asia, Africa, and Europe and the species orsubspecies of the genus *Coturnix* are native to all continentsexcept Americas. Japanese quail is one of the domesticated subspecies (Faqi *et al*., 1997). The preference for the Japanese quail is justified because the bird possesses several advantages, such as rapid growth, early sexual maturity, high rate of egg production, easy handling of adult size, and a short generation interval.

Evaluation of haematological profile of quails cannot be over emphasized as this provides useful information about the birds' physiological condition. These parameters are a useful tool in differentiating apparently healthy birds from diseased ones (Onyinyechukwu *et al*., 2017). This endeavour in quails therefore would help in the clinical management of blood and bone marrow disorders. As such, values on haematology could be utilized in cross breeding (classical breeding) (Ladokun, *et al*., 2008) as well as in advanced (modern day) breeding programmes in order to produce individualquails that are fit and more productive.

A few studies have been conducted on haematology of Japanese quail, there is dearth of information on these parameters as affected by sex and weightfor young and adult quails reared under semi-arid condition. This study therefore was designed to examine effects of sex and weight on haematological indices of young and adult Japanese quails reared in a semi-arid environment.

MATERIALS AND METHODS

Study site and management of experimental birds: The study was conducted at University of Maiduguri Livestock Teaching and Research Farm, Maiduguri, Borno State, Nigeria. Maiduguri, the Borno State capital is located in the Sahelian zone of the country on latitude 11 ^{0} 5' N, and longitude 30 ^{0}09' E and on altitude of 354 m above sea level in the North Eastern part. The seasons are divided into three: dry hot (February to May); wet (June to September); and dry cold (October to January). The dry season lasts for eight to nine months with hottest occurring between March and June at ambient temperature range of 35 and 40^0 C which are highest inApril and May. The relative humidity ranges from 45 – 50 % with minimum in February and March. It drops to as low as 10 % and a maximum of 90 % in August. Rainfall per annum ranges between 150 and 600 mm (Alaku, 1983).

Data on 58 Japanese quail (*Coturnix coturnix japonica*) were used for the study. Japanese quail chicks were purchased at 4 weeks of age from National Veterinary Research Institute (NVRI) Vom, Jos, Plateau State, Nigeria. The birds were reared under deep litter system. They were fed formulated layers' mash containing 18 % crude protein and 2,800 KCal/Kg M.E., and were given fresh clean water, *ad libitum*. The room temperature within the period of this investigation ranged between 25^0 C and 37^0 C. Proper sanitation and husbandry were carried out to prevent infection and its spread.

Blood collection procedures and determination of blood parameters: The birds were fasted overnight. Blood samples from young (5 weeks old) and adult quails (20 weeks old) were collected in the morning hour using sterile syringe and needle from the wing vein into Ethylene Diamine Tetra Acetic Acid (EDTA) bottles for haematology. These birds were taken randomly according to weight group (light: ≤80 g, medium: >80 g ≤ 120 g, heavy: > 120 g) and sex throughout the period.The haematological determination of blood samples were carried out at University of Maiduguri Teaching Hospital (UMTH), Maiduguri, Nigeria. Packed Cell Volume (PCV) was determined using the microhaematocrit method and haemoglobin (HB) using cyanomethemoglobin method according to Cole (1986). White Blood Cell (WBC) counts were determined using the improved Neubauer haemocytometer as described by Dacie and Lewis (1991).

Statistical analysis: Data were subjected to Analysis of Variance (ANOVA) using the General Linear Model of SPSS 16.0. Means that were significantly different were separated by the Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

Table 1: Mean ± standard error for the effect of sex and weight group on haematological indices of Japanese quail

Age (week)	**Young**					**Old**	
Factor	**Sex**		**Weight**			**Sex**	
Parameter	**Male**	**Female**	**Light**	**Medium**	**Heavy**	**Male**	**Female**
Eosinophils	2.68± 0.55[a]	1.88± 0.68[a]	2.62± 0.96[a]	1.87 ± 0 .69[a]	2.37 ± 0.52[a]	2.00 ±0.29[a]	1.50 ±0.41[a]
Haemoglobin	12.69 ± 0.65[a]	14.31 ± 0.81[a]	13.1±1.15[a]	14.22± 0.82[a]	13.22 ±0.63[a]	11.17 ±0.40[a]	9.87±0.57[a]
Lymphocytes	1.24±0.77[a]	0.64± .95[a]	1.78± 1.35[a]	0.35± 0.97[a]	1.40± 0.74[a]	48.00±.58[a]	51.00±0.82[a]
Monocytes	39.87±6.52[a]	42.27± 8.06[a]	27.4± 11.4[a]	50.9± 8.20[a]	44.9± 6.26[a]	1.33±0.29[a]	0.83±0.41[a]
Neutrophils	55.86±6.58[a]	54.88± 8.13[a]	67.8±11.5[a]	47.25± 8.27[a]	51.0 ± 6.32[a]	47.67±0.29[a]	46.17±0.41[a]
Packed cell Vollume	0.30± 0.02[a]	0.43± 0.02[a]	0.39± 0.03	0.43± 0.02[a]	0.39 ± 0.02[a]	0.34±0.01[a]	0.29±0.01[a]
White blood cell	15.17 ± 1.91[a]	13.25± 2.36[a]	9.94± 3.34[a]	15.86 ± 2.40[a]	16.80 ±1.83[a]	13.83±1.56[a]	9.73±2.20[a]

Means with different superscripts (a, b) within a subset in the same row differs significantly (P< 0.05) from one another

Effect of Sex (male and female): Mean values and standard errors of effects of sex and weight on haematological parameters for young and adult Japanese quails were presented in Table 1. Eosinophils values (1.88 and 2.68) for young birds were higher in males (2.68) than in females (1.88). Values for adult quails (1.50-2.00) followed same pattern: 2.00 (males) and 1.50 (females). The haemoglobin counts (12.69 -14.31) were higher in females (14.31) than male (12.69) for young quails. In contrary, these values for adult quails (9.87-11.17) were higher for male (11.17) than females (9.87). PCV counts (0.30-0.43) for young birds were higher in

females (0.43) than in males (0.30). In contrary, these values (0.29-0.34) were higher in favour of males (0.34) than females (0.29) with adult quails. For the WBC counts (13.24-15.15), there were higher sex range of 15.17 and 13.24for male and female young birds, respectively. Similar results of WBC values (9.73-13.83) were obtained for adult quails with higher value (13.83) for males and lower (9.73) for females. No significant differences were observed in these parameters for male and female quails.

Effect of weight groups (light, medium and heavy): Among the young birds (5 weeks old), eosinophils values ranged 1.87 – 2.60, with the lowest observed for the medium sized quailsand the highest for the light sized quails. The adult quail (20 weeks old) have the range values (1.00 – 2.75) with the maximum in favour of medium body sized and minimum for heavy group. Haemoglobin values for the young birds ranged from 13.11 – 14.22. The highest counts in the younger birds were recorded for medium sized birds. For the adultbirds, the values ranged from 8.95 – 12.30. Light birds had the maximum value. PCV values of the young birds ranged from 0.39- 0.43. The lowest value was obtained for light while the highest was for medium sized birds. PCV counts of 0.27-0.31were obtained for the adult birds. The minimum value of 0.27 was observed for the medium, and the maximum for light bodied birds. The WBC counts ranged from 9.94 – 16.80among the young birds while the values ranged from 10.60 – 13.80 among the adult birds. The minimum value among the young birds was obtained for the light birds while the maximum value was for the heavy birds. Minimum and maximum WBC counts for adult quails were recorded for light and heavy birds, respectively. No significant differences were observed for the haematological parameters among the weight groups in both young and adult quails.

The high PCV values of males over the females agree with Addass *et al*. (2012) who reported that sex have significant effect on haematological parameters with males having higher PCV values. Increase in PCV and Hb obtained in this study were equally observed by Ayub *et al.* (2012). However, the PCV and Hb observed in this study differed from those obtained by Oyinyechukwu *et al.* (2017) who found considerably higher results. These differences may be attributed to variation in environment where the two researches were being carried out. The PCV and Hb obtained in this study are similar to those of Mohammad (2013) on golden local quail.

CONCLUSION

Sex and weight have effects on haematological parameters of young and adult quails. The haematological counts (eosinophils, PCV and white blood cells) were higher in the males than their female counterparts. Female young quails had higher counts for PCV and heamoglobin. Heamoglobin values were higher for males with adult quails. Light adult quails had higher concentrations for haemoglobin and PCV while medium sized young quails had highest counts for PCV and heamoglobin. Heavy young and adult quails had highest counts for WBC, respectively. Findings of this study are useful in diagnosis and management purposes. This as well, could be incorporated into breeding programmes in order to produce quails that are fit and more productive.

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Proximate and Mineral Composition of Seeds of Two Roselle (*Hibiscus sabdariffa L.)* Varieties

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Absract: Variability in the proximate composition of roselle seeds may be due in part to varietal differences. Triplicate analysis each for proximate, calcium and phosphorus composition of green and red varieties of roselle seeds were conducted. Result of Independent 'T' test revealed thatcrude protein, crude fiber, ether extractand metabolizable energy values were significantly ($P<0.05$) higher in seeds of red roselle variety. No statistical difference was observed in Nitrogen free extract. Calcium was significantly ($P<0.05$) higher inseeds of the green variety, while phosphorus values did not differ ($P<0.05$) amongst the two varieties. Differences among the two seed varieties may be attributed to varietal differences.

Keywords: Roselle Seeds, Seed Varieties, Proximate Fractions, Calcium, Phosphorus

DESCRIPTION OF PROBLEM

Emphasis on substitutes and/or complements to the conventional feedstuffs for monogastric animals has been a fulcrum around which studies involving the use of unconventional seeds have revolved over the years. Roselle (*Hibiscus sabdariffa* var. *sabdariffa),* an annual, herbaceous shrub, belonging to the family malvaceae is cultivated in large quantities mainly in the Guinea and Sudan savannah vegetation zones of Nigeria (Alagbejo, 2000). It is also cultivated in India, East Indies, and parts of South East Asia, the semi – arid environments of West and North-East Africa, and to some extent in tropical America (Morton, 1987). There are two basic types; the green and the red or brown. Seed yields of 400 – 600 kg for the green type, and 1000 kg per hectare for the red type have been reported (3). The calyces have been the most utilized part of the plant, usually processed to produce jam, jelly, soup and the popular "zobo" beverage in Nigeria (Schippers, 2000); (Kwari *et al*., 2010).

Previous works (Dashak and Nwanegbo, 2002; Anhwange *et al*., 2006; Abdu *et al*., 2008; Kwari *et al*., 2011; Duwa *et al*., 2012; Ghislain *et al*., 2014) have shown that roselle seeds contain moderate to high amounts of protein (21 – 39%), dietary fiber (12 – 22%) and lipid (6 – 19%) which vary within wide ranges. It contains appreciable quantities of minerals such as phosphorus, magnesium and calcium (Ismail *et al*., 2008). Most of the previous works have focused on the seeds of the red variety or a composite of the red and green varieties. Diarra *et al*. (2011) identified varietal difference as a likely factor for significant difference in chemical composition of roselle seeds.

This study attempted to compare the nutritive and mineral composition of the seeds of green and red varieties of roselle.

MATERIALS AND METHODS

Source and preparation of sample: Seeds from green and fairly red roselle varieties were purchased from Garkawa market, Plateau State, Nigeria. The seeds were winnowed to remove debris, and each variety was sub-divided intotriplicates.

Chemical analysis

- **Proximate analysis:** Moisture content and dry matter were determined by placing the sample in a 105°C oven for 20 hours (at constant weight) (AOAC, 1980). Ash determination was performed by burning the sample at 550°C in a muffle furnace for 3 hours (AOAC, 1980). Total nitrogen was determined by the Kjeldahl procedure (AOAC, 1980) and multiplied by 6.25 to obtain crude protein (Galyean, 2010). Ether extract was determined by Soxhlet extraction method and crude fiber content was determined by digestion method (AOAC, 1980). Nitrogen free extract (NFE) was calculated by difference: NFE (%) = 100 – (%H_2O + %Ash + %CP + %EE + %CF)
- **Mineral analysis:** Calcium and phosphorus contents were analysed using spectrophotometric method as outlined by AOAC (1980).

Statistical analysis: Data obtained were analyzed using Students 't' test according to SPSS (2015).

RESULTS AND DISCUSSION

Proximate composition of seeds of green and red roselle varieties: Proximate composition of the seeds of green and red roselle varieties is presented in Table 1. The result shows that both categories of roselle seeds have relatively high amounts of crude protein and lipids in agreement with reports by many authors (Qi *et al*., 2005; Abdu *et al*., 2008; Ismail *et al*., 2008; Mahadevan *et al*., 2009). Crude protein values compare favorably with that of cotton seed meal and brewers' yeast (NIAS, 2014). Crude protein, ether extract, ash and nitrogen free extract (NFE) of seeds of the red variety compare favorably with values reported by Tounkara *et al.* (2011). Mean values for crude protein, ether extract, crude fiber, ash and metabolizable energy were significantly ($P<0.05$) different between seeds of the two varieties. Crude protein, ether extract, crude fiber and metabolizable energy values were statistically ($P<0.05$) higher in seeds of the red variety than in seeds of the green variety. No significant ($P<0.05$) difference was observed in nitrogen free extract among the seeds. Inorganic elements and compounds, expressed as ash, is significantly ($P<0.05$) higher in seeds of the green variety than inseeds of the red variety.

Table 1: Proximate composition of seeds of green and red roselle varieties (moisture free basis)**

Proximate fractions (%)	Green variety	Red variety	*t*-value	*p*-value
Crude protein	27.77 ± 0.44	33.10 ± 0.03	-12.21	0.006*
Ether extract	18.26 ± 0.48	20.14 ± 0.34	13.18	0.039*
Crude fiber	7.05 ± 0.51	9.39 ± 0.57	-3.01	0.040*
Total ash	11.31 ± 0.44	5.97 ± 0.36	9.41	0.001*
Nitrogen free extract	44.05 ± 0.74	40.63 ± 1.47	2.07	0.131^{NS}
Metabolizable energy (kcal kg^{-1})***	3316.03 ± 33.07	3590.11 ± 3.47	-8.24	0.013*

**Values expressed as Mean ± SE; NS= not significant ($P>0.05$); * Significant ($P<0.05$)
***Calculated as ME (kcal/kg) = 36.63 x %CP + 77.96 x %EE + 19.87 x %NFE (NRC, 1994), might be as a result of varietal differences and/or differences in soil mineral content.

Mineral composition of seeds of green and red roselle varieties: Calcium and phosphorus values are presented in Table 2. Roselle seeds have relatively good quantities of Ca and P in agreement with Anhwange *et al*. (2006). Calcium in the seeds of the green variety is significantly ($P<0.05$) higher than in seeds of the red variety. This

may be explained by the higher ash content in the green variety. Result indicated a non-significant (P<0.05) trending in the effectof varietal difference on phosphorus content.

Table 2: Mineral composition of seeds of green and red roselle varieties (moisture free basis)**

Minerals (ppm)	Green variety	Red variety	*t*- value	*p*-value
Calcium	0.62 ± 0.02	0.48 ± 0.01	0.259	0.004*
Phosphorus	0.92 ± 0.05	0.79 ± 0.04	0.580	0.117^{NS}

**Values expressed as Mean ± SE; NS= not significant (P>0.05); * Significant (P<0.05).

CONCLUSION AND APPLICATION

Protein, lipid, crude fiber and energy are higher in seeds of red roselle variety than in seeds of the green variety. Differences obtained in proximate fractions, energy and calcium contents between seeds of green and red roselle varieties may be attributed to variety. However, further study with varieties cultivated on soils with similar chemical characteristics may be conducted.

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Growth Response, Carcass and Sensory Quality of Broiler Chicken Served Acidified Water

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Abstract: This study was carried out with one hundred and thirty- five (135) day old arbor acre chicks to evaluate the growth response, carcass and sensory quality of broiler chickens served with two different organic acids. The chicks after brooded for a period of seven days were randomly distributed into five treatments group of twenty-seven (27) chicks per treatment replicated thrice with nine (9) birds per replicate in a completely randomized design (CRD). Treatment 1 served as the control without oral inclusion of organic acid, T_2 had 2% citric acid, T_3 had 4% citric acid, T_4had 2% acetic acid and T_5had 4% acetic acid respectively while all administration was done two weeks at starter phase and two weeks at finisher phase. Parameter measured includes feed intake, weight gain, feed conversion ratio, mortality percentage while two birds per replicate making six (6) per treatment were randomly selected and slaughtered for carcass and sensory evaluation. Result obtained showed no significant ($P>0.05$) difference in all growth parameters measured. Significant ($P< 0.05$) difference were obtained in the mean value recorded for drumstick, wing, neck, head and gizzard among all carcass parameters measured. Highest ($P<0.05$) values for drumstick was obtained on T_2 (11.17) followed by T_1 and T_4 (10.65 &10.67) while the least values were recorded for T_3 and T_5 (9.54 & 10.10). The same trend was observed for gizzard. As judged by the panelist, significant ($P<0.05$) value for drumstick meat sample was recorded in appearance, taste, flavor and overall acceptability. Conclusively, the inclusion of citric and acetic acid orally for broilers has no detrimental effect on growth performance but enhance the quality of the carcass.

Keywords: Organic acid, Meat quality, Meat sample, Primal cuts.

DESCRIPTION OF PROBLEMS

Approvals for the use of non-therapeutic antibiotics in animal feed are fast disappearingworldwide. The primary effect of antibiotics is antimicrobial; all of the digestibility and performance effects can be explained by their impact on the gastrointestinalmicroflora. Among the replacements for antibiotics are organic acids which composed of individual acids and blends of several acids. Like antibiotics, short-chain organic acids also have a specific antimicrobial activity (1). Organic acids have been used for decades in commercial compound feeds mostly for feed preservation, for which formic and propionic acids are particularly effective (2). As a group of chemicals, organic acids are considered to be any organic carboxylic acid, including fatty acids and amino acids, of the general structure R-COOH. Salts of some of these acids have also been shown to have performance benefits. A wide range of organic acids with variable physical and chemical properties exists, of which many are used in drinking water as supplement or feed additives (acidifiers). The use of organic acids has been reported to protect the young chicks by competitive exclusion (3), enhancement of nutrient utilization, growth and feed conversion efficiency (4). Citric acid is the most common organic acid used in poultry diets. It acts as a growth promoter through acidifying the gastrointestinal (GI) content and is considered as a favoured determinant in effective nutrient digestion. In addition, CA also improves the solubility of the feed ingredients, digestion and absorption of nutrients by modifying intestinal pH, (5). Acetic acid is an organic acid which is used primarily to control mold and reduce bacterial growth in feed, but it can also inhibit the growth of micro-organisms in the gastrointestinal tract, modify pH levels and improve feed utilization. Hence, this study was conducted to evaluate the growth response, carcass yield and sensory qualityof the drumstick sample of broiler chickens served oral administration of acetic and citric acids.

MATERIALS AND METHOD

The experiment was carried out at the Poultry Unit, Teaching and Research section of the Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan, South West, Nigeria. A total of 135, 7-day old chicks having initial average weight of 170g ± 5 were randomly allotted into five dietary treatments of twenty- seven chicks per treatment. Each treatment was in triplicate of nine chicks per replicate in a completely randomized design. Birds were raised on partitioned deep litter pen and the experiment lasted for 7 weeks. Acetic and Citric acid were administered orally for two weeks at both starter and finisher phases in the following order: T_1 served as the control (no oral inclusion), T_2 were served 2% citric acid, T_3 were served 4% citric acid, T_4 were served 2% acetic acid and T_5 were served 4% acetic acid respectively, all administration was done two weeks at the starter phase and two weeks at the finisher phase. Feed and water were supplied *ad libitum.* Routine vaccination and management practices were strictly adhering to while only birds on control treatment were medicated. Data on feed intake, weekly weight gain, average daily feed consumed and body gain, feed-to-gain ratio were obtained. On day 49, two birds per replicate were purposively selected, starved overnight, weighed to obtain the live weight and severed through the jugular vein for carcass analysis. Internal organ like heart, liver, kidney, lungs, abdominal fat and gizzard were weighed and recordedas well as all other parts and expressed as percentage of dressed weight. Primal cuts(drumstick) from each carcass were used to evaluate for sensory properties using a nine-point hedonic scale with ten trained panelists. Data collected were subjected to analysis of variance (ANOVA), the treatment means were separated using Duncan's Multiple Range Test using (6).

RESULTS AND DISCUSSION

Table 1 shows the effect of acidified water on growth performance of broiler chicken. Result obtained showed no significant ($P> 0.05$) difference in the growth parameter measured but the values for final weight ranges from 1946.40 – 2380.30 with Treatment 3 (2% acetic acid) having the lowest value and the highest value was recorded on treatment 2(2% citric acid). Similar trend was observed for feed conversion ratio, although the values obtained showed no significant ($P> 0.05$) difference across the group but Treatment 2 had the leastvalue (2.67).This shows that the effect of citric acid enhances digestibility through their influence on gastrointestinal microflora thereby translating into growth.Previous study reported that dietary organic acids such as citric acid increase the body weight of the birds (7). In this study, supplementation of citric acids in drinking water helps to reduce the level of pathogens in water, crop and the proventiculus, regulate the gut microflora, increase feed digestion and improve growth performance of birds in Treatment 2 which agreed with the work of (8).The level of insignificance obtained in this study is in agreement with (9) who reported no significant difference in final body weight when broiler chicken were served with acidified based diet. The mean values for carcass analysis are presented in Table 2. The result obtained showed significant ($P> 0.05$) difference in drumstick, wings, neck, head, lungs and gizzard among all parameter measured. Highest $P< 0.05$ value for drumstickwas recorded on Treatment 2 (11.17) followed by Treatment 1 and 4 (10.65 & 10.67) while the least values were obtained in Treatment 3 and 5 (9.54 &10.10) respectively. This could be attributed to the level of inclusion or probably the type of organic acid used. Similar trend was observed for gizzard. This result was contrary to the work of (5) who noted that carcass characteristics were not affected by supplementation of organic acids.

The graphical presentation of drumstick meat sample from broiler chicken served acidified water is presented on Figure 1. This showed significant ($P< 0.05$) value in appearance, flavor, taste and overall acceptability. Highest ($P< 0.05$) value for appearance, flavor and taste was recorded in T_5 while the least value for appearance and flavor was recorded in T_4 but the least for taste was recorded in T_2 respectively. This shows that oral inclusion of organic acid (acetic acid) influence the quality of the meat sample as subjectively judged by the taste panelist.

Table 1: Growth Response of Broiler chicken servedacidified water

Parameters	**T_1 (0%)**	**T_2 (2%CA)**	**T_3 (4%CA)**	**T_4 (2%AA)**	**T_5 (4%AA)**	**SEM (±)**
Initial Weight (g/b)	172.08	170.60	185.07	173.30	173.07	3.99
Final Weight (g/b)	2193.50	2550.90	2131.50	2187.00	2243.70	70.39
Weight Gain (g/d)	2021.40	2380.30	1946.40	2013.70	2070.60	87.97
Feed Intake (g/d)	5464.80	6361.10	5442.60	5424.10	6786.60	250.85
Feed Conversion Ratio	2.71	2.67	2.80	2.70	3.28	0.16
Water Intake (ml/b)	253.01	228.73	227.06	219.83	234.04	11.46
Mortality	7.41	11.11	0.50	0.00	18.52	3.19

CA: Citric Acid AA: Acetic Acid

Table 2: Carcass quality of Broiler Chicken served acidified water

Parameters (%)	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**SEM (±)**
Live weight	2416.70	2400.00	2400.00	2500.00	2600.00	39.78
De-feathered weight	92.42	94.74	88.33	91.78	90.08	1.21
Eviscerated weight	79.74	81.26	76.30	77.93	78.84	0.16
Dressed weight	70.15	72.07	66.69	67.72	68.99	1.04
Breast	23.04	25.00	22.86	22.82	23.54	0.51
Drum stick	10.65^{ab}	11.17^{a}	9.54^{b}	10.67^{ab}	10.10^{b}	0.20
Wings	11.52^{a}	8.78^{bc}	8.63^{c}	9.73^{bc}	10.45^{a}	0.35
Back	13.08	21.56	12.71	13.59	13.62	1.72
Thigh	10.43	11.34	10.33	9.85	10.14	0.23
Shank	3.97	4.30	3.64	4.97	3.90	0.12
Neck	3.03^{c}	3.41^{bc}	4.62^{a}	4.09^{ab}	3.26^{bc}	0.19
Heart	0.54	0.58	0.47	0.47	0.45	0.03
Head	3.01^{a}	2.42^{ab}	2.15^{cd}	2.09^{d}	2.56^{bc}	0.41
Gizzard	2.89^{ab}	3.11^{a}	2.41^{b}	2.70^{ab}	2.47^{b}	0.10
Liver	2.26	2.55	2.32	2.16	2.03	0.13
Lungs	0.57^{a}	0.42^{b}	0.40^{b}	0.51^{ab}	0.49^{ab}	0.02
Kidney	0.43	0.39	0.40	0.43	0.41	0.03
Abdominal pad	0.69	0.52	1.16	0.71	1.02	0.12

^{a,b,c} means along the same with different superscript are significant different ($P<0.05$)

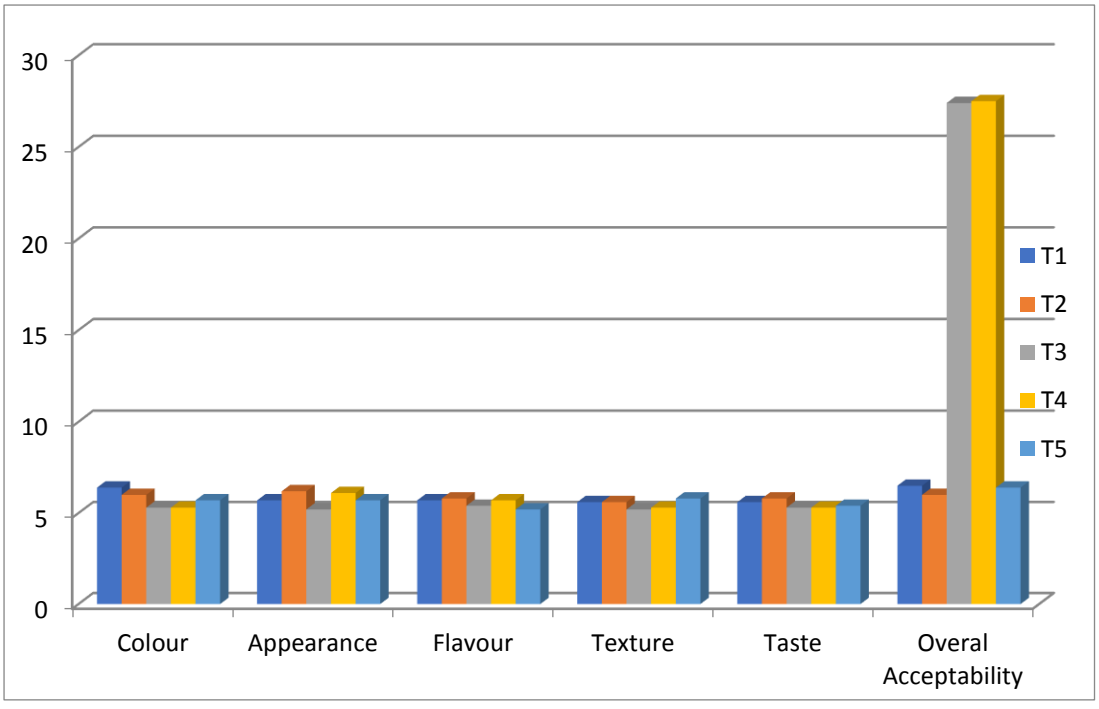

Fig.1: Sensory evaluation of drumstick meat sample of broiler chicken served different acidified water.

T_1 =0% inclusion level of citric acid T_2 = % inclusion level of citric acid

T_3 =4% inclusion level of citric acid T_4 = inclusion level of acetic acid

T_5 =4% inclusion level of acetic acid

CONCLUSION AND APPLICATION

This study shows that organic acids (citric acid) can be orally served to broiler chicken at 2% as it improves the digestibility and enhance growth as well as the quality of meat is influenced. Thus it has no detrimental effect on the birds. Also, organic acids can be used in broiler production as it has antibacterial ability thereby avoiding the use of antibiotic growth promoter and help to maintain the gut health.

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Performance of Finishing Broilers Fed Dietary Levels of Groundnut Pod

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Abstract: Effect of supplementing diets with groundnut pod in partial replacement of maize on carcass and organs weight of finishing broilers was investigated using 80 ANAK strain of four weeks old broilers. The birds were randomly assigned to four treatments (A: control diet 0% groundnut pod, B: 5% groundnut pod, C: 10% groundnut pod and D: 15% groundnut pod) the feeds were formulated and offered in mash form to the respective birds from day 21untill week 8. At day 56, six birds from each were selected and sacrificed for the determination of carcass characteristics, Gizzard weight was significantly higher ($p < 0.05$) for birds on dietary treatment D than the values recorded for the birds on dietary treatment A, B and C. However,the values observed for the heart and liver were significantly affected by the treatment ($p<0.05$) the values observed for these parameters increased linearly ($p<0.05$) from the control to the 10% level of GNP after which the values declined at 15% inclusionThe final body weight and breast weight for the birds on treatment A was not significantly different ($p > 0.05$) from the values recorded for the birds on dietary treatment D. However, the birds on treatment B and C had higher values which differed significantly ($p < 0.05$) from the values observed for the birds on treatment, A and D. The dressing weight of the birds on dietary treatment D was significantly lower ($p<0.05$) than values observed for the birds on treatment A, B and C. The same trend was observed for the thigh weight and Head and neck. The birds on dietary treatment D differed significantly ($p<0.05$) from the values observed for the birds on treatment A, B and C. The eviscerated weight observed for the birds on dietary treatment A, B, C and D had no significant difference ($p > 0.05$). The value observed for the residual weight for the birds on dietary treatment B was significantly lower($p < 0.05$) than the birds on treatment A,C and D. In conclusion, the result of this study showed that Ground nut pods can be incorporated at 10 per cent level in diet of finishing broiler chickens without compromising carcass performance.

Keywords: ground nut pod, carcass, organ, broiler

INTRODUCTION

In a developing country like Nigeria, there is inadequate supply of animal protein sources. An average Nigerian consumes only about 8.6g of animal protein per day as against 53.3g by the inhabitants of developed countries (Ojo, 2003). Sanni and Ogundipe, (2005) reported that poultry industry occupies a major position in the livestock sector of agricultural production because birds have faster gestation than other farm animals to produce meats and eggs for human consumption. According to Ogundipe and Sanni, (2002) and FAO (2006) reports, poultry is considered to be a means of livelihood towards achieving certain level of economic independence. Adegbola, (2004) reported that 41.23% of animal protein yield per annum in Nigeria is sourced from poultry meat and eggs, 9.79% from cattle and 12.43% from pigs. FAO (1995) reported that the best logical solution to Nigeria's meat scarcity is to increase broiler chicken production.

Nutrition is perhaps the most important consideration in livestock management. Inadequate supply of feeds, nutritionally unbalanced rations, adulterated ingredients or stale feeds are some of the factors responsible for low productivity of livestock in tropics (Ogundipe *et al*., 2003).

Apart from nutrition, Poultry industry contributes significantly to family income. Therefore, the major interest of the farmer is to reduce feed cost, which usually accounts for 60 to 70% of the total cost of production. Research efforts are now geared towards evaluating alternative feed ingredients for poultry. According to Atteh and Ologbenla (1993), such alternatives should have comparative nutritive values but cheaper than the conventional protein and energy sources and should also be available in large quantities.

Maize is used for other purposes such as biofuel, brewing, starch industries and for human consumption. However, inadequate production of this grain and the intense competition for maize between man, industries and livestock especially in the drier areas of the tropics has made poultry rations to be expensive (FAO, 2006). This however, could be alleviated by the use of available agricultural byproducts that are less exploited by humans. Hence, partial replacement of maize with groundnut pods will be considered. The aim of the study is to evaluate the growth performance of finishing broilers fed graded levels of groundnut pod as partial replacement for maize.

MATERIALS AND METHODS

Experimental birds and management: A total of eighty (80) Anak broilers strains were used in this study, the chicks were brooded together and randomly alotted into four treatments, replicated twice and assigned to the four different diets in a completely randomized design. The birds were fed and watered *ad libitum* daily and this lasted for four weeks.

Experimental diet: The diet consisted of four treatments containing inclusion of groundnut pod at 0%, 5%, 10% and 15%.

Table 1: Calculated Feed for finishing Broilers Fed Dietary Levels of Groundnut Pod

	T1 (Kg)	T2 (Kg)	T3 (Kg)	T4 (Kg)
Maize	60	55	50	45
Groundnut pod (GNP)	00	05	10	15
Soya bean cake	15	15	15	15
GNC	20	20	20	20
Meth	0.25	0.25	0.25	0.25
Bone meal	3.75	3.75	3.75	3.75
Lysine	0.25	0.25	0.25	0.25
Salt	0.50	0.50	0.50	0.50
Premix	0.25	0.25	0.25	0.25
Total	100	100	100	100
CP	20.94	20.99	21.05	21.12
CF	3.36	5.70	7.13	10.38

Experimental Design: Completely randomized design (CRD) was used for this study. The eighty broilers were divided into four groups and replicated twice. Each group was assigned to one of the four experimental diets.

Data collection: The chicks were weighed at the beginning of the study and subsequently on weekly intervals for the period of four weeks. The feed was always measured before feeding and leftover before the next feeding to determine the feed intake. At the end of the four weeks (8weeks from day old) six birds were randomly selected from each treatment, the birds were starved for 24 hours and slaughtered human decapitation of the neck. They were dressed and weighed to determine the dressing weight; certain organs like gizzard, heart, liver, thigh, breast, head and neck were weighed by the use of an electronic sensitive scale.

Statistical Analysis: Data collected were subjected to analysis of variance procedure as described by Steel and Tories (2000). The mean separation for significant effect was done using Duncans New Multiple Range Test.
Statistical model Yij=u+Ti+Eij
Where Yij=overall observation
U=overall mean
Ti=effect of treatment
Eij=error term

RESULTS AND DISCUSSION

Table 2 shows that the gizzard of finishing broiler fed 0% dietary GNP had a significant lower value ($p<0.05$) when compared to the birds on 5, 10 and 15% dietary level of GNP. There was an observed increase in the parameter as the level of GNP increased; this may be attributed to the high level of fibre present in the experimental diet which agrees with an earlier report that fibre in monogastric diets specifically has a mechanical effect on gizzard and cause the gizzard to increase (Ahmed and Olorede, 2003). However, there was no significant difference ($p>0.05$) when the birds on 5 and 10% were compared.
For the heart and liver, the birds on the control were significantly affected by the treatment ($p<0.05$) the values observed for these parameters increased linearly ($p<0.05$) up to the 10% level of GNP after which the values declined at 15% inclusion. The increase observed for the control, 5 and 10% GNP was in agreement with (Ugwu and Onyinmanyi 2008) who argued that the presence of anti-nutrient triggers these organs. Hence, the higher values observed for these parameters could possibly be attributed to the presence of anti-nutritional factors in the feed, which also agreed with Ajayi *et al*., (2015) who reported that groundnut pod contains high level of anti-nutrients if not processed. However, the cause for the decrease at 15% GNP remains unclear.

Table 2: Organ characteristics of broilers fed varying dietary levels of groundnut Pod

Organs (g)	Dietary Levels of Groundnut Pod			
	0%	**5%**	**10%**	**15%**
Gizzard	49.20 ± 6.15^{a}	55.70 ± 1.91^{b}	55.80 ± 1.09^{b}	58.55 ± 0.78^{c}
Heart	8.43 ± 0.08^{a}	8.80 ± 0.12^{b}	10.34 ± 0.74^{c}	8.50 ± 0.12^{b}
Liver	45.45 ± 2.31^{a}	50.30 ± 2.45^{b}	54.50 ± 5.60^{c}	37.65 ± 2.27^{d}

^{abcd} means with different superscript along the row are significantly different ($P < 0.05$) ($n = 6$)

Table 3 shows carcass weight of broilers fed varying dietary levels of GNP. The final body weight and breast weight of the birds on (the control) 0% had no significant difference when compared to the birds on 15% GNP, although there was an observed increase in these parameters up to 10% inclusion of GNP but declined at 15% inclusion, this could be attributed to higher level of fibre which might have reduced the palatability of the experimental diets which would affect the feed intake ,hence affecting the muscle formation and the weight but significantly lower ($p<0.05$) when compared to the birds on 5% and 10%, which had no significant difference ($p>0.05$).
For the eviscerated weight, head and neck and residual weight, there was no significant difference ($p<0.05$) within the birds on the control, 5%, 10% and 15% when compared.
For the dressing weight, the birds on 15% GNP had a significant lower value ($p<0.05$) when compared to the birds on the control, 5 and 10% GNP. However, there was no significant difference ($p>0.05$) between the birds on the control, 5% and 10%
For the thigh weight, the birds on the control had a significant higher value ($p>0.05$) when compared to the birds on 5, 10 and 15% GNP but there was no any significant difference ($p>0.05$) between the birds on 5, 10 and 15% GNP

Table 3: Carcass Weight of broilers fed varying dietary levels of groundnut pod

Parameters (kg)	Dietary Level of Groundnut Pod (%)			
	0	**5**	**10**	**15**
Final Body Weight	2.12 ± 0.08^{a}	2.50 ± 0.07^{b}	2.55 ± 0.11^{b}	2.10 ± 0.09^{a}
Eviscerated Weight	1.33 ± 0.12	1.45 ± 0.08	1.40 ± 0.13	1.15 ± 0.15
Dressing Weight	1.60 ± 0.10^{a}	1.62 ± 0.17^{a}	1.65 ± 0.08^{a}	1.40 ± 0.14^{b}
Thigh Weight	0.60 ± 0.07^{a}	0.43 ± 0.06^{b}	0.43 ± 0.05^{b}	0.35 ± 0.06^{b}
Breast Weight	0.20 ± 0.03^{a}	0.28 ± 0.02^{b}	0.27 ± 0.02^{b}	0.20 ± 0.01^{a}
Head and Neck Weight	0.10 ± 0.009	0.07 ± 0.01	0.10 ± 0.006	0.08 ± 0.24
Residual Weight	1.10 ± 0.13	0.63 ± 0.02	0.90 ± 0.24	1.00 ± 0.08

^{abcd} Row means with different superscript are significantly different ($P < 0.05$) ($n = 6$)

The average daily weight gain, daily feed intake, average weight gain and feed efficiency of the treatment were significantly affected. There was a significant increase for the values recorded for the control, up to 10% inclusion of GNP and declined at the 15% GNP. This suggests that finishing broilers can make maximum use of GNP up to 10% inclusion but the decrease at 15% inclusion may be attributed to the high fibre content of the feed which might have reduced the palatability of the experimental diets, hence the feed intake is reduced at this level of inclusion. Also, the reduction in weight gain at 15% inclusion could be attributed to the reduction in feed intake; moreover, the presence of anti-nutrients such as Tannin could also be a reason. This agrees with the report of Aleto, (1993) that, tannin in the biological system has the ability to chelate protein thereby impeding digestion. The finishing broilers fed varying dietary level of GNP in all the treatments did not show any significant weight difference ($p>0.05$) in the average feed conversion ratio, average initial life weight and average final life weight. This could be due to the better utilization of the GNP diet facilitated by the dietary nutrient balanced in the experimental diets. The methods of milling (fine meal) may also have contributed to the high degree of absorption which facilitated the degree of conversion of the nutrients into muscles. These agree with the report of Okorie, (2006) who argued that the method of milling may have aided the build-up of the muscular and structural tissues of the experimental broilers.

Table 4: Performance of Broilers fed varying dietary levels of Groundnut Pod

	Dietary Levels of Groundnut Pod			
Parameters	**0%**	**5%**	**10%**	**15%**
Average initial Life Weight (kg/bird)	0.570 ± 0.679	1.075 ± 0.021	1.125 ± 0.049	1.165 ± 0.049
Average Final Life Weight (kg/bird)	2.150 ± 0.071	2.350 ± 0.071	2.250 ± 0.071	2.120 ± 0.028
Average Daily Weight Gain	0.300^{a}	0.310^{a}	0.300^{a}	0.250^{b}
Average weight Gain	0.038 ± 0.018^{a}	0.039 ± 0.016^{a}	0.038 ± 0.015^{a}	0.031 ± 0.016^{b}
Daily Feed Intake (kg/bird)	0.138 ± 0.039^{a}	0.135 ± 0.028^{a}	0.135 ± 0.038^{a}	0.130 ± 0.031^{b}
Feed Conversion Ratio	3.630	3.460	3.560	4.190
Mortality	0.000	0.000	0.000	0.000
Feed Efficiency (%)	28.00^{a}	29.00^{a}	28.14^{a}	24.00^{b}

^{abcd} Row means with different superscript are significantly different ($P < 0.05$) ($n = 6$)

CONCLUSION

It was concluded that feeding finishing broilers 10 per cent dietary level of GNP yielded best carcass, and organ qualities! Hence, poultry farmers are encouraged to incorporate this level of GNP in finishing broiler's diet as it can be used without any negative effects on the carcass characteristics.

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Performance and Carcass Characteristics of Weaner Rabbits Fed Wild Sunflower (*Tithoniadi versifolia*) Inclusion in Their Diet

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Abstract: A ten-weeks study was carried out to determine the effect of Tithonia *diversifolia* inclusion on the nutrient digestibility, growth performance, organs and carcass characteristics of weaner rabbits. In a completely randomized design, twenty (8 weeks old) rabbits were randomly distributed into four dietary treatments. Treatment 1: *Tridaxprocumbens*, Treatment 2 :100% concentrates, Treatment 3: 50% *Tithoniadiversifolia*+ 50% concentrates, Treatment 4: 100% *Tithoniadiversifolia*. The results showed that there were significant differences ($P<0.05$) in the average weight gain, daily weight gain, feed intake, feed conversion ratio across the treatments. The rabbits in Treatment 2 and 3 shows better performance for all the parameters measured. Also, there were significant differences ($P<0.05$) in nutrient digestibility across the treatments. Crude protein, crude fibre, Ether extract, and Nitrogen free extract were significantly low in Treatment 4 (100%*Tithoniadiversifolia*) compared to other dietary treatments. There were significant differences ($P<0.05$) in the thigh, shoulder, back, chest, hot carcass and shrunk weight. Treatment 3 showing better performances in all the parameters. Therefore, rabbits can be fed 50% *Tithoniadiversifolia inclusion* without any adverse effect on the growth, nutrient digestibility, organ and carcass characteristics of the rabbits.

INTRODUCTION

The reduction on the reliance of importation of livestock feed in Nigeria has increased the demand and cost of conventional feedstuff (Togun *et al 2006*). Therefore, there is the need, to explore the use of non-conventional feed sources that have the capacity to yield the same output as conventional feeds, and perhaps at cheaper cost.

The recommended policy is to identify and use locally available feed resources to formulate diets that are as balanced as possible (Guèye and Branckaert, 2002). This strategy could help reduce the cost of production, and ensure cheaper meat production thereby making available the major crops for human consumption. The economization of feed cost using cheaper and unconventional feed resources is an important aspect of commercial rabbit production. (Bhatt and Sharma, 2001; Muriu *et al*., 2002)

Rabbits are efficient converters of feed to meat and can utilize 30% fibre as against10% by most poultry species Egbo *et al, (*2001). The enormous potential of Rabbits as a good source of animal protein is hinged on its attributes to thrive well on forages such as *Tridax procumbens, Tithonia diversifolia,* high reproductive potential with short gestation period, Taiwo *et al.,* (2004) early maturing, its proficiency, and ability to rebreed shortly after kindling (Odimba 2006).

Nutritionally, Rabbit meat has high protein content, low in fat, cholesterol, and highly digestible (, and highly digestibleYusuf *et al.,* (2011).

Rabbits utilize unconventional feeds like sunflower, which is cost effective and has high protein content of about 18% Olayeni *et al., ()*. A reason why attention is being shifted to rabbit production with the use of cheap feedstuffs such as *Tithonia diversifolia* is to raise the level of protein available for the populace.

Tithonia diversifolia belongs to the shrub family Astaracea. It is of high nutritional value containing all the known essential amino acids and also rich in minerals and vitamins especially the B-complex vitamins (Day and Levin,1954).

This study is designed to investigate the effect of feeding *Tithonia diversifolia* on the growth performance, digestibility status, organs and carcass characteristics of weaned rabbits.

MATERIALS AND METHODS

Experimental site: The experiment was carried out at the Rabbitry unit of Osun state University, Teaching and Research farm, College of Agriculture, Ejigbo campus, Ejigbo, Osun state.

Preparation of test ingredients: *Tithonia diversifolia* was harvested at its first inflorescence. The sunflower leaf meal was prepared by chopping the leaves into smaller units and air-drying leaves and succulent stalk on a

concrete floor of a well-ventilated roofed house to preserve its nutritive value as much as possible. The dried leaves were included with other feed ingredients.

Experimental animals and management: Twenty (20) weaned New Zealand male Rabbits were purchased from a reputable source. Upon arrival, the initial weight of the animals was obtained. Vitamins was also administered on arrival. The animals were randomly allocated to four dietary treatments with five replicates per treatments. The animals were managed intensively and housed in hutches. Daily routine management was carried out which includes cleaning, feeding twice daily. The animals were acclimatized for two weeks and the experiment lasted eight weeks.

EXPERIMENTAL DIET

Four experimental diets which consist of;
Treatment1: 100% Tridax *procumbens*
Treatment 2: 100% Grower's mash
Treatment 3: 50% *Tithonia diversifoia* + 50% Grower's mash
Diet 4: 100% *Tithonia diversifolia*

Gross Composition of Grower's Mash

Table 1

INGREDIENT	Percentage composition
Maize	47.7
Soya bean	20
Wheat offal	17
P.K.C	3.0
Bone meal	5.0
Oyster shell	6.5
Methionine	0.1
Lysine	0.1
Premix	0.5
Salt	0.1
	100

Calculated crude protein (%) 16.6
Metabolizable Energy (kcal/mg) 2600

Performance characteristics: The initial weight of the Rabbits were taken before allocating them into treatments, thereafter, data on their initial body weight, weekly feed consumed; changes in the body weight were collected. The weight gain and feed efficiency were determined on a weekly basis as follows:

Feed intake (g): A known quantity of feed given to the rabbits and left over was measured to determine both the daily and weekly feed intake.

Feed intake= feed supplied- left over

Weight gain (g): The initial body weight of the rabbits and also subsequent changes of weight on weekly basis were taken.

Weight gain= final weight- initial weight

Feed conversion ratio (FCR)

The FCR of the rabbits was determined by calculating the ratio of the feed intake to the ratio of the weight gain

$$FCR = \frac{\text{Feed intake (g)}}{\text{Body weight gain (g)}}$$

Digestibility study: During the 8th week of the experiment, feacal samples were collected for five days. A known quantity of feed was supplied and the feaces collected afterwards. The feacal samples were dried at 65^0C for a 24 hours period.

The dried feaces from each treatment were analyzed for the proximate constituent and the results were used for proximate analysis for crude protein, crude fibre, ether extract, ash and dry matter using AOAC (2005)

Digestibility of the nutrients was determined by the formula:

$$\text{Dry matter digestibility} = \frac{\text{Feed intake (g/dm)} - \text{Feacal output (g/dm)}}{} \times 100$$

Feed intake(g/dm)

% Nutrient digestibility = Nutrient in feed – Nutrient in feaces x 100 Nutrient in feed

Chemical analysis: Samples were analyzed chemically for its crude protein, crude fire, crude ash, ether extract and dry matter content according to the methods of A.O.A.C, 18th edition (2005)

Carcass and organ evaluation: The rabbits were tagged and fasted overnight. The animals were randomly selected from each treatment. The rabbit was slaughtered and fur removed by skinning. The carcass weight was determined after slaughtering. Blood was drained, then reweighed. Evisceration was carried out immediately. The bled weight, weight of the carcass, head and internal organs which includes the liver, heart and lungs were measured using a weighing balance.

Statistical analysis: All data collected were subjected to analysis of variance (ANOVA) and the significant differences were separated using Tukey HSD (Highest Significant Difference) of the same Analytical software (XLStat,2014)

RESULTS AND DISCUSSION

Table 2: Proximate Composition of Experimental Diet

Constituents	T1 *Tridax*	T2 Grower's mash	T3 Grower's mash +*Tithonia diversifolia*	T4 *Tithonia diversifolia*	SEM
DRY MATTER(%)	90.10^{b}	93.15^{a}	91.50^{b}	88.12^{c}	0.249
CRUDE PROTEIN(%)	22.98^{b}	19.25^{c}	22.05^{bc}	22.35^{a}	0.341
CRUDE FIBRE(%)	5.46^{c}	4.54^{c}	7.30^{b}	12.70^{a}	0.336
ASH(%)	3.10^{d}	5.50^{c}	10.30^{b}	15.70^{a}	0.190
ETHER EXTRACT(%)	5.10^{a}	5.50^{a}	3.50^{b}	2.11^{c}	0.275
NITROGEN FREE EXTRACT(%)	53.86^{c}	65.21^{a}	56.85^{b}	41.14^{d}	1.98

abcd means on the same row with different superscripts are significantly different (P<0.05)

Table 3: Performance Characteristics of Rabbits Fed Sunflower Inclusion In Their Diet

PARAMETER	T1	T2	T3	T4	SEM
Initial Weight(g)	1083.00	950	1033.00	1150	**55.28**
Final weight(g)	1250.00^{b}	1383.33^{a}	1450.00^{a}	950.00^{c}	**46.39**
Weight gain(g)	167.67^{b}	433.33^{a}	416.67^{a}	-200.00^{b}	**76.37**
Daily Weight gain (g)	4.66^{c}	10.32^{a}	9.92^{b}	-4.72^{c}	**1.56**
Average Feed Intake(g)	94.89^{a}	76.32^{b}	67.66^{c}	46.05^{d}	**10.13**
Feed conversion Ratio (g)	12.36^{d}	7.40^{b}	6.82^{a}	9.67^{c}	**1.26**

abcd means on the same row with different superscripts are significantly different (p<0.05)

Table 4: Apparent Digestibility of Nutrients by Rabbits to Inclusion of Sunflower in their Diets

CONSTITIUENTS	T1	T2	T3	T4	SEM
DRY MATTER (%)	88.07	89.58	90.05	90.06	1.05
CRUDEPROTEIN (%)	67.30^{b}	69.76^{b}	74.83^{a}	55.34^{c}	4.13
CRUDE FIBRE (%)	71.96^{b}	62.49^{d}	54.52^{c}	79.85^{a}	5.52
ETHER EXTRACT	55.02^{c}	61.86^{b}	72.07^{a}	55.74^{c}	3.94

NITROGEN FREE EXTRACT (%)	55.86[ab]	55.90[a]	42.98[a]	39.87[a]	0.98

abcd means on the same row with different superscripts are significantly different (p<0.05)

Table 5: Carcass characteristics of Rabbits fed sunflower Inclusion

PARAMETER (g)	T1	T2	T3	T4	SEM
RIGHT THIGH	83.37[a]	91.67[a]	101.2[a]	48.73[b]	5.19
LEFT THIGH	77.40[a]	91.47[a]	98.23[a]	52.10[b]	4.07
RIGHT SHOULDER	45.43[a]	52.17[a]	41.00[ab]	32.37[b]	2.82
LEFT SHOULDER	48.36[a]	44.03[ab]	50.33[a]	32.97[b]	3.23
HEAD	124.7	139.00	93.07	116.2	23.34
BACK	154.7[b]	200.53[a]	214.03[a]	98.03[c]	16.21
CHEST	121.17[ab]	156.17[a]	148.27[a]	89.23[b]	12.99
LEFT LEG	16.27	16.70	16.77	18.63	1.71
RIGHT LEG	17.57	17.30	16.10	16.90	1.12
LIVE WEIGHT	1183[b]	1383[ab]	1450[a]	950[c]	44.57
SKIN	111.67[b]	133.33[bc]	133.33[bc]	81.67[a]	22.33

abc means on the same row with different superscripts are significantly different (p<0.05)

Table 6: Organ Evaluation of Rabbits fed sunflower inclusion in their diet

PARAMETER(g)	T1	T2	T3	T4	SEM
LUNG	8.1[ab]	13.20[a]	10.80[b]	6.83[b]	1.21
HEART	2.80	3.37	3.07	2.63	0.30
LIVER	28.7[b]	47.4[a]	49.4[a]	20.9[b]	3.80
FULL GIT	198.8	239.80	256.17	187.23	18.50
KIDNEY	6.87[b]	9.97[a]	9.97[a]	7.60[b]	0.46

abc means on the same row with different superscripts are significantly different (p<0.05)

The proximate composition of all the experimental diets fed to the animals were given in Table2 The Crude Protein of *Tithonia diversifolia* in this study is 19.25% which is slightly higher than the value reported by Togun (2006), but similar to that of Olabanji *et al.,* (2007). The differences in the values in the values of Crude Protein may be attributed to the differences in the soil type in which the plants were grown as well as the stage of growth as at the time of harvest.

The value obtained for Ash 15.70% and Ether extract (2.11%) was similar to that obtained by Tonngent (2007) but varies with that of Olayeni *et al*., (2006). The differences in the values obtained may be due to the loss of some volatile minerals due to excessive heat during analysis. The value of the crude fibre 12.50% is lower than that obtained by Togun (2013) and this could be attributed to the stage of growth of the plant and the method of processing the meal.

Table 3 shows the initial weight, final weight, weight gain, daily weight gain, average feed intake, and feed conversion ratio of Rabbits fed sunflower inclusion in their diet. There was no significant differences (P>0.05) in the initial weight of the rabbits across the treatment. The weight range between 950g-1083g and this reflects

no difference as a result of homogeneity. The results however, shows significant difference (P<0.05) in all other parameters measured across the treatments.
Rabbits on treatment 3 has the highest value (1450g), followed by T2 (1383g), T1 (1250g) while T4 (950g) had the lowest value for average final weight and there was no significant difference (p>0.05) in the value obtained in treatment 2 compared to treatment 3. There were significant differences (P<0.05) in the average weight gain with treatment recording the highest value T2 (433.33g) recording the highest value, followed by T3 (416.67g), T1 (167.67g). In T4 there was marked decrease in weight gain (-200g). The same trend was observed for daily weight gain, with treatment 2 having the highest value.
There was significant difference (p<0.05) in the average feed intake across in the treatment. T1 recorded highest feed intake value (94.89), T2 (76.32g), T3 (67.66g), T4 (46.05g) while T4 recorded the lowest feed conversion ratio (12.36g) and T3 has the highest feed conversion ratio (6.82g). However, there were no significant difference (P<0.05) in the feed conversion ratio of T2 and T3. T4 recorded the lowest feed intake which in turn reflected on other parameters in the performance evaluation. The poor feed intake may be due to the non-palatability and anti nutrients in *Tithonia diversifolia* as reported by Dutta *et al* (2003) that animals feed consumption reduces with the presence of anti nutrients in it as well as the non-palatability of the feed ingredients.
Also, the results obtained was similar to the observations reported by Togun *et al.,* (2006) when *Tithonia diversifolia* was fed to Isa cocks. The marked decrease in weight gain may be attributed to that reported by Tangendjaja et al., (1998) that there is poor digestibility of leaf meal which tends to suppress the overall nutrient digestibility, if it constitutes a greater proportion of the diet. The improved weight gain, feed intake and feed conversion ratio of Rabbits in T3 was in line with the report of Ajayi (2007) when African wild sunflower leaf-blood mixture and Olabanji *et al.,* (2007) who reported better growth of Rabbits when fed Wild Sunflower leaf-based diet. This may be due to fact that when leaf meal is included in the meal of animals they tend to do well because of the inherent nutrients.
The table 4 shows the nutrient digestibility of the Rabbits.There were significant differences (P<0.05) for Crude Protein, Crude Fibre and Ether extract across the treatments. Rabbits on T3 recorded the highest digestibility (74.83%) for CP which may be due to that reported by Ajayi (2007), that there is increased protein digestion of African Wild sunflower when incorporated into other feed material. T3 recorded the least digestibility for fibre but also recorded highest digestibility for Ether extract which is essential for the growth of the animals. The result shows marked improvement in the digestibility of nutrient by animals in T2 and T3.
T4 recorded the least digestibility for CP and EE but highest digestibility for fibre. This could be as a result of poor digestibility of leaf meal which tends to suppress the overall nutrient digestibility, if it constitutes a greater portion of the diet. Tangendjaja (1998). Also, the poor digestibility could also be due to increased fibre digestion which tends to increase the rate of digesta in the gut Mc Donald (2000), thereby making the nutrients unavailable for use by the animals. The digestibility values of the nutrients obtained for *Tithonia diversifolia* in this study when included in the compounded feed, was lower than that recorded by Ajayi *et al*., (2007), when rabbits were fed Wild Sunflower leaf-blood mixture. The differences could be as a result of blood protein present in the mixture
Table 5 shows the values obtained for right and left thigh, right and left shoulder, right and left leg, head, chest, back and skin of the Rabbits fed sunflower inclusion. The results show significant difference (P<0.05) for the left thigh, right thigh, left shoulder, right shoulder, chest and back across the treatment. There was no significant difference (P>0.05) for head, left leg, right leg and skin across the treatments. Treatment 3 recorded the highest value (101.2g) (99.23g.) followed by T2 (91.67) (91.46), T1 (83.37g) (77.40g) and T4(48.73g) (52.10g) recorded the least for the right thigh and left thigh.
T2 recorded the highest values (52.16g) (50.33g), followed by T3 with (41.00g) (44.03), and T1 with (45.43g) (48.37g) and while T4 recorded (32.36g) (32.97g) having the least values for left shoulder and right shoulder respectively. Treatment 3 recorded the highest value of (214.03g) followed by T2 (200.53g), T1 (154.47g) and T4 recorded the least (98.03) for the back. Treatment 2 recorded highest value (156,17g), T3 (148.27g), T1 (121.17g), and least value T4 (89.23g). For all the carcass parameters there was no significant difference (P>0.05) between
Treatment 2 and Treatment 3, this may be due to the statistical indifference in the live body weight of the Rabbits in this treatment. There was no significant difference (P>0.05) for the head, left leg, right leg and skin. Treatment 2 recorded the highest values (139.07g), T1(124.77g), T3(116.17g) and T4 (93.07g) for the head.
Treatment 4 recorded highest values for (18.63g) (16.90g), T1 (17.57g) (16.27g), T2 (17.30g) (16.70g) and T3(16.77g), (16.10g) respectively. Treatment 2 and 3 recorded the highest values of (133.33g), T1 (111.67g),

and T4 (81.67g) for the skin. The differences in the values obtained may be due to the various treatments the animals were subjected to as well as the differences in the feed intake of the animals. For all the parameters the least significant ($P<0.05$) values were observed for all values in T4. The reduction in values (T4) for all parameters may be due to the value of the live weight of the Rabbits in this treatment as compared to other Rabbits across the other treatment which had higher live weight.

Table 6 shows the lung, heart, liver, kidney, full gastro intestinal tract, of the Rabbits fed sunflower inclusion. The results show significant difference ($P<0.05$) for the lung, liver and kidney across the treatment. There was no significant difference ($P>0.05$) for heart and full GIT across the treatments. Treatment 3 recorded the highest value (13.20g), followed by T3 (10.80), T1 (8.1g) and T4 (6.83g) recorded the lung. T3 recorded the highest value (49.4g), followed by T2 (47.4g), T1 (28.7g) and T4(20.9g) recorded the least for liver. Treatment 2 and 3 recorded highest value (9.97g), T4 (7.60g), and T1 recorded least (6.87g)

T2 recorded the highest value (3.37g), followed by T3 (3.07g), T1 (2.80g) and T4(2.63g) recorded the least for heart.

The values recorded for the lungs, liver, heart, and kidney for T3 was similar to the values reported by Togun., *et al* (2006) when *Tithonia diversifolia* was fed at 20% inclusion to male Rabbits. However, the results obtained for T4 was lower than to that reported by Akinola (2007) when mango-based diet was fed to weaners rabbit.

The differences in values obtained may be due to the varying level of inclusion of *Tithonia diversifolia* which may indicate that as the inclusion level increases the availability of anti nutritional factors which may cause reduction in organ weight increases. Togun *et al.,* (*2006*)

CONCLUSIONBased on this study, *Tithonia diversifolia* if included in diets at 50% inclusion can enhance feed intake, growth rate and nutrient digestibility, although it can be solely fed to rabbit unlike other forages like *Tridax procumbens* as it adversely affected the animals.

Further study on the anti nutritional factors in *Tithonia diversifolia* is recommended.

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Effect of Replacement of Groundnut Haulms with Lablab (*Lablab purpureus*) Leaf Meal on Growth Performance and Nutrients Digestibility in Weaner Rabbits

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Abstract: A feeding trial was conducted to determine the effect of replacing groundnut haulms with lablab (*Lablab purpureus*) leaf meal on growth performance and nutrients digestibility of weaner rabbits. Five diets were formulated containing groundnut haulms replaced with Lablab leaf meal (LLM) at dietary levels of 0, 25, 50, 75 and 100% designated as Treatment 1, 2, 3, 4, and 5 respectively. Thirty (30) mixed breeds (Mongrels) of weaner rabbits (Males) of averagely equal weight (491.33- 499.33g) were used for the experiment. Diets were allotted to rabbits in a completely randomized design and each treatment was replicated 3 times consisting of 2 rabbits per replicate. The experiment lasted 7 weeks. The results on performance showed there were significant differences ($P < 0.05$) in the final body weights (1409.33- 2048.67g),, daily weight gain (19.40 - 31.62g) daily and feed intake (83.22 -.94.56g) The result of nutrients digestibility revealed that there were significant differences ($P < 0.05$) in dry matter, crude protein, crud fibre and ether extract. Highest values of dry matter, crude protein and crude fibre digestibilities were recorded for rabbits fed 50% LLM diet compared to other treatments having 84.33%, 80.00%) and 84.75 respectively. The feed conversion ratio value (FCR) was recorded lower in T3 with 2.98 and the highest value for FCR was observed in T5 (100%) with 4.45. This indicated that the combination of 50% LLM with groundnut haulms was the best compared to other treatments. The feed cost/Kg gain was significantly ($P<0.05$) lowest in T3 (N149.17) compared to other treatments. It was therefore concluded that groundnut haulms can be replaced with lalab leaf meal up to 50% dietary level without any adverse effect on performance and nutrients digestibility in weaner rabbits.

Keywords: Groundnut haulms, Lablab leaf meal, weaned rabbits, performance and nutrients digestibility

INTRODUCTION: Rabbits have been recognized to have a very important role to play in the supply of animal protein to Nigerians especially in the rural and peri-urban areas [1]. Rabbit production has enormous potential in alleviating the problems of animal's protein supply in developing countries. The prolific nature of rabbit coupled with its short gestation period, generation interval and cheap cost of production makes its the choice for meeting the demand of animal protein [2]. Conventional feed ingredients are becoming too expensive in feeding livestock to produce animal protein. Thus, the use of non- conventional feed resources has become essential to reduce the cost of production of animal protein [3]. The objective of this study was to determine the effect of replacing groundnut haulms with lablab leaf meal on growth performance and nutrients digestibility in weaner rabbits.

MATERIALS AND METHODS

Experimental Site: This study was conducted at the Teaching and Research Farm of the Department of Animal Science, Kano University of Science and Technology, Wudil. The farm is located on latitude 11^0 37'N and

longitude 8^0 58' E at an altitude of 403 m above sea level. The mean annual rainfall is 890 mm. the average relative humidity and temperature are 75% and 26^0C, respectively [4].

Experimental Diets: Lablab leaves was purchased from National Animal production Research institute (NAPRI) Zaria, sun-dried for 7 days and milled into coarse particles. Five experimental diets were formulated containing groundnut haulms replaced with Lablab leaf meal at dietary levels of 0, 25, 50, 75 and 100% designated as T1, T2, T3, T4, and T5 respectively. The crude protein and crude fibre of lablab leaf meal were evaluated as 12.98 and 27.19 respectively as described by proximate analysis method [5].

Experimental Animals, Design and management: A total of thirty (30) weaner rabbits (Mongrels) of averagely equal weight were allocated to experimental diets in a completely randomized design and each treatment was replicated 3 times consisting of 2 rabbits per replicate. The room where the cages were kept was well ventilated with enough windows covered with wire mesh. It was fully protected against predators and any possible environmental hazard such as rain and wind storm. The experimental animals were immediately treated with anti-coccidia, Iverrmectin and antibiotics (Oxytetracycline soluble powder) as prophylaxis treatment. Rabbits were carefully monitored and subjected to adhered routine management. The experiment lasted 7 weeks. Water was given *ad libitum.*

Data collection: The initial weights of rabbits were recorded immediately at the beginning of the study. The rabbits were then re-weighed on weekly basis to determine the weight gain. The daily feed consumption was determined by subtracting leftover from amount offered to rabbits. The feed conversion ratio was also determined by calculation as ratio of daily feed consumed to daily weight gain. The feed samples (diets) and faecal samples from each replication were collected for 2 weeks, weighed, oven dried and evaluated for proximate compositions. The amount of nutrients digested by rabbits were then calculated

Data analysis: Data collected were subjected analysis of variance (ANOVA) using statistical analysis system (SAS) [5]. Significance differences among the means were separated using Duncan's multiple range test.

RESULTS AND DISCUSSION: The results on performance are presented in Table 2. The results showed there were significant differences ($P<0.05$) in the final body weights, daily weight gain daily and feed intake. The highest value (2048.67g) for final body weight was observed in T3 (50%) and the lowest value 1409.33g) was recorded in rabbits fed T5 (100% LLM diet). Similarly, the daily weight gain by rabbits was significantly ($P<0.05$) highest for rabbits fed T3 (31.620g) and lowest in rabbits fed T5 (100% LLM) (19.400g). This agrees with [7] who reported an increase in daily weight gain after feeding rabbits with Mulberry leaves-based diets. The daily feed intake by rabbits as recorded highest value in rabbits fed T3 (50% LLM diet) having 94.33g and the lowest value (83.23g) was recorded in T5 (100% LLM). This agrees with the report of [8] who recorded higher feed intake with increasing level of crude fibre in the diets of rabbits. The feed conversion ratio (FCR) was significantly different ($P < 0.05$). The FCR value was recorded better in T3 (50% LLM diet) with value of 2.98 and the worst value was observed In T5 (100%) with 4.45. This indicated that 50% combination of groundnut haulms and lablab leaf meal was the best. This is similar to the findings of [9] who reported that the lower the FCR the better the diet. The feed cost/Kg gain was significantly different ($P<0.05$) with lowest and better value of cost in T3 (N149.17) compared to others. This may due to efficiency in feed utilization by rabbits. This agrees with the finding of [10] who reported that the lower feed cost per Kg gain the higher savings in rabbits fed varying levels of groundnut haulms.

The result of nutrients digestibility is presented in Table 3. The results showed that there were significant differences ($P<0.05$) in dry matter, crude protein, crud fibre and ether extract digestibilities. Highest value of digestibility for dry matter was recorded in T3 (84.33%) and lowest value was recorded at T5 (67.67%). The digestibility of crude protein was observed to be highest in T3 (80.00%) and lowest value were found to be for those fed T5 (64.00%). The digestibility of crude fibre was significantly affected ($P<0.05$) with inclusion level of lablab meal and recorded highest in T3 (84.75%) and the lowest value at T5 (55.00%). This observation agrees

with that of [11] who had earlier reported significant decrease in crude fibre digestibility with increasing level of fiber in the diets.

Table 1: Composition of weaner rabbits diets containing Groundnut haulms replaced with Lablab leaf

	Treatments				
Ingredients	**T1 (0%)**	**T2 (25%)**	**T3 (50%)**	**T4 (75%**	**T5 (100%)**
Maize	38.02	38.02	38.02	38.02	38.02
Soya bean meal	15.99	15.99	15.99	15.99	15.99
Groundnut haulms	15.99	11.99	7.99	4.00	0.00
Lablab leaf meal	0.00	4.00	8.00	11.99	15.99
Wheat offal	25.50	25.50	25.50	25.50	25.50
Bone meal	3.50	3.50	3.50	3.50	3.50
Salt	0.30	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Vitamin premix	0.30	0.30	0.30	0.30	0.30
	100	100	100	100	100
Calculated analysis					
Crude protein	18.00	18.00	18.00	18.00	18.00
Crude fibre %)	11.48	11.8	12.38	13.04	11.97
Metabolizable energy Kcal/kg	2567	2538	2628	2671	2666

Table 2: Performance of weaner rabbits fed diets containing Groundnut haulms and Lablab leaf meal

	Treatments					
Parameters	**T1 (10%)**	**T2 (25%)**	**T3 (50%)**	**T4 (75%)**	**T5 (100%)**	**SEM**
Initial body weight (g)	498.00	496.67	499.33	493.33	491.33	7.94
Final body weight (g)	1554.00^{bc}	1618.00^{b}	2048.67^{a}	1471.00^{cc}	1409.33^{c}	43.16
Daily weight gain (g)	21.553^{bc}	22.88^{b}	31.62^{a}	19.95^{c}	19.40^{c}	0.75
Daily feed intake (g)	94.56^{a}	94.15^{a}	94.33^{a}	85.33^{b}	83.22^{b}	1.68
Feed conversion ratio	4.39^{a}	4.12^{b}	2.98^{c}	4.27^{b}	4.45^{a}	0.12
Feed cost N/ Kg gain	219.61^{a}	189.82^{b}	149.17^{c}	213.83^{a}	222.67^{a}	5.93

^{abc} = Means with different superscript are significantly different (P<0.05), SEM= Standard Error of Means

Table 3: Nutrients digestibility of grower rabbits fed diets containing Groundnut haulms and Lablab leaf meal

	Treatments					
Parameters	**T1 (10%)**	**T2 (25%)**	**T3 (50%)**	**T4 (75%)**	**T5 (100%)**	**SEM**
Dry matter (%)	70.67^{b}	79.67^{a}	84.33^{a}	84.32^{a}	67.67^{c}	0.50
Crude protein (%)	64.77^{c}	67.75^{bc}	80.00^{a}	73.00^{b}	64.00^{c}	1.81
Crude fibre (%)	65.00^{c}	75.00^{b}	84.75^{a}	84.33^{a}	55.00^{c}	1.02
Ether extract (%)	77.33^{a}	64.75^{c}	78.00^{a}	72.33^{b}	62.33^{c}	1.27
Ash (%)	73.00	74.33	69.75	75.33	57.75	5.24
Nitrogen free extract (%)	67.33^{c}	74.00^{cb}	86.75^{a}	76.67^{b}	67.00^{c}	2.24

^{abc}=Means with different superscripts on the same row are significantly different (P<0.05), SEM = Standard Error of mea

CONCLUSION

Based on the results obtained this study. It was therefore concluded that groundnut haulms can be replaced with lablab leaf meal up to 50% dietary level without any adverse effect on performance and nutrients digestibility of weaner rabbits.

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Heamatological Parameters of Broiler Chickens fed Uncultivated Sorrel Leaves as Dietary Fibre Source

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Abstract: An experiment was conducted to assess the blood parameters of broiler chickens fed dried uncultivated sorrel leaves (DUSL). The DUSL was collected from the wild an incorporated into broiler diets as a source of fibre at 0% (control), 20%, 40, 60%, 80%, and 100% designated as treatment 1, 2, 3, 4, 5 and 6 respectively. The control was fed wheat offal diet (10% at the starter and 15% at finisher phase respectively). One hundred and twenty (120) Anak 2000 day old chicks were randomly allocated to six (6) treatments replicated twice in a completely randomized design (CRD). The experiment lasted for eight (8) weeks. Results showed that there was no significant difference in all the blood parameters measure ($P<0.05$). It can be concluded that DUSL can be incorporated into broiler diets as a source of fibre up to 100% without deleterious effects on carcass yield and gut characteristics.

Keywords: Uncultivated sorrel, Broilers, hematological parameters

DESCRIPTION OF PROBLEM

The broiler industry in Nigeria is characterized by high production cost which is the major constraint resulting in low profit margins. It is therefore necessary to look for cheaper and simple ways of getting animal protein required for normal body growth and metabolism using agricultural waste with least cost (Maidala and Bakoji, 2016). Heamatological parameters both in human and animal sciences are important indices in physiological state of individuals (Bhatti *et al*., 2009: Maidala *et al*., 2014). Blood in animal's body serves as a medium of transporting nutrients absorbed from the digestive system or released from storage in adipose tissues or in liver. The blood picture changes with advancement of animal with age and with certain conditions such as nutrition. The heamatological parameters which are of significant diagnostic values include the packed cell volume (PCV), hemoglobin (Hb), total protein (TP) and Serum globulin (SG) are known to affect health, production and adaptability to environmental conditions in livestock (Adenkola *et al*., 2011). The prices of animal products are therefore beyond the reach of the average Nigerian owing to the increase in the production and maintenance cost of farm animals. This has necessitated the renewal of interest in exploring neglected or underutilized feedstuff. Not much has been done in evaluating the potential feed value of DUSL (*Hibiscus subdariffa*). The plant is in abundance in the wild throughout north eastern Nigeria.

MATERIALS AND METHODS

This experiment was conducted at the poultry unit of school of undergraduate College of Education, Azare farm. Azare is in Katagum local government area of Bauchi State. Katagum local government is situated on the northern part of Bauchi state, Nigeria. It is located between latitudes 11^0 42' and 11^0 40^0 and longitude 10^0 31' and 10^0 11' east (Anon, 2009). One hundred and twenty (120) Anak 2000 day old chicks were randomly allocated to six (6) treatments of experimental diets. Each treatment was replicated two times (8) birds per replicate. The experimental diets used were 0% (DUSL, wheat offal based diet) while 20%, 40%, 60%, 80%, and 100% DUSL replacing wheat offal at 10 and 15% levels for starter and finisher respectively. The design of the experiment was completely randomized design (CRD). The birds were vaccinated with Gumboro and Lasota vaccine at the required age of vaccination. The DUSL was collected from wild, sun dried for 7 days and ground

it with hammer milling machine before it was incorporated into the feed. The percentage composition of the experimental diets is given in table 1 and 2 respectively.

Data collection: A total of 2 birds were randomly selected from each of the replicate groups. Samples of blood were collected from the brachial vein using 2ml disposable syringe and needle, the blood were stored in a blood samples bottles with and without anticoagulant (EDTA). Blood samples were analyzed for hematological parameters according to routine available clinical methods described by Bush (1975). The mean corpuscular haemoglobin concentration (MCHC), Mean corpuscular hemoglobin (MCH) and mean corpuscular volume (MCV) were calculated according to Jain (1986).

MCV (μm^3) = $\frac{PCV \times 10}{RBC\ (million/mm}$

MCH (pg) = $\frac{Hb\ (g/100ml \times 10}{RBC\ (million/mm)}$

MCHC (%) = $\frac{Hb\ (g/100ml \times 100}{PCV\ (\%)}$

Data analysis: The data collected for all the parameters carcass parameters were subjected to analysis of variatnce technique. ANOVA balanced design Steel and Torrie, 1980 where significant difference exist leas significance difference can be used to separate the means.

RESULTS AND DISCUSSIONS

The percentage compositions of the experimental diets were shown in Table 1 and 2 for broiler starter and finisher respectively. The crude protein and metabolizable energy of the diets were adequate for broiler production in tropics (Atteh, 2002). The blood parameters were shown in Table 3 and results showed that heamoglobin, packed cell volume, white blood cells, mean corspcular heamoglobin, mean corspcular heamoglobin concentration were not affected by different levels of uncultivated sorrel leaves ($P<0.05$). This indicated proper utilization of sorrel leaves as asource of fibre, protein and energy metabolism was not affected by different levels of uncultivated sorrel leaves. The different blood parameters reported in this work are within the range of values reported Benergee, 2005 for healthy broiler chickens. It can be concluded that uncultivated sorrel leaves can be used as a source of fibre to broilers up to 100% without effects in blood parameters.

Table 1: Percentage composition of experimental diets fed to broiler chickens at starter phase (1-4 weeks of Age)

Ingredients	Control	20%	40%	60%	80%	100%
Maize	45.25	45.25	45.25	45.25	45.25	45.25
Soya bean	35.85	35.85	35.85	35.85	35.85	35.85
Wheat offal	10.00	8.0	6.00	4.0	2.00	00.00
Sorrel leaves	0.00	2.00	4.00	6.0	8.00	10.00
Fish meal	5.00	5.00	5.00	5.00	5.00	5.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Lysine	0.20	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20	0.20
Salt (Nacl)	0.25	0.25	0.25	0.25	0.25	0.25
Premix *	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated analysis						
Crude protein	23.00	23.00	23.00	23.00	23.00	23.00
Metabolizable energy	2800	2800	2800	2800	2800	28.00
Crude fibre	4.56	4.56	4.56	4.56	4.56	4.56

*Each kilogram contains; vit. A, 10,000,000 IU, vit.D_3 2,000,000 IU, Vit.E 23,000mg, Vit.K_3 2.000mg, Vit, B_1 1,800mg, Panthothenic Acid 7,500mg, Vit.B_6 3,000mg, Vit. B_{12} 15mg, Folic acid 750mg, Biotin 11260mg, Choline Chloride 300,000mg, Cobalt 200mg, Copper 3,000mg, Iodine 1,000mg, iron 20,000mg, Manganese 40,000mg, Selenium 200mg, Zinc 30,000mg, Antioxidant 1,250mg

Table 4: Percentage composition of experimental diets fed to broiler chickens at finisher phase 0 (5-8 weeks) of age

Ingredients	**Control**	**20%**	**40%**	**60%**	**80%**	**100%**
Maize	48.45	48.45	48.45	48.45	48.45	48.45
Soya bean	27.65	27.65	27.65	27.65	27.65	27.65
Wheat offal	15.00	12.00	12.00	6.00	3.00	00.00
Sorrel leaves	0.00	3.00	6.00	9.00	12.00	15.00
Fish meal	5.00	5.00	5.00	5.00	5.00	5.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Lysine	0.20	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20	0.20
Salt (Nacl)	0.25	0.25	0.25	0.25	0.25	0.25
Premix*	0.25	0.25	0.25	0.25	0.25	0.25
Total	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*
Calculated analysis						
Crude protein	21.00	21.00	21.00	21.00	21.00	21.00
Metabolizable energy	3000	3000	3000	3000	3000	3000
Crude fibre	5.65	5.65	5.65	5.65	5.65	5.65

*Each kilogram contains Vit A 3600, 000IU. Vit.D_3 600.000 IU.Vit E 4.000.000mg. Vit B_1-B_6 640, 1600, 600, 4.00mg.Panthothenic acid 2000mg, Biotin 300mg. Manganese 16000mg. Manganese 16000mg. Selenium 80mg. Vit. K_3 600mg. Cobalt 80mg. Copper 1200mg. Zinc 12,000mg. Folic acid 200mg. Choline chloride 700000mg. Antioxidant 500mg.

Table 3: Hematological parameters of broilers fed sorrel leaves as source of fibre

Parameters	**Control 1**	**20% 2**	**40% 3**	**60% 4**	**80% 5**	**100% 6**	**SEM**
Heamoglobin (g/dl)	9.10	10.51	9.05	10.85	10.30	11.00	NS
Packed cell volume (%)	30.50	31.50	27.00	32.50	32.00	32.50	NS
White blood cells (u x 10^3)	253.00	228.70	209.15	226.00	221.35	243.65	NS
Red blood cells (ul x10^3)	1.95	2.13	2.11	2.25	2.45	2.35	NS
MCH (%)	156.41	147.88	127.96	144.44	130.61	138.30	NS
MCH (µm^3)	4.66	4.93	4.28	4.88	4.20	4.68	NS
MCHC (%)	0.30	0.33	0.34	0.33	0.32	0.34	NS

SEM= Standard error of means, *= (P<0.005), NS= Not significant

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Performance and Carcass Characteristics of Hubbard Broiler Chickens Administered Varying Dosages of Aqueous Extract of Tamarind (*Tamarindus indica*) Pulp

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Abstract: The study was conducted to determine the growth performance and carcass characteristics of broilers supplemented with varying dosages of aqueous tamarind extract in a drinking water. A total of 300 day –old chicks were randomly distributed into four treatment groups, replicated 5 times with 15 broilers per replicate. The control group was given 0g/5L tamarind aqueous extract while the other groups received 36g/5L, 72g/5L and 108g/5L tamarind aqueous extract in drinking water respectively. Feed and water were provided *ad libitum* throughout the experimental period. The growth performance of broilers was evaluated based on their feed consumption, live weight, feed conversion ratio (FCR) while the carcass characteristics was evaluated based on the dressing weight, slaughter weight and carcass weight. The result of the growth performance showed that there was no significance difference ($p>0.05$) between the growth parameters and the feed conversion ratio (FCR) of the broiler chickens. The highest feed intake was recorded in T4 administered 108g/5L of Aqueous extract of tamarind pulp (AETP) which also recorded the highest average weight gain (901.37g). There was also no significance difference ($p>0.05$) in the carcass characteristics of the broiler chickens. It was concluded that up to 108g/5L of drinking water can serve as a natural alternative to antibiotics for optimal growth of the birds.

Keywords: Tamarind Pulp, Growth Performance, Aqueous Extract, Carcass Characteristics

DESCRIPTION OF PROBLEM

Due to rising human population, there is an increase in the demand for protein (1). In order to meet this demand, there is rise in the production of both animal and plant protein. Poultry meat is a good source of animal protein that has contributed in the consumption of animal protein (2). Research on the introduction of feed supplements and additives is also on the increase (2). Antibiotics being a growth enhancer in poultry in the past have a potential side effect on public health (3). The international ban on the use of antibiotics in animal feeds as increased the effort of researchers to study the natural source of antibiotics (4) and example of such natural source of antibiotics is the tamarind. Initially, the fruit shows a reddish- brown colour that turns black or brown becoming more aromatic and sour on ripening. It is a fruit pulp used for seasoning as a food component and in juices (5). Tamarind fruit has high level of carbohydrate and protein more than most fruit but contains a smaller amount of Vitamin A and iron (6). The aim of this study is to determine the effect of aqueous tamarind pulp extract as antibiotics on the performance and carcass characteristics of Hubbard broiler chickens.

MATERIALS AND METHODS

The experiment was carried out at the Poultry and Rabbitry unit of the Teaching and Research Farm of the Department of Animal Production, Federal University of Technology, Minna, Niger State. Minna is located in the Southern Guinea Savannah Vegetation Zone between latitude $9^0$28' North to $9^0$37' North and longitude $6^0$23' East to $6^0$33' East with annual rainfall of 1000mm – 1500mm and average temperature of 32^0C (NSADP, 2009). The sticky tamarind pulp was soaked in water and washed with hands to separate the seeds from the pulp. The pulp and the water mixture were then blended to get homogenized solution. The treatments were labeled T1 (0g/5L), T2 (36g/5L), T3 (72g/5L), and T4 (108g/5L) respectively. 300-hundred-day old broiler chicks were used for this study. The chicks were randomly allotted to four treatments with 5 replicates per treatment in a completely randomized design (CRD). Each replicate has 15 birds which were raised on deep litter system. Feed and water were provided ad-*libitum*. Data were collected on feed intake, weight gain, feed conversion ratio and

carcass evaluation. Feed intake was measured by finding the difference between feed served and feed leftover. Body weight was taken weekly and calculated by dividing the total weight of the birds by the number of the birds in each replicate. The feed conversion ratio was determined by measuring the feed utilization efficiency as average feed intake/ average weight gain. At the end of the experiments, two birds were randomly selected from each replicate and starved overnight. The selected birds were weighed individually before slaughtering. The slaughtered weight, defeathered weight and dressed weight were recorded. Data obtained from this experiment were subjected to statistical analysis using analysis of variance (ANOVA) as described by (7). Treatment means were compared and separated using (8).

Table 1: Performance characteristics of Hubbard broiler chickens administered varying dosages of aqueous tamarind extract

Parameter	T1 (0g/5L)	T2 (36g/5L)	T3 (72g/5L)	T4 (108G/5L)	SEM
Feed Intake (g)	1511.36	1477.89	1511.68	1546.89	61.60
Water Intake (ml)	3428.74	3479.00	3526.91	3498.89	124.82
Average Weight Gain (g)	836.80	887.43	891.74	901.37	54.99
FCR	3.49	3.51	3.46	3.47	0.68

Table 2: Carcass Characteristics of Broiler Chickens Administered Varying Dosages of Aqueous Tamarind Extract

Parameters (g)	T1(0g/5L)	T2(36g/5L)	T3(72g/5L)	T4(108g/5L)	SEM
Live Weight	1560	1640	1580	1430	19.83
Slaughter Weight	1390	1480	1430	1420	18.28
Dress Weight	1350	1440	1380	1380	15.76
Carcass weight	1142	1240	1230	1230	18.09
Gizzard Weight	180	120	200	110	27.02
Intestine weight	190	200	170	178	7.49

RESULTS AND DISCUSSION

The feed intake, feed conversion ratio and average daily weight gain of broiler chickens that were administered varying doses at 36g/5L, 72g/5L and 108g/5L in their drinking water is represented in Table 1. During the period of the experimental trial, the average daily weight gain of broiler chickens that were administered 108g/ 5L water was significantly higher than the average daily weight gain of broiler chickens that received aqueous extract at T (0g/5L), T (36g/5L) and T (72g/5L) in their water. During the entire experimental period, the average daily weight gain tended to be highest in the group that received aqueous tamarind pulp extract at 108g/5L, though the difference in weight gain between the groups were not significant ($p>0.05$). Throughout the experimental period, the feed intake and feed conversion ratio of the broiler chickens in all groups were not significantly different ($p>0.05$). The reason in increase in water intake as the aqueous tamarind extract increases could be attributed to its appetizing effect according to (5). However, (10) who studied the effect of tamarind on broiler diets recorded a decreasing feed intake with increase in the tamarind pulp extract, which is attributed to the nature of the feed. (9) studied the effect of crude aqueous and ethanol extract of tamarind as antibacterial and they found that the ethanol extract produces strong antibacterial against *Escherichia coli*. The carcass characteristics of broiler chickens administered varying doses of tamarind extract is shown in Table 2. This study agrees with the findings of (10) who reported that there was no significant difference ($p>0.05$) in all treatments on slaughter and dressed weight of the broiler chickens. It was observed for the cut parts with the group on 36g/5L of water recording the highest slaughter weight, dress weight, dress weight and intestinal weight.

CONCLUSION AND APPLICATION

This present study concludes that the feed intake, weight gain and feed conversion ratio of broiler chickens were not affected when administered varying dosages of aqueous extract of tamarind pulp as well as the carcass characteristics without any deleterious effect on the carcass yield and the yield of cut- up parts of broiler chickens.

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Acute toxicity and Hematological conditions of Broiler Birds fed with raw *Hura crepitans* Extract

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Abstract: This study was conducted to evaluate the acute toxicity of raw *Hura crepitans* (sandbox) seed extract using broiler birds. Forty-eight unsexed 28day old chicken of average weight (650± 0.283) were randomly allotted to four groups of 12 birds each of three replicates with each replicate having four birds. The birds were drenched with 0mg/kg, 1000mg/kg, 2000mg/kg and 3000mg/kg of *Hura crepitans* extracts (HCE) which represent groups I, II, III and IV respectively. At the end of 24hours, blood samples were collected through wing vein from a bird per replicate and analyzed for haematological indices. The heamatological indices showed significant differences, with notable reduction in red blood cells (RBC), packed cell volume (PCV) and hemoglobin- (Hb) on birds drenched with 2000mg/kg and 3000mg/kg doses of the extract. The results also showed that after 8 hours of the extract administration, birds on (3000mg/kg) dose became dizzy with some diarrheic droppings. Birds on treatments I, II, and III did not show any sign of dizziness and diarrheic dropping. However, 14 hours after the extract administration, birds on treatment III showed dizziness but with no diarrheic droppings. No death was recorded in any of the dosage. It was evident from the study that raw *Hura crepitans* is not fully acutely toxic but may be chronically toxic to broiler chicken

Keywords: *Hura crepitans*, Acute Toxicity, Extract, Drenching

DESCRIPTION OF PROBLEM

Increase in the cost of conventional feed ingredients used in formulating feed has resulted in intensive investigations into the use of agricultural and agro-based industrial by-products (Uchegbu *et al.*, 2008). Most often such products are imbued with anti-nutritional factors that if not properly processed can be toxic to the livestock.

One of such plants is *Hura crepitans* (the sand box tree) also known as the monkey's dinner bell, is not indigenous to West Africa, but its point of origin can be traced to the Tropical America (Burkill, 1967). The tree usually flowers at the beginning and end of the rainy season and is commonly planted along roads and in village in West Africa. It is also used as shade for cacao and prop for vanilla in Asia (Kerharo, 1950).

However, the fruit of the sandbox is said to be poisonous, causing vomiting, diarrhea and cramps if injected (Uchegbu, 2008). The tree sap is said to cause an angry red rash, and it can cause blindness if it gets into the eyes. It has been used to make poison darts (Keay, 2010).

However, there have been reports of observations of some free ranging turkeys, scrambling to pick and swallow wild seed, as they burst forth from dehiscing fruits (Keay, 2010) Yaakugh *et al.*, 2001), similarly chicken are seen cracking and consuming the endosperm of the seeds, in both cases no adverse effect was reported from these actions (Yaakugh, 2001). The objective of this study therefore was to determine the acute toxicity of *Hura crepitans* to broiler birds.

MATERIALS AND METHODS

Source of materials/extraction procedures: Matured seeds of *Hura crepitans* were plucked from trees within Calabar Municipality in Cross River State. The seeds were milled with a meadow model 35 harmer mills and

sieved through a mesh of 5mm after passing it through ethanol as a deffating agent. The extract was prepared by the method of Liener (1955) with some modification. The phosphate buffered saline (PBS) of 7.0 PH a universal solvent was used in preparing the extract.

Experimental birds: Forty-eight unsexed 28day old broiler birds of average weight 675±0.28g were used for this experiment. They were weighed and randomly allotted to four groups of 12birds each and of three replicates of 4 birds each. The birds were drenched with 0mg/kg, 1000mg/kg, 2000mg/kg and 3000mg/kg of the *Hura crepitans* extract which represents treatment groups I, II, III, and IV respectively. They bird where then observed for 24 hours.

Determination of concentration of extract: One millitr of *Hura crepitans* extract was put into a weighed clean dry empty beaker and the beaker was weighted again with the extract before being heated with a Bunsen burner for about 3 minutes, brought down allowed to evaporate to dryness, and weighed again after it was cold. The difference in weight; average after repeating the process three times was used in estimating the concentration of solute in extract.

Weight of empty beaker = 102.52g
Weight of beaker + dry sample = 102.97g
Weight of dry sample = 102.97g-102.52g = 0.45g
0.45g = 450mg
Therefore, concentration of extract = 450mg/ml
Calculation of value of extract to be given to each bird using a typical case of 300mg/kg body weight as described by Ukachukwu (1992)
Calculating the value of extract to be given to 650g broiler chick is as follows:
Concentration of extract = 450mg/ml
Weight of bird = 650g
Dose of extract per body weight = 3000mg/kg
It means that 1000g bird will take 3000mg of solute 650g bird will take

$$\frac{3000\text{mg}}{1000\text{g}} \times 650\text{g} = 1950\text{mg}$$

Therefore, volume of extract to be given

$$= \frac{1950\text{mg}}{450\text{mg}} \times 1\text{ml} = 4.3\text{ml of } \textit{Hura crepitans} \text{ extract}$$

Blood collection: Blood samples (2ml each) were collected via wing vein at the end of the experimental periods; put in labeled sterile universal bottles and analyzed as described by Sastry (2004) for haemathological indices.

Statistical analysis: All data were subjected to analysis of variance and the means were separated using Dincan's Multiple Range Test as outlined by Daniel (1991)

RESULTS AND DISCUSSION

Eight (8) hours after the administration of the extract the birds in last dose (3000mg/kg) became dizzy with diarrheic droppings. while other groups showed no such effect, however, birds on treatment group 111(2000mg/kg) showed dizziness but no diarrheic droppings, 14hours after the administration of the extract. No death was recorded in any of the doses.

The dizziness and diarrheic droppings are indicative of some level of toxicity of the extract in broiler birds. It also shows the effect of the toxic elements in the extract on the central nervous system (CNS) of the birds

(Ukachukwu, 1992). Lectin purified from field pea (*Pisum arvenso)* decreased the duodenal absorption of n-histidine in mice (Kawatra and Bhatia, 1979). Hura has been reported to contain saponin, cyanogenic glycosides, phytates, oxalate, Hamoglutinin and other inhibitory substances. Saponin may have caused the diarrhea. Noah *et al*. (1980) reported that in 1976 a part of school boys on holiday ate kidney beans soaked in water but had not been cooked. All nine who ate the beans become acutely nauseated within 1 and 1½ hours and began to vomit followed by diarrhea.

Administration of the *Hura crepitans* extract did not result in any death even at a high dose of 3000mg, this does not suggest non toxicity of the extract since dizziness and diarrhea according to Ukachukwu, 1992 could rather suggest that the level of toxicity was not high enough to be acute. The result of the experiment revealed that *Hura crepitans* is not fully acutely toxic but may be chronically toxic to broiler chicken.

Birds on treatments III (2000mg/kg) and IV (3000mg/kg) showed significant ($P<0.05$) reduction of red blood cells (RBC), packed cell volume and hemoglobic (Hb). The observed haematological reduction suggest that trypsin inhibitor could be implicated. The raw sand box had earlier been found to have trysin inhibitory activity by many authors, Ohoghobo *et al.,* (1993) reported localization of trypsin inhibitor in a base soluble fraction of lima bean. They fed the base soluble protein fraction to broilers and observed consistent reduction of RBC and Hb in the birds. This suggests direct involvement of trypsin inhibitor.

CONCLUSION

Hura crepitans seed extract of high dosage of 2000mg per kilogram of body weight in broiler birds and above was found to be acutely toxic and had direct reduction effect on red blood cell, packed cell volume and hemoglobin values of broiler birds

Table 1: Body weight of broiler birds with the corresponding volumes of *Hura crepitans* extracts given to the birds in each dose.

Rep	1000mg/kg Body wts (g)	Extract vol. (ML)	2000mg/kg Body wts (g)	Extract vol. (ML)	3000mg/kg Body wts (g)	Extract vol. (ML)
1.	650.00	1.4	648.00	29	654.00	43
2.	655.00	1.4	650.00	2.9	650.00	4.3
3.	645.00	1.4	656.00	2.9	645.00	4.3

Table 2: Haematological parameters of broiler birds drenched with *Hura crepitans* seed extract

Parameters	Trt 1 (0mg/kg)	Trt II 1000mg/kg	Trt III 2000mg/kg	Trt IV 3000mg/kg
Packed cell volume (%)	37.41^{a}	35.62^{a}	31.44^{b}	28.30^{c}
Haemoglobin (g/dl)	13.14^{a}	13.10^{a}	12.44^{b}	12.49^{b}
Red blood cell (g/dl)	4.30^{a}	4.22^{a}	4.02^{b}	3.86^{c}
White blood cell ($x10^{3}$dl	5.87	5.89	5.81	5.90
Platelet (g/dl)	185.00	189.21	183.66	181.40

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Effects of *Enterolobium cyclocarpum* seed meal (ecsm) with and without enzyme supplementation on nutrient digestibility of broiler chickens

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Abstract: A 63 days experiment using one hundred and fifty, day old broiler chicks in six dietary treatments was conducted to evaluate the effects of *Enterolobiumcyclocarpum*seed meal (ECSM) with and without enzyme supplementation on nutrient digestibility.Enterolobiumcyclocarpum seeds were toasted using stove top method after which the endocarp was manuallyseperated from the epicarp and groumdfor inclusion in the feed of broiler chicken at various inclusion levels.Thediets were formulated to contain 0,5 and 10% ECSM as partial replacement for full fat soya. Diet one had 0% ECSM and this served as positive control, diet two 5% ECSM, diet three 10% ECSM, diet four, five and six contained ECSM at 0,5 and 10% with enzymes. At the end of the experiment two birds per replicate were randomly selected and placed in metabolic cages for the collection of fecal samples. Percentage digestibility was calculated. Results showed that there was significant difference ($p < 0.05$) in all the parameters across the treatment in the main effect except in ether extract and ash which showed no significant difference ($p > 0.05$) across the treatment. Results obtained from this study led to the conclusion that, 10% inclusion of *Entrerolobiumcyclocarpum* with enzyme supplementation and 5% inclusion of *Enterolobiumcyclocarpum* without enzyme supplementation yielded better results in terms of nutrient digested.

Keywords: Endocarp, Epicarp, stove top method, Full fat soya and metabolic cages.

INTRODUCTION

Poultry production has an unquestionable propensity to close the existing gap in animal protein consumption in the country. This according to (1) is because of their short gestation and generation intervals, large number, fast growth, greater affordability, easy raising, absence of taboo to production and consumption and absence of barrier to production in any climatic zone in the country. It was further stated that poultry enjoys a relative advantage over other livestock in terms of its ease of management, high turnover, quick return to capital investment and wide acceptance of its product for human consumption (2 and 3)

Globally, there are problems related to monogastric animal feeding in terms of matching the available feed resources with their nutrient requirements and this has been a major concern, part of effort to finding solution to this problem is the use of tropical trees and shrub legumes plant. Tropical trees and shrubs have great potentials to serve as feed resources for ruminant animals, they are less susceptible to climatic fluctuations, and they provide feed of high digestibility and protein content but they have been found to contain anti-nutritional factors which tends to affect both their intake and digestibility (4). *Enterolobiumcyclocarpum* is a legume tree which belongs to the family mimosadeae (5). The legume is easily established and fast growing to maturity over a short period of time than the most common legume plants in Nigeria and can be used in intensive feed garden in some parts of Nigeria (6). Its agronomic potential has been exploited. Also, as a leguminous multipurpose plant, it has the potential of fixing atmospheric nitrogen into the soil and can also be exploited for feeding of animals (7).

Supplementation of diets of monogastric animals with exogenous enzymes has been increasingly investigated and applied during the past decade as a means of enhancing and increasing the effectiveness of nutrient utilization (8). Enzymes induce their effect by stabilizing the intestinal microbial flora thereby preventing proliferation of specific intestinal pathogens.Due to the high cost of feed ingredients, scarcity and competition between man and livestock for feed ingredient, It has become imminent to seek for alternative and cheaper source of nutrients ,

because feed constitute high percentage in broiler production.Hence, this study aimed at evaluating the effect of *Enterolobiumcyclocarpum* seed meal on nutrient digestibility of broiler chickens.

MATERIALS AND METHODS

The experiment was conducted at the student experimental site of the Federal college of Animal health and Production Technology Moor Plantation Ibadan.*Enterolobiumcyclocarpum* pods were sourced for around Ibadan metropolis. They were de-husked and the seeds were air dried before toasting them using stove top method. After toasting the endocarp of the seeds were separated manually from the epicarp. The endocarp was grinded and included in the feed of broiler chicken at various inclusion levels. One-hundred-and-fifty-day old broiler birds were gotten from the hatchery of the Federal college of Animal Health and Production Technology Moor Plantation Ibadan.The birds were allotted into six dietary treatments with three replicates consisting of eight birds per replicate. Feed and water were supplied *ad libitum* to the animals throughoutthe experimental period. Prophylactic measures such as vaccination and routine management practices were strictly adhered to. The experiment lasted for 9weeks(63days).

Diets were formulated to contain 0,5 and 10% *Enterolobiumcyclocarpum* Seed Meal as partial replacement for full fat soya. Diet one had 0% inclusion of ECSM and this served as positive control, diet two contained 5% ECSM, diet three contained 10% ECSM, diet four, five and six contained ECSM at 0,5 and 10% with enzymes. Experimental diets were fed to the animals on treatment basis *ad libitum* and water was also supplied *ad libitum* throughout the experimental period. On the ninth week of the experiment two birds per replicate were randomly selected and placed in metabolic cages. They were left to acclimatize for two days after which the feed samples based on each treatment and a marker was given the birds and fecal samples were collected for a period of five days. The fecal samples were weighed and oven dried for five days and they were packed together according to treatment. Percentage Digestibility was calculated using the formula;

Digestibility (%) = Nutrient intake –Nutrient in feacesx100/Nutrient intake

The data collected weresubjected to a 2*3 factorial arrangement in a completely randomized design using (9) andmeans were separated using Duncan Multiple Range test (DMRT). (10).

RESULTS AND DISCUSSION

Table 1 shows the effect of nutrient digestibility of broiler chicken fed diets containing graded levels of *Enterolobiumcyclocarpum* seed meal with or without enzymes supplementation. Result shows that there was significant difference ($p < 0.05$) in all the parameters across the treatment except in ether extract and ash which shows that there was no significant difference ($p > 0.05$) across the treatment. Enzyme inclusion in the feed increases the crude protein (78.73%); in 10% ECSM inclusion in the feed indicate a better crude protein digested (80.08%), Ether extract (86.36%) followed the same trend except for crude fiber (68.41%), ash (70.20%) and NFE (81.30%) that had highest value in 5% ECSM inclusion level. Occurrence of higher levels of other ANFS e. g trypsin inhibitors and alkaloids in *Enterolobiumcyclocarpum as* reported by (11) was probably responsible for the negative effect produced by *Enterolobiumcyclocapum.*Typsin inhibitors reduces digestibility of crude protein (12). The increase in the level of *Enterolobiumcyclocarpum* in the broiler diet significantly affects the apparent nutrient digestibility coefficient of dry matter, crude protein and Nitrogen free extract. The nutrient digestibility of dry matter decreased linearly, the quadratic response of the nutrient digestibility of crude protein increased, the nutrient digestibility of Nitrogen free extract decreased with inclusion of *Enterolobiumcyclocarpum* seed meal. However, increase in dietary fiber can be the explanation for the reduction in nutrient digestibility in the present trial as crude fiber levels increased as the amount of *Enterolobiumcyclocarpum* seed meal in the diet increased.

Table 1: Effect of enzyme inclusion and inclusion level of *Enterolobiumcyclocarpum* seed on the Nutrient digestibility of broiler chicken

Enzyme Inclusion	**ECSM Inclusion Level**						
Parameters (%)	**-**	**+**	**SEM±**	**0**	**5**	**10**	**SEM(±)**
Dry matter	62.57[b]	72.63[a]	1.47	61.54[b]	70.77[a]	70.49[a]	1.80
Crude protein	67.36[b]	78.73[a]	1.22	62.26[b]	76.79[a]	80.08[a]	1.49
Crude fibre	56.49[b]	71.57[a]	2.29	61.24[b]	68.41[ab]	62.44[a]	2.80
Ether extract	71.07	79.68	4.07	67.32	72.44	86.36	4.98
Ash	63.01	69.03	3.45	59.77	70.20	68.23	4.22
Nitrogen free extract	76.34	80.44	1.23	78.01[ab]	81.30[a]	76.01[b]	1.51

[a,b] means with the same superscript along the row were not significantly differently ($p < 0.05$), ECSM: Enterolobiumcyclocarpum seed meal, SEM: Standard Error Mean, - Enterolobiumcyclocarpum without enzyme, + Enterolobiumcyclocarpum with enzyme

Table 2 shows the interaction effect of nutrient digestibility of broiler fed diet containing graded levels of *Enterolobiumcyclocarpum* seed meal with or without enzymes supplementation. From the result there was no significant difference ($p < 0.05$) in all the parameters across the treatments except for ash which shows that there was no significant difference across the treatments. However, the result indicated that crude protein digestibility has the highest value in T6 (10% ECSM with enzyme) and the lowest is recorded in T1 (0% ECSM with enzymes). Also, the highest value was recorded for crude fiber (75.32%), Ash (77.13%) and NFE (85.03%) IN T6 (10% ECSM with enzymes), crude fiber has the highest value in T3(10% ECSM without enzymes). In summary, the result indicated that birds fed 10% ECSM with enzymes supplementation) were able to absorb, digest and utilize the nutrient in the feed. The effect of energy availability is likely as a result of incremental improvement in protein (13) Starch and fat (14).

Table 2: Interaction effect of *Enterolobiumcyclocapum* seed inclusion level on the Nutrient digestibility of broiler chicken.

	ECSM without Enzyme			**ECSM with Enzyme**			
Parameters (%)	**T1(0%)**	**T2(5%)**	**T3(10%)**	**T4(0%)**	**T5(5%)**	**T6(10%)**	**SEM±**
Dry matter	51.79[c]	70.28[ab]	65.63[b]	17.29[ab]	71.25[ab]	75.35[a]	2.54
Crude protein	50.81[c]	74.81[b]	76.47[b]	73.71[b]	78.77[ab]	83.70[a]	2.10
Crude fiber	53.17[b]	66.75[a]	49.55[b]	69.31[a]	70.07[a]	75.32[a]	3.96
Ether extract	62.20[b]	63.14[b]	87.85[a]	72.43[ab]	81.74[ab]	84.86[ab]	7.05
Ash	59.93	70.04	59.34	59.60	70.37	77.13	5.97
Nitrogen free extract	82.86[a]	79.97[ab]	66.99[c]	73.95[b]	82.63[a]	85.03[a]	2.13

[a,b] means with the same superscript along the row were not significantly differently ($p < 0.05$),SEM: Standard Error Mean, ECSM: *Enterolobiumcyclocarpum* seed meal

CONCLUSION

Based on the result obtained in this study, it can be concluded that 10% inclusion of *Entrerolobiumcyclocarpum*seed meal with enzyme supplementation and 5% inclusion of *Enterolobiumcyclocarpum*seed meal without enzyme supplementation presented better results in terms of nutrient digested.It can therefore be recommended that 10% *Enterolobiumcyclocarpum* seed meal with enzyme supplementation and 5% *Enterolobiumcyclocarpum*seed meal without enzymes supplementation can be used partially to replace full fat soya as protein source in the diet of broiler chickens.

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Growth Performance of Japanese Quails (*Coturnix coturnix* japonica) Fed Diets Containing Varying Levels of Sweet Potato (*Ipomoea batatas*) Meal

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Abstract: A feeding trial was conducted to evaluate the effect of diets containing varying levels of Sweet potato (ipomoea batatas) meal on growth performance of Japanese quails (Coturnix coturnix japonica). Three hundred unsexed 2 weeks old Japanese quails (mean weight 32.00g) were fed the different diets for a period of 28 days during which data were collected. The birds were randomly assigned to four dietary treatments each (0, 10, 20, 30% sweet potato meal) consisting of 75 grower quails per treatment with three replicates of 25 birds in a completely randomized designed (CRD. Water and feed were supplied ad libitum. Result showed that inclusion of sweet potato meal in diets of grower quails significantly improved($P<0.05$) their final live weights, weight gain, cost per gain and age at 1st egg across dietary treatments. Feed intake decreased significantly ($P < 0.05$) as the levels of sweet potato increased in diets. The feed conversion ratio showed no significant ($P>0.05$) differences across the entire treatment groups. It was concluded that sweet potato inclusion at 10% enhanced growth performance of Japanese quails up to 6 weeks of age compared to other dietary treatments.

Keywords: Dietary treatments; Graded levels; Japanese quails; Performances, Sweet Potato;

Target Audience: Monogastric Nutritionist, Japanese quails producers, livestock feed millers

DESCRIPTION OF PROBLEMS

The Nigerian poultry industry is faced with a lot of problems that have resulted to a gross shortage of meat to meet the population challenge in the country and there is acute shortage of animal protein in the diet of an average Nigerian [1]. This is due to the high cost of conventional protein and energy concentrates, increasing competition between man, industries and livestock for the available grains, price fluctuations and unavailability of the feed ingredients for the formulation of animal feeds [2]. Profit maximization cannot be attained unless the birds are fed diets at lowest costs. There is need to search for non-conventional feed resources that are cost-effective, non-toxic and readily available and alternative sources of energy concentrate. Sweet potato can be a good alternative source of energy in poultry ration.

Japanese quails (*Coturnix coturnix japonica*) are beginning to make useful contribution to meat supply in Nigeria where there is shortage of animal protein. They have unique characteristic of fast growth, early sexual maturity, short generation interval that make them suitable for diversified animal agriculture [3]. They are fairly resistant to disease and required little demand for vaccination [4]. This study was designed to evaluate the effect of varying dietary sweet potato levels on growth performance of Japanese quails and compared cost benefit effect of experimental diets.

MATERIALS AND METHODS

The study was conducted at the Quail Unit, Teaching and Research Farm, Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria. Zaria is located within the Northern Guinea Savanna Zone on latitude 11^0 11' 06" N and longitude 7^0 38' 55' E, at an altitude of 706m above sea level. A total of three hundred (300) quail birds were purchased from Maizuma farm at Galma New Jos Road, Along Dakace Zaria, Kaduna State. Sweet Potato was sourced from Samaru market in Zaria, Kaduna State (during dry season). The sweet potato was sliced into chips, washed and sun-dried on concrete floor (under hygienic condition), after

which they were winnowed to get rid of any foreign materials. Sample of the winnowed sweet potato were oven dried, milled and used for chemical analysis. The other ingredients were sourced from Rebson Feed Mill, Samaru Zaria, Kaduna State.A total of three hundred (300) 2 weeks old quail birds were used for the study. On arrival, the quails were weighed and randomly assigned into four groups of 75 birds each. Each of the groups was subdivided into 3 replicates of 25 birds per replicate in a completely randomized design (CRD). Common diet was given for a day and all necessary routine management practices were adhered to throughout the study period. Four Experimental diets were formulated for the trial. The quail birds were given their respective diets and water *ad-libitum* throughout the trial period. The birds were weighed at the beginning of the trial and weekly thereafter. Performance parameters were monitored. Feed intake and body weight gain were taken weekly. These were used to calculate average or daily feed intake and weight gain. Feed conversion ratio was calculated on the basis of unit of feed consumed to unit of body weight gain. Samples of the Sweet Potato were taken to the Animal Science Biochemical Laboratory for proximate analysis using the methods described by [5]. Metabolizable energy (ME) was computed using the method described by [6]. Data generated were statistically analyzed using the General Linear Model Procedure of Statistical Analysis System [7]. Significant means were separated using Dunnett's Test in the SAS package.

Table 1: Proximate Composition of Sweet Potato Meal and Experimental Diets Containing Varying Levels of Sweet Potato Meal for Grower Japanese Quails (2 – 6 weeks)

		Inclusion levels of Sweet Potato (%)			
Parameters (%)	Spm	0	10	20	30
Dry matter	92.95	93.50	93.03	93.02	92.70
Crude protein	5.25	21.44	22.50	26.38	20.19
Ash	6.29	8.74	8.81	6.79	6.81
Crude fibre	7.29	6.33	7.39	6.44	6.78
Ether Extract	5.28	4.48	4.69	4.66	5.08
Nitrogen free Extract	76.85	59.01	56.61	60.39	61.14
ME (Kcal/ Kg)	3343.833211.72	3180.80	3448.333292.66		

Spm=Sweet potato meal.ME=metabolisable energy.ME (Kcal/Kg) =(35.0x%CP) +(81.8xEE) +(35.5xNFE), Pauzenga, 1985

RESULT AND DISCUSSION

The result of proximate composition of sweet potato meal and experimental diets is shown in table 1. The effect of diets containing varying levels of sweet potato meal on the growth performance of grower Japanese quails is presented in Table 2. The final weight (141.47g) and weight gain (109.47g) were significantly ($P < 0.05$) higher in birds fed 10% sweet potato-based diets. The feed intake was significantly ($P < 0.05$) higher in birds fed 10% sweet potato-based diets (130.07g). The feed conversion ratio showed no significant ($P > 0.05$) difference across dietary treatments. The average age at first egg (AAFL) showed no significant difference (($P > 0.05$) across dietary treatments. The weight of first egg showed no significant difference ($P > 0.05$) across dietary treatments. The cost of daily feed intake (₦ 10.88) and cost of total feed intake (₦ 304.67) were significantly ($P < 0.05$) better in birds on 30% sweet potato-based diets. The proximate composition of the sweet potato meal was similar to values reported by [8] that sweet potato meal contained 92.76% DM, 5.36%CP and 81.78% NFE. Birds on 10% sweet potato meal performed better on the basis of feed intake, weight gain, feed conversion ratio and dressing percentage compared to the control diet and other treatments. This may be due to the increased level of digestibility of the diets. [9] and [10] reported the carbohydrate fraction in sweet potato to be about 90% digestible in grower birds. The result showed significant difference between the weight gained and the level of dietary Sweet potato. The 10% sweet potato diets appeared to be the most efficiently utilized compared to the

other diets. The 30% diets were the most poorly utilized. The increase in the inclusion levels of sweet potato resulted in decline in feed intake and growth. This agreed with the report of [11] who reported that a significant decline in weight gain was noticed with increase in the inclusion of sweet potato during the starter and finisher phases. The significantly reduced weights of birds on diets containing 30% sweet potato meal could be as a result of increased fibre in the sweet potato meal which also increases the fibre content and anti-nutrients factor [12]. [13] reported that the main physiochemical characteristics of dietary fibre with nutritional significance was hydration properties, which influence solubility, water holding capacity (WHC), and swelling capacity. Birds on 10% sweet potato inclusion in their diets had better feed conversion ratio compared to those on 0% sweet potato inclusion in their diets. This agreed with the observation of [14] who reported that the performance of birds fed diets containing sweet potato especially at the higher levels was less satisfactory compared to corn. The significant difference in feed conversion ratio observed across the dietary treatments agrees with the observation of [15] who reported that birds fed diets containing 10% to 20% sweet potato meal performed better than those on 30 and 40% inclusion levels. The significant difference among dietary treatments may be as a result of the presence of anti-nutritional factors which affected nutrient utilization. [16] reported that the growth of poultry birds has been known to reduce due to the presence of anti-nutritional factors in the diet which reduced the utilization of energy, protein and specific amino acids. No mortality was observed across the treatments.

This agrees with earlier reports that though sweet potato may contain unidentified growth inhibitors, the level in sweet potato definitely posed no danger of death to birds. Many researchers [17]; [18] have attested to the claim that sweet potato in broiler chickens' diets does not result in mortality. Observation by [11] however differed and the authors attributed the high mortality recorded in their experiment to sweet potato inclusion in the diets. The difference in the present result and that of [11] may be due to the difference in the type of sweet potato cultivars used. Diets containing 10, 20 and 30% sweet potato meal reduced cost of production by 1.97% (₦0.62), 3.2% (₦1.01) and 5.35% (₦1.68) respectively. Increase in inclusion of sweet potato meal, decreases cost of feed.

Table 2: Effect of Varying Levels of Sweet Potato Meal on Growth Performance of Grower Japanese Quails (2 – 6 weeks)

	Inclusion levels of sweet potato (%)				
	0	**10**	**20**	**30**	**SEM**
Parameters					
Initial weight (g/b)	32.00	32.00	32.00	32.00	0.00
Final weight (g/b)	141.28^{a}	141.47^{a}	137.60^{b}	134.80^{c}	0.44
WG (g/b)	109.28^{a}	109.47^{a}	105.60^{b}	102.80^{c}	0.44
Total Feed intake (g/b)	128.37^{ab}	130.07^{a}	127.37^{ab}	124.97^{b}	1.17
DFI (g/b/d)	4.59^{ab}	4.65^{a}	4.55^{ab}	4.46^{b}	0.04
FCR	1.18	1.19	1.21	1.22	0.01
AAFL (d)	36.67	37.67	38.67	37.67	0.67
AWFE (g)	8.87	8.44	9.12	8.49	0.34
Cost/kg WG (₦ /kg)	31.42^{b}	30.80^{ab}	30.41^{ab}	29.74^{a}	0.22
Cost of feed (₦ /kg)	26.63^{d}	25.88^{c}	25.13^{b}	24.38^{a}	0.00
Cost of daily feed intake (₦)	12.21^{c}	12.02^{c}	11.43^{b}	10.88^{a}	3.57

^{abcd} Means with different superscript on the same row are significantly different (P < 0.05) SEM: Standard Error of Means. WG: weight gain. DFI: daily feed intake. FCR: feed conversion ratio. AAFL: average age at first lay. AWFE: Average weight of first egg. (g/b): gram/bird. (g/b/d): gram/bird/day.

CONCLUSION AND APPLICATION

It was concluded that Sweet potato meal inclusion at 10% enhanced growth performance of quails at least cost of production compared to those on the control diets.

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Effects of Different Processing Methods on the Chemical Composition of Sickle Pod (*Senna obtusifolia*) Leaves

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Abstract: A study was conducted to evaluate the effects of different processing methods on the chemical composition of *Senna obtusifolia* leaves (SOL). Fresh *Senna obtusifolia* leaves were harvested and divided into five representative batches. The first batch was air-dried under shade designated as T1. The second, third, fourth and fifth batches were sun-dried, soaked, boiled and fermented in triplicates designated as T2, T3, T4 and T5, respectively. Each of the processed sample was properly sun dried milled and analyzed in triplicates for proximate composition and levels of anti-nutritional factors using standard laboratory procedures. The chemical composition of SOL was significantly ($P<0.05$) influenced by the different processing methods. The different processing methods were observed to significantly ($P<0.05$) reduced the proximate componentsand levels of the anti-nutritional factors except for the fermentation method which significantly increased the protein and ash content of the leaves. An increase of 16.10 and 6.64% was observed for the protein and ash content of the fermented leaves. The highest dry matter losses of 4.22 and 6.20% were recorded in the boiled and fermented SOL. The highest protein loss of 14.38% was observed in the boiled SOL. The highest levels of reduction of 64.95, 57.21 and 49.74% were recorded for oxalates, tannins and phenols in the fermented SOL. It was concluded that fermentation was more effective in detoxifying SOL and also in enhancing the nutritional value of SOL.

Keywords: Chemical composition, *Senna obtusifolia*, processing methods.

INTRODUCTION

Leaves of wild legumes have continued to gain popularity in Nigeria as livestock feed resources. Igene *et al*. (2012) reported that the persistent increase in the cost of conventional feed resources is a major reason to search for suitable alternative feed resources. One of such alternative feedstuffs is *Senna obtusifolia* leaf. The chemical composition of the leaves as revealed by Ayssiwede *et al*. (2012) and Yakubu *et al*. (2017) indicated that it has good nutritional properties (25.44 and 27.4% crude protein) as alternative protein source for livestock. However, the authors further reported the presence of anti-nutritional factors such as tannins, phytates, saponins and oxalates in the leaves. Therefore, some forms of processing are required before the leaves can be safely and properly utilized as feed resource.

Processing methods such as boiling, sun-drying, fermentation and soaking have been reported to reduce the levels of anti-nutritional factors in legumes. However, nutritional depreciation has been observed when some of these processing methods are used (Nsa *et al*., 2011; Ari *et al*., 2012; Augustine *et al*., 2017). In view of the above, it has become necessary to evaluate the best processing method(s) for detoxifying *Senna obtusifolia* leaves. At the moment, base-line information regarding the best method(s) of processing *Senna obtusifolia* leaves seems to be scanty hence the need to conduct more studies and bridge such information gap. It is in view of the above that this study was conducted to investigate the effects of different processing methods on the chemical composition of *Senna obtusifolia* leaves.

MATERIALS AND METHODS

Study area/harvesting and processing of *Senna obtusifolia* leaves: *Senna obtusifolia* leaves were harvested in Mubi area of Adamawa State, Nigeria. The leaves were divided into five representative samples. The first sample was air-dried under shade while the second, third, fourth and fifth samples were sun-dried, soaked in

water, boiled and boiled + fermented, respectively. The samples were properly sun-dried, milled into powder and taken to the laboratory for analysis.

Chemical analysis: Proximate composition of the processed *Senna obtusifolia* leaves was determine using standard laboratory procedures of (AOAC, 2004).

The energy values of the leaves were calculated using the formula of Pauzenga (1985) expressed as:

ME (kcal/kg) = 37 x %CP + 81 x %EE + 35.5 x %NFE

The levels of anti-nutritional factors and amino acid profile were determined using the chromatographic methods specifically the High Power Liquid Chromatography (HPLC) Buck Scientific BLC 10/11 model as described by Pearson (1991).

Experimental Design: Each representative sample was randomly analyzed in triplicates in a completely randomized design (CRD).

Statistical Analysis: Data obtained were subjected to a statistical package (Statistix, 9.0). Least significant different (LSD) was used to separate the means where significant differences occurred. The results were considered significant at 5% level of probability.

RESULTS AND DISCUSSION

The proximate composition of *Senna obtusifolia* leaves (SOL) subjected to different processing methods is presented in Table 1. The proximate composition was significantly ($P<0.05$) influenced by the different processing methods. The dry matter, crude protein, crude fibre, ether extract, nitrogen-free extract and energy were observed to reduce in the sun dried, soaked and boiled SOL. This finding is consistent with the observations made by Hassan *et al*. (2007) for sun dried *Cynandropsis gynandra* leaves, Savage *et al*. (2009) for soaked and cooked taro leaves. The decrease in the protein content was attributed to leaching out of soluble nitrogenous compounds into the soaking or boiling water consequently reducing the protein content.

Table 1: Proximate Composition of *Senna obtusifolia* Subjected to Different Processing Methods

Proximate composition (%)	SADSOL	T1(SDSOL)	T(SKOL)	T(BSOL)	T4(FSOL)	SEM
Dry matter (DM)	93.50^{a}	91.35^{a}	90.95^{b}	9.55^{b}	87.70^{b}	3.09
% DM increase	0.00	0.00	0.00	0.00	0.00	
% DM decrease	0.00	3.31	3.79	4.22	6.20	
Crude protein (CP)	19.68^{b}	18.03^{c}	16.85^{d}	16.95^{d}	22.85^{a}	0.97
% CP increase	0.00	0.00	0.00	0.00	16.10	
% CP decrease	0.00	8.38	13.87	14.38	0.00	
Crude fibre (CF)	15.25^{a}	14.76^{b}	13.15^{bc}	11.75^{c}	10.65^{d}	1.19
% CF increase	0.00	0.00	0.00	0.00	0.00	
% CF decrease	0.00	3.21	13.77	22.95	30.16	
Ash	7.83^{b}	7.16^{b}	7.10^{b}	7.21^{b}	8.35^{a}	2.33
% ash increase	0.00	0.00	0.00	0.00	6.64	
% ash decrease	0.00	8.56	9.32	7.91	0.00	
Ether extract (EE)	3.21^{a}	3.18^{a}	2.80^{b}	2.23^{bc}	2.05^{c}	0.72
% EE increase	0.00	0.00	0.00	0.00	0.00	
% EE decrease	0.00	7.47	12.77	30.53	36.13	
NFE	38.69^{a}	37.85^{a}	36.95^{b}	35.78^{c}	35.35^{c}	9.63
% NFE decrease	0.00	4.19	5.04	6.25	7.34	
Energy (kcal/kg)	2361.67^{a}	2268.36^{b}	2161.98^{b}	2077.97^{c}	2266.43^{b}	12.09
% energy decrease	0.00	3.94	8.55	12.01	4.03	

a, b, c, d = Means in the same row with different superscripts are significantly different at 5% level of probability; SADSOL = shade air-dried *Senna obtusifolia* leaves; SDSOL = sun-dried *Senna obtusifolia* leaves; SKSOL = Soaked *Senna obtusifolia* leaves; BSOL = Boiled *Senna obtusifolia* leaves; and FSOL = fermented *Senna obtusifoli*a leaves; SEM = Standard error of mean

This result is consistent with the findings of Nsa *et al*. (2011) and Augustine *et al*. (2017). Similarly, dry matter loss was observed in all the processed SOL. However, the dry matter loss was less in the sun-dried SOL. NAP (1992) explained that processing such as cooking, soaking and microbial activities often lead to considerable dry matter loss in a feed material.

An increase in the crude protein and ash content of the fermented SOL was observed. This observation is consistent with the findings of Bakrie *et al*. (1996) who reported that the protein content of fermented cassava leaves increased from 19.2 to 25.6% after fermentation. Augustine *et al*. (2017) in a similar study subjected *Senna obtusifolia* seed to fermentation treatment and reported an increased in the protein, amino acid and ash content of the seed meal.

It was reported by Uwagbute *et al*. (2000) that during fermentation, there is net synthesis of protein by the fermenting microbes. Anthony further added that increase number of microbes during fermentation can increase protein content.

The levels of the anti-nutritional factors as affected by the different processing methods is presented in Table 3. A reduction for all the levels of the anti-nutritional factors was observed in the sun-dried, soaked, boiled and fermented SOL. Similar findings were reported for sun-dried *gynandropsisgyandra* leaves, soaked and cooked taro leaves and fermented Kaneh leaves (Hassan *et al*., 2007; Savage *et al*. 2009; Kurniawatiet *al*., 2016). The loss of anti-nutritional factors in sun-dried leaves was attributed to the loss of water molecules accompanied by loss of both nutrients and non-nutrients as earlier reported by Hassan *et al*. (2007). Reduction of anti-nutritional factors in the soaked leaves was linked to the leaching out of soluble anti-nutritional factors such as tannins, saponins, phytates and oxalates into water which is discarded thereafter. Augustine *et al*. (2017) in a similar study soaked *Senna obtusifolia* seeds and reported a decrease in the levels of the anti-nutritional factors.

Table 3: Levels of Anti-Nutritional Factors of *Senna obtusifolia* Subjected to Different Processing Methods

Anti-nutritional factors	SAD	SDSOL	SKSOL	BSOL	FSOL	SEM
Oxalates	1.37[a]	0.96[b]	0.77[c]	0.68[d]	0.48[e]	0.012
% oxalate reduction	0.00	29.92	36.50	48.26	64.96	
Tannins	2.08[a]	1.95[b]	1.05[c]	0.95[d]	0.49[e]	0.076
% tannin reduction	0.00	4.80	49.32	36.06	57.21	
Phenols	13.69[a]	12.06[b]	9.08[c]	7.95[d]	6.88[e]	0.01
% phenol reduction	0.00	11.90	33.67	41.92	49.74	
Phytates	4.11[a]	3.75[b]	3.21[b]	2.85[c]	1.75[d]	0.012
% phytates reduction	0.00	8.76	21.89	40.38	54.98	
Saponins	3.79[a]	2.98[b]	2.33[c]	2.04[c]	1.89[d]	0.035
% saponin reduction	0.00	6.33	38.52	46.17	63.58	

a, b, c, d = Means in the same row with different superscripts are significantly different at 5% level of probability; SADSOL = shade air-dried *Senna obtusifolia* leaves; SDSOL = sun-dried *Senna obtusifolia* leaves; SKSOL = Soaked *Senna obtusifolia* leaves; BSOL = Boiled *Senna obtusifolia* leaves; and FSOL = fermented *Senna obtusifoli*a leaves; SEM = Standard error of mean.

Heat treatments by boiling have been reported to denature the chemical structure of anti-nutritional factors and deactivate them (Abeke *et al*., 2008). During fermentation, enzymatic reactions and the activities of fermenting microbes can breakdown the carbon and nitrogen bond of the anti-nutritional factors and use them in the production of energy for their metabolic activities (Dhankher *et al*. 1987; Ikemefuna *et al*., 1991; El-hag *et al*., 2002). Furthermore, rearrangement of the phenolic structures caused by the acid environment created by the microbes might be the reasons for the decrease in the levels of the anti-nutritional factors (Taiwo *et al*., 2006; Towo *et al*., 2006). Among the different processing methods used, fermentation was more effective in reducing

the levels of the anti-nutritional factors and also in improving the nutrient profile of the leaves. However, the dry matter loss in the FSOL was compensated by the increase in the protein and amino acid content of the SOL.

CONCLUSION

The outcome of this investigation revealed that the different processing methods were effective in reducing the levels of the anti-nutritional factors. However, significant dry matter losses and nutrient depreciationwas observed in the soaked and boiled *Senna obtusifolia* leaves. Fermentation method was observed to be the most effective in reducing the levels of the anti-nutritional factors as well as enhancing the nutrient profile of the leaves.

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Growth Performance and Nutrient Digestibility of Broiler Chicken Administered Aqueous *Moringa oleifera* Leaf Extract at The Finisher Phase

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Abstract: Growth performance and nutrient digestibility of Hubbard broiler chickens administered aqueous *Moringa oleifera* leaf extract (AMOLE) at the finisher phase was investigated. Aqueous *Moringa oleifera* leaf meal extract were included at 0- (ordinary water), 0+ (antibiotic in water), 60, 90, 120 and 150 mL per litre of water and tagged $AMOLE_{0-}$, $AMOLE_{0+,}$ $AMOLE_{60,}$ $AMOLE_{90,}$ $AMOLE_{120}$ and $AMOLE_{150}$respectively. A total of 240-day old broiler chicks was allotted to the six treatments consisting of four replicates with ten birds per replicates using completely randomized design. They were fed *ad-libitum* for 6 weeks and data were collected on initial weight, growth rate, feed intake, final weight, water intake, feed conversion ratio and nutrient digestibility at the finisher phase. The results showed that there were no significant ($p<0.05$) differences in initial weight and water intake among the treatments. However, significant ($p>0.05$) differences were observed in the final weight, growth rate, feed intake and feed conversion ratio. Birds in the control group had the highest final weight (2392 g/bird), weight gain (49.78 g/bird) and better feed conversion ratio (1.93) than birds in the other treatments. The digestibility studies showed birds on AMOLE had better CP and EE digestibility. It was concluded that AMOLE can be included at 60 to 120 mL per litre of water to improve growth performance and nutrient digestibility of broiler chickens.

Keywords: Hubard broiler chicken, Aqueous *Moringa oleifera* leaf extracts (AMOLE), Growth performance, Nutrient Digestibility and Finisher phase

INTRODUCTION

Poultry meat is usually from spent layers and parent stock in the past, but recently cross breeding techniques has led to development of broilers (FAO, 1990). The main goal of broiler rearing is the production of quality carcass that will be acceptable by the consumer (FAO, 1990). The poultry industry has witnessed tremendous improvement from the past. These have been as a result of the discovery of vitamins and mineral additives, use of antibiotic growth promoters (AGP) and other growth hormones (FAO, 1990). The growth promoter effect of antibiotics was discovered in the 1940s, when it was observed that animals fed dried mycelia of *Streptomyces aureofaciens* containing chlortetracycline residues improved their growth (Castanon, 2007). These have enhanced gut health and controlled sub-clinical diseases. However, because of public concerns about bacterial resistance to antibiotics, the use of antibiotics and other synthetics have become limited or eliminated in many countries. European Union for example, banned the use of antibiotics as growth promoters since 1st January 2006 (Catalá-Gregori, *et al.*, 2008). Therefore, alternatives to AGP need to be proposed to livestock producers in order to maintain animal health, productivity and carcass quality.

Moringa oleifera is one of the promising plants with organic properties which could contribute to increased intake of some essential nutrients and health-promoting phyto chemicals (Balbir, 2006). *Moringa oleifera* contains active substances that can improve digestion and metabolism and possess bacterial and immuno stimulant activities (Ghazalah and Ali, 2008). It also contains bioceutical agents that could substitute synthetic growth enhancers and supplements in poultry birds (Lannaon, 2007). All parts of *Moringa oleifera* are edible and consumed by animals (Fuglie, 2001). However, there are limited studies on the use of aqueous *Moringa*

oleifera leaf extract on the growth performance of broilers in poultry production in Nigeria. This study investigated the growth performance and nutrient digestibility of broiler chicken administered aqueous *Moringa oleifera* leaf extract at varying concentration at the finisher phase.

MATERIALS AND METHODS

The study was carried out at Abeezainab Integrated Farms, near Niger Baptist Schools Gidan Mangoro, along Minna-Bida Road, Minna, Niger State, Nigeria. Minna is located in the North Central Zone of Nigeria, it is found in the Southern Guinea Savanna Vegetation Zone and it lies between latitude 9°36' North and longitude 6°33' East. Minna has an ambient temperature range of 38 to 42° C. (Student Hand Book, 2014).Two hundred and forty Hubbard broiler chickens from *Bnot Harel* Hatchery in Ibadan, Oyo State, Nigeria was used for this study.

Moringa oleifera leave were purchased from Minna Central Market. The plant materials were air-dried at room temperature for five days and then ground into fine powder using a hammer mill grinding machine and stored for later use. The ground *Moringa* leaves was soaked in water for 24 hours at 60 g per litre of water. After that, the soaked *Moringa* leaves were filtered using a muslin cloth of 2 mm. The filtrate was used for the Treatments at different concentration while the residues were discarded according to the procedure of (Rathi *et al.,* 2006). A total of 240-day old birds were randomly allotted to six treatment levels of aqueous *Moringa oleifera* leaf extract in a Completely Randomized Design (CRD) (Table 1). The six treatments were replicated four times with ten birds per replicate. The birds were housed in deep litter system where they received uniform care and management for the eight weeks duration of experiment. Birds on each Treatment were fed *ad-libitum*. Water was provided for 20 hours and later deprived of water for four hours before the administration of the extract.

Table 1: Inclusion level of aqueous *Moringa oleifera* leaf meal extract per liter of water

Treatments	Inclusion level
AMOLE$_{0+}$	Positive control (ordinary water)
AMOLE$_{0-}$	Negative control (Antibodies at 1.25 g/L)
AMOLE$_{60}$	60 mL/L
AMOLE$_{90}$	90 mL/L
AMOLE$_{120}$	120 mL/L
AMOLE$_{150}$	150 mL/L

The parameters measured were growth performance and nutrient digestibility and data were collected on feed intake, water intake, live weight changes, feed conversion ratio, mortality, nutrients digestibility and final weight. The proximate composition of *Moringa oleifera,* feed and the collected faecal droppings were analysed based on the procedure of AOAC (2012). All data collected were subjected to one way analysis of variance (ANOVA) of completely randomized design, using statistical analysis system (SAS, 2012). Where differences occured at $P<0.05$, they were separated using Duncan Multiple Range Test (SAS, 2012).

RESULTS AND DISCUSSIONS

The results of proximate analysis of *Moringa oleifera* leaf showed that it had protein (23.80%) and crude fibre (16.57%) which was similar to the findings of Mabruk *et al.* (2010) and Zaku *et al. (*2015). The dry matter (94.47%) and ash (9.75%) contents were similar to those obtained by Mabruk *et al.* (2010) and Ogbe *et al.* (2013); the fat contents (5.50%) and nitrogen free extract contents (38.82%) were also similar to those reported by Mabruk *et al.* (2010) and Zaku *et al.* (2015).

The results indicate that the birds in the control treatment had the highest final weight. Furthermore, the final weight of birds on the AMOLE treatments increased until AMOLE$_{120}$ and later declined, this implies that the effective dosage must have been reached at about 120 mL. This result was in contrast to the previous report that *Moringa oleifera* inclusion levels resulted in higher final weights than the control (Chongwe, 2011; Portugaliza

and Fernandez, 2012; Nkakwana *et al*. 2014). The reason for the disagreement may be due to the fact that they did not use aqueous *Moringa oleifera*.

The results of the present study also showed that birds on the control group had the highest growth rate compared to birds on the AMOLE Treatments; the growth rate showed a pattern similar to final weight which increased as inclusion level increases until $AMOLE_{120}$ and then decreased. This result agrees with the findings of (Nkukwana *et al*. 2014, but disagrees with reports of Olugbemi *et al*. 2010, Juniar *et al*. 2008 and Tesfaye *et al*. 2012). The reason for the conflicting result may be as a result of the different forms in which the *Moringa* was administered. The results showed that Birds on $AMOLE_{90}$ had least feed intake while the others are similar to the control group. The AMOLE Treatments had significant influence on feed consumed as the difference between treatments are significant. This disagrees with the literatures, (Chongwe, 2011, Olugbemi *et al*. 2010; Juniar *et al*. 2008 and Paguia *et al*., 2012).

The results also show that birds in the control groups were better converters of feed than some of the AMOLE treatments. $AMOLE_{90}$ had best feed conversion ratio than $AMOLE_{150}$. Thisis similar to reports of (David *et al*. 2012; Portugaliza and Fernandez 2012 and Nkukwana *et al*. 2014).

The digestibility results show that there were significant ($p<0.05$) differences in the values obtained for DM, CP, CF, FAT, ASH and NFE between treatments and control groups. This revealed that the birds on AMOLE efficiently utilized the Nutrients than the control groups. This result does not agree with the findings of (Nkukwana *et al.* 2014). This could be due to the form in which the *Moringa* was administered.

Table 2: The proximate composition of *Moringaoleifera*leaf meal

Nutrients analyzed	Composition (%)
Dry Matter	**94.47**
Crude Protein	**23.80**
Crude Fibre	**16.57**
Fat	**5.50**
Ash	**9.75**
N.F.E	**38.85**

Table 3: Growth performance of broiler chicken administered aqueous *Moringa oleifera*leaf extract

Parameter	$AMOLE_{0-}$	$AMOLE_{0+}$	$AMOLE_{60}$	$AMOLE_{90}$	$AMOLE_{120}$	$AMOLE_{150}$	SEM	
I.W. (g)	1348.47	1304.72	1304.72	1264.72	1387.85	1332.78	21.25	
G.R. (g)	49.68^{a}	49.76^{a}	42.29^{a}	46.52^{a}	46.61^{a}	33.76^{b}	1.48	*
F.W. (g)	2392^{a}	2350^{c}	2200^{e}	2242^{d}	2367^{b}	2042^{f}	25.28	*
F.I. (g)	100.85^{bc}	95.48^{b}	102.55^{c}	90.00^{a}	100.65^{bc}	99.68^{bc}	1.72	*
W.I. (mL)	497.2	495.9	445.7	456.1	484.2	760.7	49.83	
FCR	2.05^{ab}	1.93^{a}	2.47^{b}	2.00^{ab}	$2.18a^{b}$	2.96^{c}	0.10	*

a, b, c- means with different superscript along the row differs significantly (p,0.05). I.W= Initial Weight, G.R= Growth Rate, F.W= Final Weight, F.I= Feed Intake, W.I= Water Intake, FCR = feed conversion ratio, SEM= Standard Error of Mean, LS= Level of Significance, *= Significant ($p<0.05$)

Table 4: Nutrient digestibility of broiler chicken administered AMOLE at the finisher phase

Parameter	$AMOLE_{0-}$	$AMOLE_{0+}$	$AMOLE_{60}$	$AMOLE_{90}$	$AMOLE_{120}$	$AMOLE_{150}$	SEM	
D M	81.63^{e}	86.86^{c}	86.98^{b}	79.94^{f}	86.14^{d}	88.82^{a}	0.77	*
C P	80.63^{e}	88.89^{b}	93.54^{a}	76.09^{f}	82.20^{d}	84.39^{c}	1.37	*
C F	99.10^{b}	99.17^{a}	99.13^{b}	99.00^{c}	99.11^{b}	99.12^{b}	0.01	*
E E	99.72^{d}	99.64^{e}	99.89^{a}	99.75^{c}	99.83^{b}	99.43^{f}	0.04	*
ASH	53.00^{f}	68.50^{b}	66.93^{c}	55.63^{e}	66.39^{d}	71.90^{a}	1.68	*
N F E	17.63^{b}	12.41^{d}	12.25^{e}	19.25^{a}	13.08^{c}	10.40^{f}	0.77	*

a, b, c- means with different superscript along the row differs significantly (p,0.05). C P= crude protein, C F= crude fibre, D M= dry matter, N F E= nitrogen free extracts E E Ether Extract

CONCLUSION

1. The results of the growth performance studies on Hubbard broiler chickens administered aqueous *Moringa oleifera* leaf extracts at the finisher phase shows that growth rate, feed intake, final weight and feed conversion ratio were influenced by AMOLE treatment.
2. Nutrients digestibility were influenced by AMOLE Treatments. It could be concluded that aqueous *Moringaoleifera* leaf meal extract can be included up to 120 mL in broilers drinking water to improve growth rate, feed conversion ratio, feed intake and final weight and up to 60 mL to improve nutrient digestibility of the chickens.

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Growth and production performances of laying guinea fowl (*Numida meleagris*) fed diet containing oyster shell as the main calcium source

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Abstract: The dietary calcium source to laying guinea fowl in the wild are largely through scavenges. An 84-day feeding trial carried out to evaluate the performance and haematology responses of 75 Pearl laying guinea fowl (28 – 32 weeks of age) to diets in which dietary calcium was sourced mainly from oyster shell at graded levels of 2.5%, 3.0%, 3.5%, 4.0% and 4.5%. Growth and hen day production performances and haematology indices were monitored. The average daily feed intake (ADFI) was significantly higher in birds fed 3.0% Ca^{2++} (65.8±0.99 g) and similar to others except those on 4.5% Ca^{2++} with the least value (62.1 ±0.01 g). The feed conversion ratio (FCR) was best in laying guinea fowl fed 4.5% Ca^{2++} (2.98±0.09) and poorest in those on 2.5% (3.31±0.15%). Average daily weight gain (ADWG), hen day production, internal and external qualities indices of egg and all the haematology indices namely, packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC), neutrophils, eosinophils and monocytes were not affected by the dietary treatments ($p>0.05$). The study showed that oyster shell as the main source of dietary calcium at 3.0% gave the optimum performance in laying guinea fowl.

Keywords: Dietary calcium, oyster shell, laying guinea fowl, performance, haematology.

INTRODUCTION

Guinea fowl are varieties of poultry that has not been given the necessary attention for improved production indices as obtained for other species like chicken [1]. The nutrient requirements of guinea fowl are however, been assumed to be the same as that of the chicken as regards the major nutrients [2]. Laying guinea fowl was documented to averagely consume 53 g of feed containing 15% crude protein [3]. Feeding of guinea fowl is an area that has attracted the attention of nutritionists in recent times particularly the peculiarity of its eggshell thickness makes its calcium requirement of research interest. However, in the wild, guinea fowl feed on large proportion of calcium when on free range, which contributes to the hardness attributable to its eggshell. Recent studies showed that 3.25% - 3.75% dietary calcium and 0.35% or 0.40% available phosphorous will be adequate for Pearl Grey guinea fowl [4]. Oyster shell is one of the credible dietary calcium sources for the feeding of farm animals. Therefore, this study evaluated the influence of oyster shell on growth and production performances and haematology of laying guinea fowl (*Numida meleagris*)

MATERIALS AND METHODS

A total of 75 Pearl laying guinea fowls at point-of-lay (POL), aged 28 – 32 weeks old were collected from the Kainji Lake Research Institute, New Bussa, Nigeria, transported to the Teaching and Research Farm of the Faculty of Agricultural Sciences, Ekiti State University, Ado Ekiti for the study. The birds were raised on floor in cages with dimension 2 m x 4 m x 4 m constructed using wire mesh. The birds were divided into 5 treatment groups of 15 birds each in a completely randomized design trial. They were fed experimental diets in which

oyster shell was the main source of calcium at graded levels of 2.5%, 3.0%, 3.5%, 4.0% and 5.0% (Table 1). Each treatment group was further divided into three replicates of 5 birds each. Body weight and feed intake were measured every week throughout the experimental period. The experimental feeds and water were given *ad libitum* throughout the trial.

Data collection: The ADWG and ADFI were recorded from each replicate on weekly intervals. Weekly BWG was then calculated by subtracting the weight at the end of the previous week from the current weight of the birds. Feed conversion ratio was calculated as feed to dozen egg produced.

At the end of 5th week, 2 birds of average weight from each replicate were selected and blood was collected from the wing vein into well labeled sample bottles containing ethylene diamine tetra acetate (EDTA) as anti-coagulant. The samples were immediately transported to the laboratory for analyses. The haematology indices namely, packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC), haemoglobin, (Hb) and the differentials were analyzed as described by Sastry [5]. The feed samples were analyzed for proximate as described by AOAC [6].

Statistical analysis: All the data was subjected to one-way ANOVA statistical analysis at 5% probability ($p<0.05$) using SAS [7]. Means were separated using Duncan's Multiple Range Test of the same software.

RESULTS AND DISCUSSION

Table 1 Composition of experimental diets fed laying guinea fowl (%)

Ingredients	***Calcium***	***inclusion***	***levels* (%)**		
	2.5	**3.0**	**3.5**	**4.0**	**4.5**
Maize	51.56	51.56	51.60	51.66	51.72
Wheat offal	12.00	9.50	7.00	5.00	3.00
PKM	5.00	6.00	7.00	8.00	8.50
SBM	12.00	11.13	11.21	11.48	11.65
GNC	9.00	9.94	9.89	9.13	8.97
Fish meal	2.00	2.00	2.00	2.00	2.00
Oyster shell	7.14	8.57	10.00	11.43	12.86
Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
*Premix	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00
ME Kcal/kg (Calc.)	2626.52	2622.85	2620.06	2612.90	2601.60
CP (%)	17.98	17.79	17.57	17.18	16.94
Ca (%)	2.69	3.15	3.69	4.19	4.69
P (%)	1.23	1.22	1.21	1.23	1.21

*Supply the following per kg of diet: vit. A, 10,700 iu; vit. D3, 2,900 iu; vit. E, 15 iu; vit. K, 2.2 mg; B1, 1.6 mg; B2, 4.0 mg; Niacin, 1.5 mg; Pantothenic acid, 11.5 mg; vit. B6, 2.0 mg; vit. B12, 0.01 mg; Folic acid, 1.0 mg; Biotin, 0.03 mg; Chloride, 150 mg; Mn, 70 mg; Fe, 25 mg; Zn, 4.5 mg; Cu, 25 mg; Co, 0.2 mg; Se, 0.2 mg; Anti-oxidant, 125 mg.

Table 2: Performance of guinea fowl fed diet with oyster shell as main calcium source

	Calcium	***inclusion***		***levels* (%)**	
Parameters	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**

Average daily feed intake (g)	64.3 ±0.22 [ab]	65.8±0.99[a]	63.5 ±3.45 [ab]	64.4 ±0.85 [ab]	62.1±0.01[b]
Average daily weight gain (g)	19.6 ±0.55	20.5 ±0.20	20.1 ±3.33	20.5 ±0.46	**20.7 ±0.05**
FCR	3.31 ±0.15 [b]	3.22 ±0.08[ab]	3.17 ±0.19[ab]	3.17[a]±0.19[ab]	**2.98±0.09 [a]**
Egg production 9%)	48.1±12.5	38.1±0.41	37.7 ±1.37	36.1 ±0.82	44.8 ±0.40
Egg weight (g)	37.6 ±2.65	40.2 ±1.73	38.8 ±0.58	39.8±1.86	38.1 ±1.00
Egg mass (g)	78.6 ±2.35	75.5 ±3.22	73.8 ±3.45	90.8 ±3.33	73.7[a]±0.19

a,b, c, means with different superscripts in the same row differs significantly (p<0.05)

Table 3: Haematology of guinea fowl fed diet with oyster shell as main calcium source

Parameters	***Calcium***	***inclusion***		***levels* (%)**	
	2.5	**3.0**	**3.5**	**4.0**	**4.5**
PCV (%)	41.3±3.76	44.7±4.48	39.0±4.36	36.0±3.06	40.7±0.67
Hb(g/L)	7.01±2.45	11.5±3.65	10.5±2.52	11.0±2.89	3.89±1.78
WBC(10^{-6}/L)	51.4±2.53	51.7±2.32	51.1±2.44	51.3±2.22	51.2±2.51
RBC(x10^{-12}/L)	2.28±0.23	2.33±0.25	2.42±0.32	2.02±0.18	2.40±0.30
Neutrophils (%)	35.7±1.20	34.0±3.06	28.7±4.67	35.3±2.91	30.3±3.18
Lymphocytes (%)	44.0±2.31	50.0±5.03	53.3±6.96	44.7±2.91	50.3±2.33
Monocytes (%)	8.67±0.67	8.00±1.15	8.67±0.67	8.00±0.11	10.0±1.16
Eosinophils (%)	11.7±1.67	8.00±1.55	9.33±1.76	12.0±1.16	9.33±0.67

The growth and production performances of the laying guinea fowls are presented in Table 2. The average feed intake (ADFI) and feed conversion ratio (FCR) were both significantly affected (p<0.05) by the dietary calcium levels. Birds fed 3.0% dietary calcium showed significantly higher (p<0.05) ADFI (65.8±0.99 g) which was similar to data obtained from those on 2.5% (64.3±0.22g), 3.5% (63.5±3.45g) and 4.0% (64.4 ±0.85) dietary calcium. The best (p<0.05) FCR was recorded by birds on treatment with 4.5% dietary calcium while those on 2.5% calcium (3.31±0.15) was poor (p<0.05) The ADWG and production performance parameters such as egg weight, egg mass and hen day production were not significantly affected (p<0.05) by the dietary calcium levels. The observed increase in ADFI perhaps was due to the birds eating to meet its calcium need for egg production, which was found similar in this trial. The observation indicated that consumption of dietary calcium above 3.0% was of no significant benefit in term of production. However, previous findings showed that increase in dietary calcium did not translate into improved egg production [8, 4]. The haematology indices were not affected by the dietary calcium. The values recorded differ and were higher than those reported by Uko and Ataja [9] and might be due to environmental issues and management practices. It can be concluded that dietary calcium of 3.0% sourced exclusively from oyster shell support adequate production and growth performance in laying guinea fowls.

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Performance, Meat Quality Characteristics and Consumer Acceptability of Guinea Fowl Fed Varied Dietary Energy Levels

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Abstract: Ten weeks feeding trial was conducted to evaluate the performance and meat quality characteristics of African guinea fowl birds under the influence of four dietary energy levels (2600, 2700, 2800 and 2900Kcal/kg). One hundred and twenty (120), eight weeks old birds were equally and randomly distributed to the four treatments. Each treatment was sub-divided to three replicates of 10 birds per replicate. Feed was supplied 8am and 4pm daily likewise water. Leftovers were collected and feed intake was estimated. At the expiration of 10 weeks, 3 samples per replicate were randomly selected, slaughtered and carcass (Breast and Thigh muscles parts) were obtained and used for meat quality and sensory evaluation. Highest average weight gain and daily weight gain were obtained at 2700kcal/kg, so also best feed conversion ratio. Meat quality analysis revealed that dried matter increased ($P<0.05$) as energy level increased in thigh muscle but decreased in breast. Crude protein had no definite trend while crude fat increased as energy level increased. Sensory evaluation test shows that general acceptability increased as energy level increased and highest value was recorded from 2700kcal/kg. Thus, could be concluded that 2700kcal/kg is most appropriate for meat type guinea fowl.

Keywords: Guinea fowl, Energy level, Meat quality

DESCRIPTION OF PROBLEM

The term "guinea" fowl is the common name of the seven species of gallinaceous birds of the family *Numididae,* which is indigenous to Africa. The fowls derive their name from Guinea, part of the west coast of Africa. It is well adapted to the realities of life on African continent. The strains are descended from the helmeted guinea fowl, *Numida meleagris.* In many parts of the world, the three principal varieties of guinea fowl recognized are the Pearl, Lavender and White with the Pearl being the most common. (1) reported that guinea fowl had long contributed substantially to the supply of animal protein in form of meat and eggs. Guinea fowl meat has a higher protein content of approximately 28% compared to 20% for domestic fowl (2). Guinea fowl eggs are thicker than chicken eggs (3). It was also reported that guinea fowl meat also commands a premium price (4). Other advantages of rearing guinea fowl include low production costs, greater capacity to utilize green feeds, control of ticks and other pests as well as better ability to protect itself against predators (4) and a unique ability to utilize a wide range of flora and fauna as feed resources (5). In the wild, they eat a wide variety of feedstuffs but most important are weeds, grasses, insects and waste grains (6).

Guinea fowl plays a significant role in the lives of people, ranging from socio-cultural to economic and religious purposes. Guinea fowls are raised mainly for their gamey flesh and eggs because of its taste that is similar to other game birds and has many nutritional qualities like flavour, tenderness etc that make it a worthwhile addition to the diet (7). Guinea fowls have a high yield of 75-80% after processing with excellent meat to bone ratio. Other people raise them for their unique ornamental value in addition to for mentioned insect pests and weed seeds control on the fields. Poultry meat is a popular and versatile source of protein consumed in large amounts relative to other meats. Enriched poultry meat can therefore serve as a vehicle for supplying nutrients such as

the n-3 fatty acids (FA) whose human consumption is below recommendations (8). Previous reports demonstrated that feeding poultry different dietary sources increased the n-3 FA content of meat (9).
In spite of the importance and advantages of guinea fowls over other poultry species, scant information is available on guinea fowl production practices in some African countries of which Nigeria is not left out, particularly the southern part of Nigeria. The derived savannah zone of Nigeria is not left out of this observation. There is also limited information on the performance of guinea fowl under semi-intensive and intensive systems of production and its potential to increase meat production among these identified hungry countries. This study therefore aims to evaluate the performance, meat quality characteristics and consumer acceptability of guinea fowl fed varying dietary energy levels under intensive management.

MATERIALS AND METHODS

Experimental Site: The experiment was conducted at the poultry unit of Teaching and Research Farm of Ladoke Akintola University of Technology, Ogbomoso, Oyo state Nigeria.

Experimental Diets: Four experimental diets were formulated such that diet 1, 2, 3 and 4 containing varied proportion of Metabolizable energy; E1 = 2600Kcal/kg; E2 = 2700Kcal/kg; E3 = 2800Kcal/kg and E4 = 2900Kcal/kg respectively (Table 1) and fixed dietary protein value (20% CP).

Table 1: Composition of Experimental diets fed to Guinea fowls at grower phase

Ingredients	**El**	**E2**	**E3**	**E4**
Maize	45.5	49.0	55.0	60.0
Soybean meal	11.4	10.0	11.0	12.0
Groundnut cake	10.0	10.0	11.0	11.0
Wheat offal	22.0	20.0	12.0	6.00
Fish	4.30	4.30	4.30	4.30
Oyster	3.00	3.00	3.00	3.00
Bone	3.00	3.00	3.00	3.00
Premix	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10
Methionine	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**
Crude protein (%)	20	20	20	20
Energy (Kcal/Kg)	2600.2	2700	2800.84	2900.06

Vitamin Premix per kg of diet; vitamin A, 12,000UI; vitamin D3, 25,000UI; vitamin E, 30UI; vitamin K,2.0mg; vitamin B2, 6.0mg; vitamin B6,4.5mg; vitaminB12, 0.015mg; Niacin 40mg; Panthetonic acid 15mg; Folic acid 1.5mg; Biotin 0.05mg; Chlorine chloride 300mg; Manganese 80mg; Zinc 50mg; Iron 20mg; Copper 5.0mg; Iodine l.0mg; Selenium 0.02mg; Cobalt 0.5mg; Antioxidant 125mg.

Experimental bird and distribution: One hundred and twenty (120) eight weeks (8wks) old of African breed guinea fowl was used for the experiment. They were equally and randomly divided into four (4) groups of 30 birds per group which was further divided into three (3) sub-group (replicates) using a completely randomized design. Each group of 30 birds were assigned to individual treatment of the four (4) varying dietary energy level of El E2, E3 and E4.

Feeding regime and other management practices: The birds were fed early in the morning (8am) and evening (4pm) on daily basis. Feed given were weighed using a top sensitive scale to obtain the required quantity of feed per treatment per replicate. The orts (leftover) were collected, weighed and recorded on a daily basis to know the amount of feed consumed by the birds per day. Water was supplied to the bird's *ad libitum.* All vaccination and medication program were carried out at when due. At the end of every week, the birds in each replicate were

weighed and the outcome was used to determine the average weight gain of each replicate as well as their feed conversion ratio (FCR).

Meat quality and properties assessments: Breast and Thigh meat samples were used for the meat quality and sensory (colour, flavour, tenderness, juiciness and general acceptability) evaluation of the birds. A proportion of the meat sample was collected from the replicates and subjected to proximate analysis using AOAC method (10).

Another proportion of the meat was cut and cooked in water bath at 80ºC for 30 minutes. The samples were removed, allowed to cool before being served to the 20 trained individuals (panellists). They were randomly allotted to the treatments. Each sample was evaluated independent of the other sample. Mouth was rinsed each time a piece of meat was tasted. Scores were made using questionnaire of nine-point hedonic scale.

Statistical Analysis: All data generated were subjected to Analysis of variance using the general linear model of SAS (11). Mean were separated using Duncan's multiple range option of the same statistical package.

RESULTS AND DISCUSSION

Growth performance of growing guinea fowl fed varying dietary energy level: Considering the best weight gain (1254.93g), average daily weight gain (22.4g) and feed conversion ratio (3.66) recorded, E2 (2700Kcal/kg) was significantly ($P<0.05$) better than others, E3 and E4 were statistically ($P>0.05$) similar and better than E1 (2600kcal/kg). This result was similar to the report of Veldkamp *et al.,* (12) but deviated from the findings of Rabie and Szilagyi (13) who reported that feeding of high ME diet significantly improved body weight gains and feed conversion ratio of broiler chickens. Broilers fed high ME diets showed better FCR than those fed lower energy diets (14). However, it could be ascertained that feeding high dietary energy to obtain improved body weight gain is not applicable to all classes of poultry bird and at the same time has its optimum level.

Table 2: Growth performance of growing guinea fowl fed varying dietary energy level

Parameters	El (2600kcal)	E2 (2700kcal)	E3(2800kcal)	E4 (2900kcal)	SEM
Average total weight gain (g)	1068.98^{c}	1254.93^{a}	1182.26^{b}	1186.73^{b}	30.89
Daily weight gain (g)	19.08^{c}	22.4^{a}	21.11^{b}	21.19^{b}	0.55
Total feed intake (g)	4762.35	4581.35	4340.05	4366.96	97.89
Daily feed intake (g)	63.08	65.44	62.00	62.38	1.39
Feed conversion ratio	4.48^{a}	3.66^{b}	3.67^{b}	3.68^{b}	0.130

^{abc} means on the same row with different superscript were significantly different ($P<0.05$).

Proximate composition of thigh and breast muscle of growing guinea fowl fed varying dietary energy level: Proximate composition of meat samples obtained from the guinea fowl revealed a significant ($P<0.05$) variation in the parameters such as dry matter content, crude protein, crude fat and total ash contents (Table 3). Meat CP was significantly influenced by the variation in dietary energy, though no definite trend was observed. Meat quality in term of CP was also observed to be under the influence of the cut parts. Higher CP percentage was recorded from the breast meat compared to thigh meat samples. Crude fat content of meat sample was found to be significantly increased as the dietary energy increased. Rate of fat deposition in the thigh was observed to be higher than that of breast.

Dry matter content of guinea fowl meat under intensive and semi intensive system of management was reported to be 22.9% and 26.1% respectively (5). The values recorded for muscle fat content recorded were in agreement with the report that the fat content of whole carcass was significantly increased with increasing energy content of diet (15). Same result was observed by (3) and (16) who reported that the percentage of carcass fat

significantly increased as the dietary energy level increased. Similar observation was reported in the case of broiler and broiler meat where the extra deposition of fat is usually observed when the dietary energy is increased (17).

The nutritional composition of the meat depends on the cut part of the Birds carcass used and also can be influenced by the nutritional quality of the feed given to the birds (18). Though the muscle protein content was significantly ($P<0.05$) influence but no definite trend was observed. However, all were still within the range (18.4-23.4%) reported for poultry birds (19).

Table 3: proximate composition of thigh and breast muscle of growing guinea fowl fed varying dietary energy level

Parameters	El	E2	E3	E4	SEM
Thigh					
Dry matter	24.05^{d}	25.25^{c}	25.89^{a}	25.43^{b}	0.08
Moisture	74.95	74.58	74.11	74.57	0.08
Crude protein	20.34^{a}	18.59^{b}	20.12^{a}	19.68^{ab}	0.68
Crude fat	16.75^{a}	20.97^{b}	21.53^{b}	24.50^{a}	0.71
Total ash	1.19^{b}	1.47^{a}	0.85^{d}	0.95^{c}	0.06
Breast					
Dry matter	31.70^{a}	27.10^{d}	27.82^{b}	27.63^{c}	0.47
Moisture	68.30	72.90	72.18	72.37	0.47
Crude protein	23.18^{b}	22.96^{d}	22.98^{C}	23.84^{a}	0.09
Crude fat	7.46^{d}	7.49^{c}	8.62^{b}	14.50^{a}	0.75
Total Ash	**1.47^{b}**	**1.27^{d}**	**1.91^{a}**	**1.44^{c}**	**0.61**

Organoleptic properties of guinea fowl fed varying dietary energy levels: Table 4 shows the influence of dietary energy on colour, flavour, juiceness, tenderness and overall acceptability of the thigh and breast muscles. No significant difference was recorded among the treatments in all the parameters measured except for juiciness, colour and overall acceptability. Increasing value of juiciness as the energy level increased could be traced to increase in fat deposition or content of the adipose muscles or the meats (20). Although lower scores were recorded from birds fed lower energy diet El (2600kcal/kg) and the meat was less acceptable by the panelists, whereas the meat from birds that are fed high energ2y E4 (2900kcal/kg) had high scores and more acceptable. This result was in accord with the findings (21) who reported that tenderness of meat from broiler was similar when birds were fed varying dietary energy and protein.

Table 4: Organoleptic properties of guinea fowl fed varying dietary energy levels

Parameters	El	E2	E3	E4	SEM
Texture	4.80	5.50	5.89	6.00	0.28
Juiciness	5.10^{b}	5.60^{b}	5.11^{b}	6.20^{a}	0.32
Tenderness	3.90	4.10	4.56	5.50	0.30
Flavor	5.60	5.20	5.11	6.00	0.30
Colour	6.00^{ab}	6.90^{a}	4.70^{b}	6.67^{a}	0.28
Overall acceptability	6.80^{b}	8.10^{a}	6.90^{b}	8.10^{a}	0.1

CONCLUSION AND APPLICATION

Best feed conversion ratio was obtained from treatment E2 (2700kcal/kg energy level). Also, the highest acceptability was recorded from the treatment. It could therefore be concluded that 2700kcal/kg is most appropriate, especially when meat type guinea fowl is demanded. Thus, broiler-guinea fowl producer could adopt the use of moderate energy level of 2700kcal/kg for optimum productivity and maximum gain to the farmer.

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Influence of Maize Grains Treated with Insecticides on Growth Performance and Liver Function Tests of Chickens

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Abstract: Increase in the cost of livestock production has been linked with activities of pests as destructive agents of agricultural crops used as animal feed ingredients. This may also threaten food security. The use of pesticides becomes essential in order to control or reduce the effect of agricultural pests. However, the increase use of pesticides in crop protection may lead to increase possibility of feed/food contamination. This study was therefore carried out to examine the influence of maize grains treated with insecticides on performance and liver function tests of chickens. Three batches of diet were formulated: the control diet (G1), the diet containing maize grains treated with 20% chlorpyrifos at the dosage of 2 mL/kg of maize grains (G2) and diet containing 20% imidacloprid, 20% metalaxyl-M and 2% tebuconazole at 2 g/kg of maize grains (G3). The study lasted for 14 days. Twenty-five weeks old Nera Black strain laying hens were fed the diets in a completely randomised design. The insecticide-treated diets lowered the feed intake, while the chlopyrifos-treated diet reduced the body weight of the experimental animals. Aspartate amino transferase and alkaline phosphatase were significantly higher for the treatment diets than the control. The study concluded that caution should be made when animals are exposed to insecticide-treated diets.

Keywords: Chickens, Food Security, Food Safety, Insecticides, Liver

INTRODUCTION

The multiple roles livestock production play in the livelihood of people in the developing countries cannot be over-emphasized. It is a source of food, nutrition and employment. It ensures environmental sustainability and confers economic and social status (Moyo and Swanepoel, 2010). Central Bank of Nigeria (2007) noted that livestock production accounts for one-third of agricultural gross domestic product in Nigeria with poultry contributing the highest percentage to the gross domestic product in the livestock sub-sector. Gueye (2009) observed that poultry production is an important activity for supplying the teeming human population with quality protein, as well as providing additional income to the farmers.

Pests are major agents which affect agricultural crops, which consequently raise the cost of livestock production, as well as threaten food security. In order to control or reduce the effect of agricultural pests, pesticides are used to combat the effects at pre-planting and post-harvest stage. Grains to be planted are treated with different classes of seed dressers such as insecticides, fungicides etc. to ensure adequate germination and emergence. Hence, it becomes necessary to examine the effects of seed dressers on growth performance, and serum biochemical profile of laying hens.

MATERIALS AND METHODS

Three batches of diet were formulated. The first group contained no pesticide and served as the control diet (G1). The 2nd group (G2) contained maize grains treated with 20% chlorpyrifos at the dosage of 2 mL/kg of maize grains and the 3rd group (G3) contained maize grains treated with 20% imidacloprid, 20% metalaxyl-M and 2% tebuconazole at 2 g/kg of maize grains. as recommended by the manufacturers and the diets were fed to 25-week old Nera Black chickens. The experimental diet is shown in Table 1. Each of the diets was fed for 14 days. Each treatment had 3 replicates with 4 birds per replicate. Liver function test was performed using Randomx commercial kits. The design of the study was a completely randomized design. Data obtained were subjected to one-way analysis of variance and analysed using 9.1 version of SAS statistical package (SAS, 2003), while Duncan's multiple range test was used to separate means where significant differences existed.

Table 1: Composition and nutrient contents of experimental diet for laying hens

Ingredients	Amount (%)
*Maize	45.50
Soya bean	19.00
Fish meal 72% CP	2.00
Wheat offal	23.80
Bone meal	6.00
Oyster shell	3.00
Salt	0.20
Methionine	0.25
Premix	0.25
Determined nutrients	
Dry matter	88.02
ME (kcal/kg)	2705.72
Crude protein	16.69
Crude fibre	4.82
Ether extract	5.64
Calcium	3.47
Phosphorus	1.14
Lysine	0.82
Methionine	0.53

*Maize grains in the diets were treated differently for each treatment: G1=control diet, maize grains in G2 were treated with 20% chlorpyrifos; those in G3 were treated with 20% imidacloprid, 20% metalaxyl-M and 2% tebuconazole

Table 2: Performance characteristics of laying hens fed with diets containing seed dresser-treated maize

Parameters	G1	G2	G3	SEM
Feed intake (kg/bird)	0.89^{a}	0.81^{b}	0.82^{c}	0.003
Initial weight (kg/bird)	1.61^{b}	1.73^{a}	1.65^{ab}	0.002
Final weight (kg/bird)	1.67^{ab}	1.65^{b}	1.63^{b}	0.001
Weight change (kg/bird)	0.07^{a}	-0.08^{b}	-0.02^{b}	0.002

SEM= standard error of mean; G1=control diet; G2= contained 20% chlorpyrifos treated maize grains; G3= contained 20% imidacloprid, 20% metalaxyl-M, 2% tebuconazole treated maize grains. Means with different superscripts within the same rows are significantly (P<0.05) different.

Table 3: Serum biochemical profile of laying hens fed with diets containing seed dresser-treated maize

Parameters	G1	G2	G3	SEM
AST (IU/L)	18.83^{c}	22.50^{a}	20.40^{bc}	0.06
ALT (IU/L)	4.10^{c}	4.70^{b}	6.77^{a}	0.05
ALP (IU/L)	288.60^{c}	374.33^{a}	343.77^{b}	0.53

SEM= standard error of mean; G1=control diet; G2= contained 20% chlorpyrifos treated maize grains; G3= contained 20% imidacloprid, 20% metalaxyl-M, 2% tebuconazole treated maize grainsAST = aspartate aminotransferase, ALT = alanine aminotransferase, ALP = alkaline phosphatase. Means with different superscripts within the same rows are significantly (P<0.05) different.

RESULTS AND DISCUSSION

Tables 2 and 3 show performance characteristics and serum biochemical profile of laying hens fed diets containing seed dresser-treated maize. Feed intake was significantly (P<0.05) lower for the birds fed experimental diets, which was statistically higher than those of control (0.89 g/bird). Weight change was generally low for all the birds fed with experimental diets. The AST, ALT and ALP values were higher for all the birds fed with insecticide-treated maize grain, although the AST value obtained for G3 was statistically similar to the control group.

Serum enzymes are commonly used as sensitive biochemical markers for the assessment of hepatocellullar injury, as well as liver disease. Increased values obtained in this study may be an indication of early indicators of liver disease. Liver of birds fed seed dresser-treated maize might be experiencing gradual damage. Abnormal increase in serum enzymes such as AST, ALT and ALP has been shown to be an indication of liver damage (Nduka, 1997). Although AST and ALT have been reported to be found in high concentration in the cytoplasm and mitochondria of liver cells than in the blood (Aliyu *et al.*, 2007), increased activities of the enzymes have been attributed to increased membrane permeability and leakage into the blood circulation when hepatocytes are injured (Benjamin, 1978). Lemus and Abd El-Ghany (2000) earlier reported that administration of sub-lethal dose of chlorpyrifos resulted in altered enzyme activities of liver, renal damage and reproductive disorders to experimental animals. The influence of insecticides on heart and liver histology and haematology of laying chickens had earlier been reported (Adejumo and Ologhobo, 2015; Adejumo *et al.*, 2015). El-Deeb *et al.* (2007) also observed a decrease in body weight, kidney and testis weight of albino rats exposed to chlorpyrifos orally at a dose of 0.955 mg/100 g body weight for 3 months.

CONCLUSION

It is thus concluded from the result of the study that the seed dressers should be handled with extra care and proper awareness should be given to the farmers to consult with extension agents before using these harmful chemicals. Bio-insecticides may be considered as potential substitute for the used insecticides, if their safety to humans and livestock is ascertained.

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The Effects of Nutrase – Xylan (Enzyme) Supplementation on the Utilization of Blod Rumen Content Mixture by Broilers

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Abstract: A trial with 360 day – old broilers were conducted for a period of six (6) weeks to determine the optimum level of blood rumen content mixture (BRCM) that broilers can tolerate in their diet. There were five dietary treatments which contained 5%, 10%, 15% and 20% BRCM supplemented with enzyme (nutrase – xyla) and the control diet (0% BRCM) without enzyme supplementation. Birds fed on 10% BRCM diet had a significantly higher ($p<0.05$) feed intake than those fed on other diets. Body weight gain were comparable ($p<0.05$) for birds on all the experimental diets. The birds on the control diet "tended" to have a better feed to gain ratio than the birds on the BRCM based diets. The price of feeds decreased as the level of BRCM increased in the diets. Similarly, the cost of rearing broilers to six (6) weeks of age also decreased as the BRCM inclusion level in their diets increased. The result of this study therefore, showed that broilers can tolerate up to 20% level of BRCM in their diets without adverse effects.

Keywords: Blood – Rumen content mixture (BRCM), Nutrase – xyla (enzyme), Curry, Broiler.

INTRODUCTION

Poultry industry globally has undergone remarkable growth over the years however, expansion of this industry has been hampered inadequate supply of quality feeds. This is due to the competition for feed ingredients between man and livestock. The increasing cost of feed has been a threat to the survival of livestock industry in developing countries and with the situation particularly serious for monogastric animals (Akinwumi, 1988). As a result, emphases have been directed towards the use of non – conventional feedstuffs such as abattoir wastes in the feeds of livestock.

Blood - Rumen content mixture (BRCM) is a mixture of blood and rumen contents processed into a single ingredient. They are both abattoir by – products that constitutes environmental hazards at the abattoir. Efforts have been made to feed chicks with the by – product from abattoir (Adeniji and Balogun, 2001a). The repulsive odour of the by – products which consequently reduce the acceptability and palatability when fed to birds have been suppressed by the use of flavouring agents such as curry, fish broth, meat broth and vanilla (Adeniji and Balogun, 2002). The BRCM is readily available all year round with the raw wastes obtained at the abattoir, free of charge. Most of the unconventional feed stuffs or wastes identified are high in fibre and low in digestibility by monogastrics. This has led to the inclusion of certain synthetic enzymes in the diets of monogastrics which aid effective utilisation of these fibrous feedstuffs. Enzymes have been shown to increase digestibility, availability of nutrients and energy values of these feedstuffs and rations.
The study was therefore aimed at recommending the optimum inclusion level of the enzyme nutrase – xyla, supplemented blood - rumen content mixture (BRCM) that will give the best performance in broiler chicken.

MATERIALS AND METHODS

The blood was collected into a clean container during the time of slaughtering. It was boiled in a container for about one hour, with continuous stirring. The boiled blood was then sun dried until the moisture content was below 15% the rumen content was collected into a separate container and then boiled for the period of about two and half hours with intermittent stirring. The boiled materials were then sun dried until the moisture content was

below 15%. The blood and rumen content were ground separately and mixed at the ratio of 1:3 (w/w). The mixture was then favourized with curry at rate of 200 g/100 kg of blood rumen content ratio (BRCM). This was done to mask the inherent odour of BRCM and to improve its palatability (Adeniji and Balogun, 2000). This material (BRCM) was then used as the test ingredient in the experimental diet.

A total of 360 day old broilers were used for the experiment which lasted for a period of six weeks. There are five (5) experimental diets with three replicates of 24 birds each. The five treatment diets had BRCM at 0%, 5%, 10%, 15% and 20% inclusion levels. All except the control (0% BRCM) had enzyme supplementation at the rate of 100g of Nutrase xyla to a ton of feed. Feed and water were supplied *ad libitum* throughout the experimental period and the birds were housed in the litter system. Vaccines and drugs were given to them at different stages of their development. Vitamins and Antibiotics were given to them at first week of age. Gomboro vaccine was given to them orally in the 2nd week of age. At week four (4), Coccixine was given and was repeated at 6th week of age.

Proximate analysis of feed samples was carried out by the method of A.O.A.C. (1980). Records of initial weight, weekly weight gain, daily feed intake and mortality were kept. All data were subjected to statistical analysis appropriate for the randomized complete block design (RCBD) and where significant treatment means were compared by the Duncan's multiple range test (Steel and Torrie, 1980).

Table 1: Composition of Experimental Diet (Kg/100kg)

Ingredients	**Diets**				
	1	**2**	**3**	**4**	**5**
Blood Rumen Content Mixture	0.0	5.0	10.0	15.0	20.0
Maize	54.0	54.0	54.5	55.0	55.5
Soyabean Meal	22.5	20.5	19.5	16.5	13.5
Fish Meal	4.5	4.5	4.5	4.5	4.5
Wheat Offal	5.5	4.0	6.0	3.5	1.0
Palm Kernel Cake	8.0	6.5	-	-	-
Oyster Shell	2.5	2.5	2.5	2.5	2.5
Bone Meal	2.0	2.0	2.0	2.0	2.0
Broiler Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.35	0.34	0.34	0.34	0.34
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.30	0.30	0.30	0.30	0.30
Enzyme (Nutrase xyla)	0.00	0.01	0.01	0.01	0.01
TOTAL	**100**	**100**	**100**	**100**	**100**
CP (%, analysed)	20.78	22.40	21.43	19.00	19.20
ME (kcal/kg, Calculated)	2909.5	2927.5	2900.01	2934.6	2969.4
Either Extract (%, Calc.)	4.13	4.08	3.90	3.88	3.86
Crude Fibre (%, Calc.)	4.41	4.89	5.27	5.78	6.28
Calcium (%, Calc.)	1.89	1.90	1.90	1.91	1.92
Phosphorus (%, Calc.)	0.85	0.83	0.82	0.79	0.77

The vitamin-mineral premix used was produced by animal care service consult (Nig) Ltd, and each 25g contained Vit. A: 10,000,000Ui; Vit. D3: 2,000,000Ui; Vit. E:100,00Iu; Vit. K: 2,000mg; Thiamine B1: 1,500mg; Panthotenic acid:5000mg; Vit. B12:10mg; Folic acid: 500mg; Biotin: 20mg; Choline Chloride: 200g; Antioxidant: 125g; Mn:80g; Zn:50g; Fe:20g; Gu:5g; Iodine: 12g; Selenium:200mg and Co: 200mg. Nutrase-xyla, an endoxylanase enzyme was produced by Nutrex company in Belgium.

Table 2: Performance Characteristics of Broilers Fed Blood-Rumen Content Mixture (Brcm) Supplemented with Nutrase Xyla

Performance Characteristics	Levels of Blood Rumen Content Mixture					
	0%	**5%**	**10%**	**15%**	**20%**	**SEM**
Initial Body Weight (g)/bird	14.00	14.73	15.23	12.80	14.33	0.52
Final Body Weight (g)/bird	1,326.67	1,316.67	1,373.33	1,203.33	1,236.67	0.066Ns
Feed intake/bird/day	71.81^{b}	73.50^{b}	78.76^{b}	72.29^{b}	74.15^{b}	1.34S
Rate of gain (g)/bird/day	31.26	31.00	32.33	28.36	29.12	1.60Ns
Feed/gain ratio	2.30	2.37	2.44	2.55	2.55	0.19Ns
Mortality (%)	0.00	1.11	0.00	1.11	1.11	Ns
Price (N/kg) of diet	127.87^{c}	125.35^{b}	125.244^{b}	122.72^{ab}	119.17^{a}	S

Treatment means in the same role followed by the same subscript letter are not significantly different (P>0.05)

DISCUSSION

The low mortality rate (i.e. 3.33) recorded over a period of 42 days (6 weeks) suggested that the Blood – Rumen content mixture (BRCM) supplemented with nutrase – xyla as a feed ingredient, is not harmful when properly processed and prepared. Nutrase – Xyla supplementation in the diet containing Blood – Rumen content-based diet aided the breaking down of indigestible fibre of Blood _ Rumen to make the trapped nutrients in the fibre available. Thus, enzyme treatment reduced the variation in digestibility which in turn increased the growth of bird. On commercial scale, this could help to improve the utilisation of nutrients present in poor quality feedstuffs thereby reducing the cost of production (Cowienson *et al*., 2000).

The enzyme inclusion seemed to have stimulated better feed intake which was observed on the BRCM diet compared with the control. This could also be as a result of the high fibre in the BRCM based diet. Fibre has been associated with high rate of feed passage necessitating more feed intake. The increase in feed intake could also be attributed to the addition of curry as a flavouring agent to mask the repulsive odour of BRCM and increases palatability (Adeniji and Balogun, 2001b).

The drop observed in weight gain of birds fed on diets containing 15% and 20% despite the increased in feed intake implies that feed was not well utilized. This could be as a result of the increased in feed level of the diet as the BRCM level increased and Broilers cannot tolerate high fibre diets.

The action of enzyme nutrase-xyla supplementation did encourage an improvement in good feed to gain ratio of birds fed on BRCM diet. The birds fed on control diet tended to have the best feed to gain ratio when compared to birds fed on BRCM based diet despite the insignificant differences. The addition of nutrase-xyla helped the gut enzyme to make nutrient available which had been locked up in the fibre of the BRCM. Atteh, (2000) also reported the efficient nutrient utilization in the replacement value of Nutrase-xyla supplemented wheat bran for maize in broiler diet.

The reduction in the price of feed as seen with the increased in the level of BRCM in the diet was a result of the cheap price/kg of the BRCM feedstuff. The estimated cost of BRCM was calculated to be approximately N 25/kg which is far cheaper compared with prices of most conventional protein supplements available. Peter and Hoffmann (1996) repeated that there is a bright future to be open – up as enzymes become practical tool, offering the possibility of replacing expensive raw materials with the cheap ones by using home grown plants for incorporation with poultry diets, utilising alternative raw materials and protecting the environment.

Based on the insignificant feed to gain ratio, the 20% BRCM supplemented with enzyme is recommended for inclusion in the diets of broilers.

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Chromatographic and Spectrophotometric Assay for Aflatoxin B_1 of Finished Poultry Feeds in Nigeria

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Abstract: Four batches of feed ingredients and the resulting finished poultry feeds obtained from a proprietary livestock feeds manufacture located in Lagos Nigeria, over a period of three months (April – June) were assayed for aflatoxin B_1 (AFB_1) levels by a combined thin layer chromatographic and spectrophotometric method. Of the seven feed ingredients examined, only meat meal, palm kernel cake (PKC) and groundnut cake (GNC) showed AFB_1 contamination levels higher than 0.50ppm. Meat meal had the highest concentration at 1.66 ppm. The finished feeds all had low aflatoxin concentrations except one growers mash (batch 1), one chick mash (batch 2) and a grower's mash sample (batch 3) which had contamination levels of 0.88, 0.55 and 0.52 ppm respectively. It was concluded that the feed ingredients used and the finished feeds, produced by the livestock feeds producer during the present survey were of excellent quality with respect to aflatoxin B_1 contamination.

Keywords: Aflatoxin B_1, ingredients, feeds, chromatography, spectrophotometry

INTRODUCTION

Although mycotoxins are found world-wide, their contamination generally occurs in the tropical and sub-tropical regions in the world. Mycotoxins are often found as natural contaminants in raw ingredients of poultry feed (Khan *et al.,* 2011). Poultry are highly susceptible to mycotoxicoses caused by aflatoxins (Anjum *et al.,*2011). The aflatoxins, the major components of a group of secondary metabolites produced by several fungi Aflatoxicosis causes severe economic loss in the poultry industry affecting ducklings, broilers, layers, turkeys and quails (CAST, 2003). In poultry, aflatoxins impairs most of the important production parameters including weight gain, feed intake, feed conversion efficiency, pigmentation, processing yield, egg production, and male and female reproductive performance (Hussain *et al.,* 2010). As a common rule, poultry should not get more than 20 μg/kg of aflatoxins in the feed. Aflatoxin contamination in feed may cause reduction of immune response in poultry,thus the birds become vulnerable to several diseases (Dhanasekaran *et al.,* 2009).Toxigenic *Aspergilus flavus* isolates generally produces aflatoxins B_1 and B_2, (Davis and Diener,1983).

The major hosts of *A. flavus* among food and feed commodities are cereal grains, peanut, cotton seed and protein sources such as rapeseed meal, cottonseed meal, soyabeen meal, sunflower meal, corn gluten meal, copra meal, and palm kernel meal (Anjum *et al.,* 2012). Aflatoxin producing fungi utilize the nutrients present in the ingredients for their metabolism and propagation, and thereby reduce the nutritional quality of the feed ingredients (Akande *et al.,* 2006). In Nigeria, different feed ingredients that are used in poultry feeds are likely to be contaminated with aflatoxin producing fungi because most commercial feed mills in Nigeria provide suitable environments for fungal growth provoked by improper harvesting and storage, unhygienic method of processing and production. Therefore, regular monitoring of aflatoxin in poultry feeds is an important precondition to check toxins buildup in poultry feeds.

The prevalence study on mycotoxins in feeds is regularly and frequently practiced in many countries like Brazil (Rosa *et al.,* 2006), Kuwait (Beg *et al.,* 2006), Nigeria (Osho *et al.,* 2007), India (Vijayasamundeeswari *et al.,* 2009), Iran (Beheshti and Asadi, 2014), and Malaysia (Reddy and Salleh, 2011).Few studies have also been conducted upon presence of mycotoxins in poultry feeds and agricultural products in country like Pakistan (Saleemullah et al., 2006; Khan *et al.,* 2011; Anjum *et al.,* 2011, 2012) but there is dearth of information on mycotoxic contamination of feed ingredients in Nigeria. However, regular monitoring is crucial for ensuring the safety of animal or poultry feeds. Mold strains isolated from the Nigerian environment have been shown to produce toxic metabolites (Bababunmi et al., 1976) and work by Emerole and Uwaifo, (1980) had shown that several of our staple foodstuff can serve as suitable mediafor the growthof these molds. It is therefore pertinent to note that mold contamination of the Nigerian environment and those several other tropical countries with the resultant production of aflatoxins could constitute a problem. This present study was designed to evaluate the chromatographic and spectrophotometric assay for aflatoxin B_1 of finished poultry feeds in Nigeria.

MATERIALS AND METHODS

This study was carried out at the University of Ibadan research laboratories of Departments of Animal Science and Veterinary Pathology. Feed ingredients used in making several classes of poultry feeds as well as the finished feeds were collected monthly from a particular livestock feed mill located in Lagos, Nigeria and brought to Ibadan for processing. The collection started in April and ended in July. Samples were processed immediately they arrived as follows: Two 50 g amounts of freshly ground ingredient or finished feed were extracted in organic solvents and the AFB_1 separated by thin layer chromatography (TLC) according to the method of Seitz and Mohr (1976). A total of 97 samples from 4 batches of feed ingredients and finished feeds were run in duplicate. Positive samples were scrapped off the TLC plates and the AFB_1 concentration quantified spectrophotometrically according to the method of Nabney and Nesbitt, (1965)). The results obtained were analysed using descriptive statistics.

RESULTS

The mean aflatoxin B_1 concentration (ppm) in feed ingredients and the finished feeds which they were used to compound are presented in Table 1.

Table1: mean aflatoxin b_1 concentrations (ppm) in poultry feed ingredients and finished feeds.

	Mean Aflatoxin concentration (ppm)			
Feeds/Feed ingredients (Batches)	**1**	**2**	**3**	**4**
GNC	0.51	0.42	0.16	0.12
PKC	0.95	0.21	0.00	0.00
SBM	0.22	0.00	0.16	0.00
Wheat Offal	0.14	0.42	0.08	0.11
Maize	0.13	0.29	0.14	0.13
Fish Meal	**ND**	0.00	0.04	0.00
Meat meal	1.01	0.00	0.04	1.66
Broiler Starter	0.40	0.00	0.00	0.00
Broiler Finisher	0.12	0.00	0.28	0.00
Growers Mash	0.88	0.26	0.18	0.21
Layers Mash	0.32	0.32	0.52	0.00
Chick Mash	**ND**	0.55	0.00	0.00

ND = not done; GNC=Groundnut cake; PKC=Palm kernel cake

SBM=Soya bean meal

All the feed ingredients except meat meal, PKC and GNC showed AFB_1 contamination levels which were below 0.50ppm. The lowest contamination was seen with the soya bean meal. Batch 1 samples of GNC, PKC and meat meal had AFB_1 concentrations in excess of 0.50 ppm. However, both PKC and GNC had low contamination levels in Batches 2, 3 and 4 samples. The Batch 4 meat meal sample had the highest concentration of AFB_1 (1. 66 ppm) of all the samples studied. The finished feeds generally had low aflatoxin levels (less than 0.5 ppm) except one grower's mash samples (batch 1) which was contaminated to the extent of 0.88 ppm.

DISCUSSION

Data from the present study indicate that this livestock feeds producer used ingredients which had very low levels of AFB_1 contamination during the period of survey and in general, produced uncontaminated finished feeds. The exceptions were the meat meal ingredients of batches 1 and 4 which had AFB_1 concentrations higher than 1.0 ppm, and the GNC and PKC of batch 1 both of which were contaminated at levels higher than 0.5 ppm. Since contamination levels of up to 1.0 ppm have been known to lead to metabolic disorders and retard growth when fed to chickens for long periods (Akinyemi *et al.*,1984 and Smith et al., (1971), it is important to determine AFB_1 levels in finished feeds. The slight contamination of the GNC found here was not unexpected. This is because studies (Akinyemi *et al.*,1974; Oyejide *et al.*,1987; Firdous, 2003) have shown that groundnuts and products constitute an excellents medium for the growth of moulds and the subsequent elaboration of aflatoxin. (Khan *et al.,* 2011) reported that in a 3 years survey study (2006 to 2009) in the Punjab province of pakistan, 1,021 samples were analysed, of which 646 were found positive for the presence of aflatoxin, among which 47, 51, 60 and 66 % were cereals, cereal byproducts, oilseed meals and poultry feeds, respectively. The fact that only one batch of the GNC had AFB_1 concentration in excess of 0.50 is thus an indication that this particular livestock feeds manufactures purchased high quality GNC during the survey period. One of the four batches of PKC had a substantial aflatoxin (0.95 ppm) contamination. This ingredient has only recently been added to poultry rations as a source of energy. However, it is generally used in low proportions because of its limitation including low palability, grittiness and dryness in texture resulting in salivation in animals (Smith *et al.*,1971).

Our results indicates that care should be taken by all users of PKC to exclude conditions such as dampness, heat and long storage which promote mold growth from the products (Richard, 2007). Two batches of meat meal were contaminated at levels in excess of 1.00 ppm. This finding is unexpected and therefore quite significant. It suggest the processing and storage of meat meal should be carried out under condition which preclude the growth of fungi as it has been reported by Abidin *et al.,* (2013) that high moisture content, long storage and heavy rains during storage may increase the level of Aflatoxin. Several investigators have argued that aflatoxins are present in feed ingredients and when they do are only at sub lethal levels. Based on field observations (Oyejide *et al.*,1987) pointed out that very few samples ever exceeded 5ppm of aflatoxin and that aflatoxicosis is usually a mild but insidious disease rather than a catastrophic disease characterized by high mortality. The finished feeds studied here had low levels of AFB_1 (all less than 1 ppm). These levels are lower than those previously reported by our group (Oyejide *et al.*,1987). The discrepancy can be explained in relationship to the freshness of the present samples which were obtained on the mill floor as opposed to previous studies where samples were obtained in feed stores and on the farm, probably several weeks or even months after production.

CONCLUSION

It is therefore concluded from this study that although Aflatoxin contamination was not found to be a problem in the feed mill studied, individual ingredients could be substantially contaminated. Thus part of the quality control practices of a good feed mill should be a spot check of its moisture and mold contamination. Heavily

contaminated ingredient should not be used for poultry feed formulation or the feed miller will risk having its products associated with poor growth that will ultimately put them out of business.

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Performance of Rabbits Fed Graded Levels of Mulberry Leaf Meal in Replacement of Soybean Meal

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Abstract: This study examined the nutritional value of Mulberry leaf meal (MLM) as substitute for soybean meal (SBM) at graded levels. Forty cross-bred young rabbits of mixed sexes used for the study were purchased from a reputable farm in Osogbo, Osun State, Nigeria. The animals were balanced for the initial weight and randomly allocated to five experimental dietary treatments of 8 rabbits per treatment. There were 4 replicates of 2 rabbits per replicate. The rabbits were provided with pelletized experimental diets and clean water ad libitum, and the study lasted for 8 weeks. Five (5) diets containing 0 (control), 25, 50, 75 and 100% MLM as replacement for SBM were formulated., and contained ME ranging from 2617 – 2661 kcal/kg and crude protein ranging from 15.01 – 16.00%. The average daily weight gain (8.71 g/R/d) obtained in control was similar to 8.03 g/R/d (25.00% MLM), and both significantly ($P < 0.05$) reduced to 6.75 g/R/d (50.00% MLM), 6.73 g/R/d (75.00% MLM) and 5.98 g/R/d (100.00% MLM). The average daily feed intake (60.08 g/R/d) obtained in animals fed the control diet reduced ($P < 0.05$) to 53.44 g/R/d (25.00% MLM), 53.44 g/R/d (50.00% MLM), 55.36 g/R/d (75.00% MLM) and 51.52 g/R/d (100.00% MLM) respectively. Cost of feed per kg live weight gain were ₦471.39(0.00% MLM), ₦396.80 (25.00% MLM), ₦459.52 (50.00% MLM), ₦454.67 (75.00% MLM), and ₦473.24 (100.00% MLM). It was concluded that MLM could economically replace SBM up to 75% level; but 25% level of substitution was the cheapest and most economical level.

Key words: Mulberry Leaf Meal, Replacement, Soybean Meal, Performance

DESCRIPTION OF PROBLEM

Feed is one of the main problems of intensive livestock production in Nigeria due to competition among the various alternative users of the conventional feed ingredients. It accounts for up to 70% of total cost of production in monogastrics. High cost of soybean meal an important protein source for livestock is also a great challenge. This has been the prime stimulant for continuous search for alternative feedstuffs that can meet the nutritional requirements of micro-livestock; and reduce the cost of feed and subsequently the cost of animal production. Prices of most of the non-conventional feed ingredients like leaf meals are relatively low due to their non-competitive nature in terms of human consumption. The low animal protein content of Nigerians' diets could also be attributed to high cost of production. Rabbit production is one of the quickest ways of meeting the animal protein of ever increasing populace. Mulberry leaves have quality attributes that makes it a potential replacement for concentrate in rabbit feeds. Manuel, (2000) identified the attractive biomass yield, palatability and exceptionally high nutritive value for ruminant and monogastric animals as reasons behind the great interest in mulberry for animal feeding; and preferred feed for guinea pigs, rabbits and snails. Trigueros and Villalta, (1997) with Manuel, (2000) reported replacement of a commercial concentrate with 15% mulberry leaf in growing pigs' diets. The nutritional potential of mulberry leaf meal as substitutes for soybean meal was investigated through its effect on performance.

MATERIALS AND METHODS

Source and preparation of mulberry leaf meal: Mulberry leaves were harvested from Sericulture farm site, Ado Ekiti, Ekiti State, Nigeria. The leaves were collected and air-dried for some days until they were completely dried. The leaves became crispy and still retained the greenish colour after been air dried. They were then milled to form Mulberry leaf meal (MLM) before being incorporated into the rabbit diets.

Experimental diets: Five (5) diets containing 0 (control), 1.25, 2.50, 3.25 and 5% mulberry leaf meal (MLM) at the expense of soybean meal in the control diet (5%) were formulated. The formulated feeds also contained maize, palm kernel cake, brewer dry grain, bone meal, methionine and salt; and was pelletized into size 4mm. The five diets (Table 1) were formulated to contain metabolizable energy ranging from 2617 – 2661 kcal/kg and crude protein ranging from 15.01 – 16.00%.

Experimental animals, plan and their management: Forty cross-bred young rabbits of mixed sexes used for this study were purchased from a reputable farm in Osogbo, Osun State, Nigeria. The animals were balanced for the initial weight and randomly allocated to five experimental dietary treatments of 8 rabbits per treatment. There were 4 replicates of 2 rabbits per replicate. The experimental rabbits were housed in wooden cages netted with wire mesh measuring 40 x 60 x 54cm in dimension. Adequate ventilation was provided for the rabbits by placing the cages in a building having 1m dwarf walls. The hutches were raised approximately 80cm from the concrete floor and aluminium drinkers and clay pot feeders were adopted. The rabbits were provided with the pelletized experimental diets and clean water *ad libitum*, twice daily at 8.00 and 14.00 hour respectively, for 2 weeks pre-experimental period; and then for 8 weeks experimental period. The experimental animals were weighed at the beginning of the feeding trial and thereafter on weekly basis. Feed consumption was recorded, routine medication administered and welfare of the animals was strictly monitored. At the end of the feeding trial, feed conversion ratio was computed.

Data collection and statistical analysis: Feed intake, weight gain and feed conversion ratio were monitored. Cost per kg feed and cost of feed per kg weight gain of the experimental animals were computed from the prevailing prices of the feed ingredients. Mean of the data collected were subjected to analysis of variance using SAS statistical package, SAS (2001); and the treatment means compared using Duncan option of the software.

Chemical analysis: The proximate composition of the mulberry (*Morus indica*) leaf meal was determined according to method of AOAC, (2005). The metabolizable energy was calculated according to the procedure of Pauzenga, (1985) as: ME (kcal/kg DM) = 37 x % Protein + 81.8 x % Fat + 35.5 x NFE.

RESULTS AND DISCUSSION

Table 1: Proximate analysis of mulberry (*Morus indica*) leaf meal

Constituents	Composition
Dry matter (%)	99.48
Crude protein (%)	28.56
Ether extract (%)	5.34
Crude fibre (%)	4.31
Ash (%)	2.87
Nitrogen free extract (%)	58.40

Table 2: Gross composition of experimental diets

Ingredients	Treatments				
	T1 (0% MLM)	T2 (25% MLM)	T3 (50% MLM)	T4 (75% MLM)	T5 (100%MLM)
Maize	40.00	40.00	40.00	40.00	40.00
SBM	5.00	3.75	2.50	1.25	0.00
MLM	0.00	1.25	2.50	3.75	5.00
BDG	25.00	25.00	25.00	25.00	25.00
PKC	28.20	28.20	28.20	28.20	28.20
Bone meal	1.30	1.30	1.30	1.30	1.30
Methionine	0.20	0.20	0.20	0.20	0.20
Salt	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis (%)					
Dry matter	87.00	91.20	91.30	91.30	91.50

Crude protein	16.00	15.52	15.34	15.20	15.01
ME (kcal/kg)	2617.00	2628.00	2639.00	2650.00	2661.00
Crude fibre	13.21	13.30	13.31	13.40	13.40

SBM = soybean meal, MLM = mulberry leaf meal; BDG = brewer dried grain, PKC = palm kernel cake

Table 3: Performance of rabbits fed graded levels of mulberry (*Morus indica*) leaf meal based-diets

Parameters	Treatments					SEM
	T1 (0% MLM)	T2 (25% MLM)	T3 (50% MLM)	T4 (75% MLM)	T5 (100% MLM)	
Average initial body weight (g/R)	450.00	450.00	450.00	450.00	450.00	13.57
Average final body weight (g/R)	937.50	900.00	893.33	826.67	785.00	28.73
Average weight gain (g/R)	487.50^{a}	450.00^{a}	443.33^{ab}	376.67^{ab}	335.00^{b}	29.57
Average daily weight gain (g/R/d)	8.71^{a}	8.03^{a}	6.75^{ab}	6.73^{ab}	5.98^{b}	0.65
Average daily feed intake (g/R/d)	60.08^{a}	53.44^{ab}	53.44^{ab}	55.36^{ab}	51.52^{b}	1.22
FCR	7.71	6.66	7.92	8.23	8.62	0.64
Cost (₦/kg feed)	61.14^{a}	59.58^{b}	58.02^{c}	56.46^{d}	54.90^{e}	0.51
Cost (₦/kg live weight gain)	471.39	396.80	459.52	464.67	473.24	35.29

R = rabbit, FCR = Feed conversion ratio,

^{a,b,c,d,e} Means in the same row bearing different superscripts are significantly different (P<0.05).

A result of the analysed proximate composition of mulberry leaf meal is presented in Table 1. The MLM contained 28.56% crude protein, 5.34% ether extract, 4.31% crude fibre, 2.87% ash, 58.40% nitrogen free extract and 99.48% dry matter. Results of chemical composition of mulberry fractions from various authors indicate that crude protein content in leaves varies from 15 to 28% depending on the variety, age of the leaves and growing conditions. Datta, (2000) stated that the mulberry leaf composition differs according to variety and maturity; and based on the analysis carried out at CSRTI (Mysore) the author reported 19 – 25% crude protein. Carlos, (2000) also reported that the chemical composition of leaves was affected by planting density, cutting height and frequency.

The gross composition of the experimental diets is shown in Table 2. The metabolisable energy increased from 2617 to 2661 kcal/kg and the crude protein decreased from 16.00 to 15.01% as mulberry leaf meal (MLM) inclusion level increased. The crude protein range values of 17 – 18% , 15.84 – 16.85% and 15.34 – 17.50% respectively have been adopted for growing rabbits (deBlas and Wiseman, 2003; Abegunde *et al.,* 2014; and Olajide *et al.,* (2016). The protein level reduced with increase in mulberry leaf meal (MLM) inclusion level in the diets. This could be attributed to the lower crude protein content of MLM (28.56%) compared to soybean (44.00%) crude protein level. The crude fibre of the experimental diets was comparable with 13 – 14% reported by Coudert *et al.,* (1986) and 14% reported by Cheeke *et al.,* (1987). The metabolisable energy on the other hand increased as the MLM inclusion level increased; and the values higher than 2520.08 – 2528.90 kcal/kg and 2522 – 2555.31 kcal/kg reported for rabbits (Abegunde, et al., 2014; Olajide and Adeniyi, 2015). The values were true reflections of the nutrients and caloric contents of MLM and SBM.

Performance of rabbits fed with the experimental diets is presented in Table 3. The animals were balanced for the initial weight. The average weight gain, average daily weight gain, average daily feed intake and cost per kg feed differed significantly ($P < 0.05$) among the dietary treatments. The highest ($P < 0.05$) of all these parameters were obtained in the experimental animals fed with the control diet. The highest average weight gain value (487.50 g/R) obtained at 0.00% MLM which was similar to 450.00 g/R (1.25.00% MLM) were significantly ($P < 0.05$) higher than 443.33 g/R (2.50.00% MLM), 376.67 g/R (3.75.00%MLM) and 335.00 g/R (5.00% MLM). The average daily weight gain (8.71 g/R/d) obtained in Treatment 1(0.00% MLM) was similar to 8.03 g/R/d (1.25.00% MLM), and both significantly (P < 0.05) reduced to 6.75 g/R/d (2.50.00% MLM), 6.73 g/R/d

(3.75,00% MLM) and 5.98 g/R/d (5.00% MLM) respectively. The highest average daily feed intake (60.08 g/R/d) obtained in animals fed the control diet (0.00% MLM) significantly (*P < 0.05*) reduced to 53.44 g/R/d (1.25.00% MLM), 53.44 g/R/d (2.50.00% MLM), 55.36 g/R/d (3.75.00% MLM) and 51.52 g/R/d (5.00% MLM) respectively. Cost (₦61.14) per kg feed of the 0.00% MLM (T1) significantly (*P < 0.05*) reduced to ₦59.58 (1.25.00% MLM), ₦58.02 (2.50.00% MLM), ₦56.46 (3.75.00% MLM), and ₦54.90 (5.00% MLM) respectively. The average initial body weight (already balanced for weight), average final body weight, feed conversion ratio, and cost per kg live weight gain were not significantly (*P >0.05*) affected by dietary treatments. Although the variations among the dietary treatments for the average final body weight were not significant, the values however, numerically decreased with MLM inclusion levels. This eventually translated into significant reduction in the average weight gain and average daily weight gain as the level of substitution of MLM for SBM increased. The decrease in feed intake agrees with the submission of Stanford (1986) that growing rabbits tends to regulate their feed intake according to energy content. The decrease in weight gain and increasing value of the feed conversion ratio are in line with the results of Adegbola *et al.,* (1985), Bamidele and Ezenwa (1999) where weight losses of rabbits were reported even though adequate level of diets were served. In rabbits, the reduction of concentrate offered daily from 110 to 17.5g with *ad libitum* fresh mulberry reduced gains from 24 to 18g/day; but decreased to more than half the cost of the meat produced (Lara y Lara, Sangines and Dzib *et al.*, 1998 with Manuel, 2000). Average daily weight gain obtained in the present study were lower than 9.29 – 12.14g/d (Abegunde *et al.,* 2014), 12.92 – 13.74g/d (Olajide and Adeniyi, 2015); and 9.37 – 11.33g/d (Olajide *et al.,* 2016). The daily feed intake (68.93 – 74.29g/d (Abegunde et al., 2014), and 65.22 – 78.95g/d (Olajide *et al.,* 2016) were also higher than the present values. The feed conversion ratio 5.97 – 7.99 (Abegunde *et al.,* 2014) and 7.08 – 8.44 (Olajide *et al.,* 2016) were comparable to the present values. The differences in these parameters could be as a result of variations in the diets, age, and breed of the rabbits among others. Al-Kirshi e*t al.,* (2010) reported that amino acid composition in mulberry leaves could have compensated for low feed intake brought about by fibres. The significant reduction in the cost of feed per kg was due to the lower price of MLM than that of SBM. The cost of feed per kg live weight gain at 25.00, 50.00 and 75.00% MLM were also lower than the control (0.00%MLM), but 1.25.00% MLM level being the cheapest (most economical). Beyond 3.75.00% MLM there was increase in cost of feed per kg live weight gain which tends to show that replacement of SBM with MLM at 100.00% was not economical.

CONCLUSION AND APPLICATION

It was concluded that MLM can economically replace 75% of SBM (5%) in growing rabbits' diets; but 25% level of substitution (1.25%) was the most economical.

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Effect of Feeding Cassava Grit Supplemented with Enzyme (Maxigrain) on the Growth Performance Characteristics of Finishing Broiler Chickens

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Abstract: A four weeks feeding trial was conducted to assess the effect of replacing Cassava grit supplemented with Maxigrain for maize on the performance of one hundred and twenty (120) four weeks old Anak 2000 broiler chickens.Four treatments diets were formulated; diet 1contain 45% maize to serve as control, while in diets 2, 3 and 4 Cassava grit-maxigrain (CG+MaxG) replaced 50, 75 and 100 **%**maize respectively. Chicks were randomly assigned to the four treatment dietsin a completely randomized designed (CRD) each treatment group replicated thrice. with ten chicks per replicate. Performance indices results revealed that live weight was significantly (P<0.05) higher (2.85kg/bird) from birds fed75% CG+MaxG, daily and weekly weight gain were also significantly (P<0.05) influenced by the dietary treatment with highest (116.85 and 825.00g/bird) values observed in birds placed on 75% CG+MaxG. Feed conversion ratio was better among birds fed the control diet comparable to those on diet 3. It is concluded therefore that 30% inclusion level of CG+MaxG can replace maize in the diet of broiler finisher without detrimental effect on their performance.

Keywords: Broiler chickens, Cassava grit, Maxigrain, growth Performance

INTRODUCTION

Livestock consume more than a third of all the world's grains particularly maize (Thompson and Weber, 2010). Maize has remained the chief source of dietary energy in compound feed and constitutes about 50-60% in most poultry nutrition. Despite its worldwide production, a stiff competition for the usage of maize by humans, livestock and industries persists. This is simply because, maize is high in energy and forms the standard (100) against which other cereals grains is compared (Atteh, 2002). Maize has a fat content of about 4% and this fat is high in linoleic acid (about 50%) making it an excellent source of this essential fatty acid. Olomu (1995) reported that metabolizable energy (ME) and crude protein (CP) of maize stand at 3510 kcal/kg and 8.80% respectively. The ever-increasing competition between man and animals for available grains (Egbunike *et al.*, 2002), the inadequate production of farm crop to meet the needs of man and his livestock (Babatunde *et al.*, 1990), and the ever-increasing cost of maize had made it necessary to critically re-evaluate some other alternative source of energy in poultry production.

Several researchers have earlier reported the successful use of cassava and its by product as energy sources in poultry diet. Akintola and Oruwari, (2007). Found that cassava root meal is capable of totally replacing maize in the diet of laying hen. Furthermore, Eguaoje and Okosun, (2017) also reported that cassava grit at 66.6% inclusion and 5% supplementation of cassava can replace maize in cockerel diet without any deleterious effect on their performance. Recently, Ehebha and Eguaoje, (2018) reported no detrimental effect in broiler performance when 20% sun dried cassava peels were included in their diets.Cassavais known to contain cyanogenic glycosideslotaustralinand linamarin (Cardoso *etal.*, 2005); both compounds are hydrogen cyanidederivatives. The substance (HCN) has been shown tobe toxic to livestock (McDonald *et al.*, 1995) andtherefore limits the use of cassava in the rawstate as feed for livestock (Smith, 1988). Feed enzyme application in farm animal diet complementsthe limiting enzymelevel of the younganimals (Bimrew, 2014).Phytase supplementation of P-deficient diets resulted in improved growth performance of pigs (Han *et al.*,

1997; Zyla *et al.,* 2000), also improved P and Ca utilization (Adeola, 1995). Adding carbohydrases to a wheat-based diet in young pigs resulted in improved average daily gain (ADG) and average daily feed intake (ADFI) (Cadogan *et al.,*2003), increased total tract digestibility of DM, N (Mavromichalis *et al.,* 1990) also improved energy digestibility in wheat-soybean meal diet (Li *et al.,* 1996).Consequently, this study was designed to evaluate the effect of feeding cassava grit supplemented with enzyme (maxigrain) on the growth performance characteristics of broiler chickens.

MATERIALS AND METHODS

Location and duration of the experiment: The research was conducted at the poultry unit of the Livestock Teaching and Research Farm of Agricultural Science Education Department, Adeniran Ogunsanya College of Education, Oto/Ijanikin, Lagos State, Nigeria for the period of six weeks.

Sourcing and processing of cassava root: Cassava (*Manihot esculenta*) for the feeding trial was purchased from a reputable farm in Oto/Ijanikin, Lagos State, Nigeria. The woody part was chopped off, and the cassava was thoroughly washed to reduce the silica level. It was then grated without peeling and screw pressed for about 48 hours to reduce the hydrogen cyanide level to the barest minimum. It was mixed with palm oilto further encapsulate the cyanide in the milled whole cassava (Okosun and Eguaoje, 2017). Thereafter it was oil-fried and air dried then bagged into product known as the cassava grit which was used in formulating the experimental diets.

Chemical Analysis: Feed samples were analyzed for proximate composition according to the method of AOAC (1990).

Table 1: Proximate composition of the experimental materials

Parameters	CG+MaxG	Maize
Moisture	10.07	10.03
Crude Protein	3.05	9.81
Crude Fibre	4.06	4.62
Esther extract	2.38	3.15
Crude Ash	2.52	4.02
Nitrogen Free Extract	77.92	68.37
Carbohydrate	23.28	25.12
ME (Kcal/kg)	3015	2985
HCN (Mg/kg)	10.28	0.00

Management of experimental birds and design

A total of One hundred and twenty (120) four weeks old Anak 2000 broiler chickens of an average initial weight of 780g/bird were used for the experiment. They were randomly sub-divided into 4 dietary treatments of three replicates, with ten birds each in a completely randomized design (CRD). Feed and water was given to the birds *ad-libitum.* Lighting and heat source were provided using electricity bulbs and coal pot during the night. The birds were administered anti-stress and vitamin/mineral premix orally at the recommended dosage after randomization before the commencement of the experiment. The birds were reared on deep litter in an open-sided wire mesh constructed poultry house to allow for adequate ventilation. Medications, vaccinations and other routine management practices were strictly followed. The birds were offered experimental diets and cool, clean water *ad-libitum* throughout the four weeks period of the experiment.

Experimental diet and treatment

Four experiment diets were formulated to contain cassava grit meal supplemented with Maxigrain enzyme to replace maize (45%) at 0, 50, and 75 and 100% as T1, T2, T3 and T4 respectively. Treatment 1 was the control

diet with no cassava grit meal and enzyme inclusion while diets 2, 3 and 4 contained Maxigrain® enzyme at the rate of 100mg/kg. The experimental diets composition is presented in Table 2

Table 2: Percentage compositions of broiler finisher diets

Ingredients (Kg)	T1	T2	T3	T4
Maize	45.00	22.50	15.00	0.00
Cassava grit	0.00	22.50	30.00	45.00
Soya bean meal	12.56	12.56	12.56	12.56
GNC	7.44	7.44	7.44	7.44
Fish meal	2.25	2.25	2.25	2.25
Wheat offal	28.20	28.20	28.20	28.20
DCP	1.50	1.50	1.50	1.50
Lime stone	2.50	2.50	2.50	2.50
Premix	0.30	0.30	0.30	0.30
Salt	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis				
Crude protein	**18.03**	**18.00**	**18.02**	**18.00**
ME (Kcal/Kg)	**2950**	**2972**	**2992**	**2997**

DCP; Dicalcium phosphate

Performance characteristic study

During the feeding trial, the broiler chickens were weighed at the beginning of the experiment (end of 4wks) and subsequently on a weekly basis. Weight changes and feed consumption were recorded daily and weekly, while, feed conversion ratio (FCR) were calculated to assess the growth performance of the birds. Feed intake was calculated as weight of feed offered minus weight of left over, weight gain was calculated as final weight minus initial weight, feed conversion ratio (FCR) as feed intake divided by weight gain.

$$\text{Feed conversion ratio} = \frac{\text{Feed intake (g)}}{\text{Weight gain (g)}}$$

Statistical analysis

All the data collected were subjected to analysis of variance (ANOVA) using the model for completely randomized design and differences between means and treatments were determined using Duncan's multiple range test (DMRT) at 5 percent level of probability. All statistical procedures were according to (Steel and Torrie, 1990) using SPSS version 20

RESULTS

Performance characteristics of broiler chickens fed Cassava grit +Max G

The performance characteristics of the experimental broiler chickens fedthe dietary treatments are shown in Table 3. At the finisher phase, the treatment diets significantly ($P<0.05$) affected the final live weight,weekly anddaily weight gains,as well as feed conversion and protein efficiency ratios while daily and weekly feed intake did not differ significantly ($P>0.05$). Broiler chickens on diet containing 75% Cassava grit with maxigrain supplementation (CG+MaxG)had a higher live weight of 2.85kg/bird, followed by 2.65kg/bird in those fed the control diet and least in birds fed 100% CG+max G with a mean value of 2.30kg/bird.Average daily and weekly feed intake was not significantly ($P>0.05$) affected by the treatment diets but numerically highest value of 445.15g and 3.12kg/bird were observed from birds fed 75% CG+MaxG, followed by 444.15g and 3.11kg/bird from those maintained on 100% CG+MaxG while lowest value of431.74g and 3.03kg/bird in birds fed 50% CG+MaxG. Average daily and weekly weight gain were significantly ($P<0.05$) highest in birds fed 75% CG+MaxG with an average value of 116.85 and 815.95g/bird, followed by (103.12 and 721.84g/bird) from those on the control diet while least values of 86.15 and 603.05g/bird were recorded from birds placed on 50% CG+MaxG. Broiler chickens maintained on 100% CG+MaxG had higher feed conversion ratio value of 4.75, followed by 3.01 from birds fed 50% CG+MaxG, 2.64 in birds fed 75% CG+MaxG while least and better value of 2.52 was recorded from birds fed the control diet

Table 3: Performance characteristics of broiler finisher fed Cassava grit +MaxG

	Inclusion levels of CG+Max G (%)				
	0	50	75	100	
	Diets				
Parameters	1	2	3	4	SEM±
Final live weight (kg/bird)	2.56^{b}	2.48^{bc}	2.85^{a}	2.30^{c}	0.20
Daily feed intake (g/bird)	438.25	431.74	445.15	444.18	6.24
Weekly feed intake (g/bird)	3.07	3.08	3.10	3.11	0.07
Daily weight gain (g/bird)	103.12^{b}	86.15^{c}	116.85^{a}	89.59^{bc}	4.17
Weekly weight gain (kg/bird)	720.85^{ab}	603.05^{c}	815.95^{a}	627.12^{b}	3.20
Feed conversion ratio	2.52^{c}	3.01^{ab}	2.64^{b}	4.75^{a}	0.51

abc: Means on the same row with different superscripts are statistically different P<0.05
CG+Max G: Cassava grit + Maxigrain
SEM±: Standard error of mean

DISCUSSIONS

Performance characteristics of broiler chickens fed Cassava grit +Maxigrain

The performance data of broiler chickens fed cassava grit with maxigrain supplementation at varying levels of inclusion showed significant (P<0.05) variation infinal live weight, daily and weekly weight gain, feed conversion ratio and protein efficiency ratio respectively.The increase in the daily and weekly weight gain and the consequent higher final live weight recorded in birds fed 75% CG+MaxG based diet may be due to the improved nutrient availability and density which eventually translated to the improvement in growth rate of the birds. These findings corroborate the works of Igene and Esobhawan (2003); Oboh *et al.* (2004) that an increase in dietary energy increased weight gain of birds. Findings from this study also agree with Bhuiyan and iji (2013); Okosun and Eguaoje,(2017) who reported a significant variation in the weight gain of broilers fed cassava product supplemented with or without enzyme.The similarity in the daily and weekly feed intake with highest valuesobserved among birds fed 75% cassava grit supplemented with maxigrain enzyme shows that the diet at various levels of inclusion did not negatively impact the palatability of the dietsEl- Boshey and vanderpoel,(1994). This corroborate the report of Rafiu *et al.*,(2015); Okosun and Eguaoje, (2017) who observed similarity in the feed intake of broiler chickens fed varying levels of cassava grit as replacement for maize but negate the report of Ehebha and Eguaoje, (2018) who observed a significant variation in the feed intake values of broiler chickens fed sundried cassava peel meal without enzyme supplementation.The significant feed conversion ratio of birds fed dietary treatments with best feed to gain ratio observed in those fed the control comparable to thoseon diet 3 may have been responsible for the better weight gain and consequent higher live weight recorded from birds maintained on the treatment diets. This observation conforms with the report of Nworgu *et al.*, (2000) and Oduguwa *et al.*, (2004). It also goes to attest that cassava grit with enzyme supplementation was efficiently utilized by the bird. This supports the report of Olayemi *et al*, (2007), and Eniolorunda *et al.*, (2007) who observed significant improvement in the feed conversion ratio and subsequent growth rate of layer hens fed varying levels of biscuit waste and indomie waste meal respectively without enzyme supplementation.

CONCLUSION

It is concluded therefore based on the overall result of this study that the inclusion of Cassava grit at 30% with Maxigrain supplementation at 100mg/kg at the expense of maize improves performance of finishing broilers.

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Effect of Lemon Juice on Growth Performance of Stater Broiler Chickens

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Abstract: One hundred and fifty (150) day old unsexed Hubbard broiler chicks were used in a 28 day feeding trial to determine the dietary effects of lemon juice on growth of starter broiler chicks. There were five dietary treatments (T1 – T5) containing lemon juice 0, 10, 15, 20 and 25ml/kg diet respectively. The diet which contained no lemon juice was a basal diet (control). Other treatment groups were formed by adding the lemon juice to the basal diet. Each treatment was replicated three times with 10 birds each, giving 30 birds per treatment. The experiment was arranged in completely randomized design (CRD). Starter diet and water were given *ad libitum* for four weeks. Results showed that 20 and 25ml/kg improved final live weight and protein efficiency ratio. Therefore, addition of 15ml/kg lemon juice in starter broiler diets could be a good practice and is recommended.

Keywords: Starter Broilers Chicks, Growth Performance, Lemon Juice.

DESCRIPTION OF PROBLEM

Poultry nutrition has transcended from emphasis on quality of feed to adequacy of feed utilization. This is because feed could have high quality but it is not well utilized by birds due to some underlining factors such as the health condition of the gut which will process the feed (1). Considering the fact that feed quality has been recognized, attention has been shifted to how to modulate the gut to improve its health status for better nutrient utilization efficiency. For decades, antibiotics have been efficaciously used for this purpose (2), but are recently regarded as unsafe for both the animals and consumers (3). Earlier, nutritional strategies using safe feed additives have been advocated for this purpose (4). Later, reports indicated that use of natural ingredients as growth promoters such as organic acids, spices, essential oils, carotenoids and flavonoids are key to achieving this task (5). Organic acids both in feed and drinking water have been viewed as effective feed additives to improve broiler productivity (6). Later (7) reported increase in the use of organic acids as substitutes for antibiotic growth promoters in broiler production. The dietary acidification of feeds and water for broilers is to inhibit intestinal bacteria that compete with the host for available nutrients, reduction of possible toxic metabolites which result in the improvement of nutrient digestibility, absorption and host immunity (8).

On the other hand, organic acids (formic, citric, ascorbic, acetic and butyric acids etc.) among others have been reported to be efficacious by modifying intestinal pH, improving digestion and absorption of nutrients (9). It has been opined that because organic acids currently in use are synthetic types which are expensive and most farmers do not have access to them, natural sources should be explored and exploited (9). Fruits are major sources of natural organic acids especially fruits of citrus *spp* (lime, lemon, grape) which contain citric and ascorbic acids. Therefore, the objective of this study was to determine the dietary effect of lemon juice on starter broiler chicks.

MATERIALS AND METHODS

Site of the experiment: The experiment was conducted at the poultry unit of Teaching and Research Farm of the University of Uyo, Nigeria, located on latitude 5° 32' N and longitude 7° 54' E with average annual rainfall of 1500 mm. The average relative humidity during the experiment was 75% and average ambient temperature was 30°C.

Processing of Lemon Juice: The lemon fruits used to process the juice were obtained from citrus farm of the Department of Crop Science, University of Uyo, Uyo, Nigeria. The lime fruits were washed and cut into two with a sharp knife. The juice was expelled manually by squeezing the cut halves with hand. The juice was collected into a container. The juice containing the seeds and pulp was filtered in order to have a clear juice. The juice was stored in the refrigerator at the temperature of $4^{O}C$ to reduce oxidation and fermentation.

Experimental Design: Completely randomized design (CRD) was employed. The experiment was conducted with 150 day-old unsexed broiler chicks of Hubbard strain. The chicks were randomly divided into five dietary groups (T1, T2, T3, T4 and T5) each having 30 chicks. Each treatment was replicated three times with 10 chicks each. Starter basal diet (Table 1) was formulated to form the control (T1). 10 ml, 15 ml, 20 ml and 25 ml of the lime juice /kg feed were respectively added to the basal diet to form T2, T3, T4 and T5. This represented 1.00, 1.50, 2.00 and 2.50% of the diet respectively.

Table 1: Ingredient and Nutrient Composition of Experimental Diet.

Ingredients (%)	**Starter**
Maize	51.0
Soybean meal	30.0
Fish meal	4.00
Palm kernel cake	10.20
Bone ash	4;00
Salt	0.25
Lysine	0.20
Methionine	0.10
*Premix	0.25
Total	100
Calculated Nutrient Composition (%)	
Crude protein	23.05
Crude fibre	4.38
Ether extracts	4.56
Lysine	1.20
Methionine	0.47
Calcium	1.25
Phosphorus	1.00
Energy (KcalME/kg)	2880

***premix supplied per kg starter diet:** vitamin A 15,000 i.u., vitamin D_3 13000 i.u, thiamine 2mg, riboflavin 6mg, pyridoxine 4mg, niacin 40mg, cobalamine 0.05g, biotin 0.08mg, choline chloride 0.05g, manganese 0.096g, Zinc 0.06g, iron 0.024g, copper 0.006g, iodine 0.014g, selenium 0.24mg, cobalt 0.024mg and antioxidant 0.125g

Management of Experimental Birds: The birds on arrival to the farm were given glucose solution after they had been allotted randomly to the various treatments. Heat was provided using kerosene stove for three weeks. All necessary vaccinations against Newcastle and infectious bursal (gumboro) diseases were done under the supervision of a Veterinary Officer. The birds were raised in an open sided deep litter house. Feed and water were provided *ad libitum* for four weeks.

Data Collection and Statistical Analysis: Live weight was measured weekly and feed intake daily. The live weight and feed intake were used to calculate the feed: gain ratio. All data collected were subjected to one-way analysis of variance (ANOVA). Significant means were separated using Duncan New Multiple Range Test according to (10).

RESULTS AND DISCUSSION

The effect of lemon juice on performance of starter broiler chicks is shown in Table 2. Addition of 20 and 25ml/kg diet significantly (P<0.05) improved final live weight, daily gain and protein efficiency ratio compared to the control. Feed intake, protein intake and feed: gain ratio were not significantly (P>0.05) influenced. Within the lemon juice groups, the final live weights and protein efficiency ratios produced by 15, 20 and 25ml/kg were similar but higher than 10ml/kg. The same parameters were similar in control, 10 and 15ml/kg.

Table 2: Effect of lemon juice (ml/kg diet) on growth of starter Broiler chickens

Parameters	T1 (0)	T2 (10)	T3(15)	T4 (20)	T5 (25)	SEM
Initial live weight (g)	42.05	41.85	42.0	41.01	41.90	5.75
Final live weight (g)	700.0^{c}	720.05^{bc}	760.23^{abc}	780.11^{ab}	800.50^{a}	59.05
Daily gain (g)	23.50^{c}	24.22^{bc}	25.65^{abc}	26.40^{ab}	27.09^{a}	4.04
Total feed intake (g)	1350	1360	1378Res	1375	1425	145.05
Daily feed intake (g)	48.21	48.57	49.21	49.11	50.89	6.14
Feed: gain ratio	1.89	2.01	1.92	1.86	1.88	0.08
Daily protein intake (g)	11.11	11.20	11.34	11.32	11.73	3.01
Protein efficiency ratio	2.12^{b}	2.16^{b}	2.26^{ab}	2.33^{a}	2.31^{a}	0.13

abc means along the same row with different superscripts are significantly (P<0.05) different.

The improved growth performance of lemon juice above 15ml/kg revealed the ability of lemon juice to support broiler productivity. This fit has been linked to its antibacterial action both in the feed and in the gut, and other endogenous activities due to presence of bioactive substances such as organic acids (ascorbic and citric acids) and flavonoids (11) in lemon juice. Young chicks require acidic medium to be able to effectively digest protein, but the level produced by young chicks is inadequate to do this (4). Also (4) advocated for dietary application of organic acids to reduce the pH of the *proventriculus* for adequate protein digestion. This was shown in better performance of 20 and 25ml/kg at the starter phase where protein was better utilized resulting to better final live weight even when there was no difference in feed intake. Studies have reported that administration of ascorbic acid alleviated the deleterious effects of heat stress on performance and metabolism of broiler chickens (12). Also (13) reported that ascorbic acid is the first line of defense against reactive oxygen species, hence the immunity of the birds could have been improved.

CONCLUSION AND APPLICATION

The lemon juice used in this study at 20 and 25ml/kg inclusion in the diet improved growth. Therefore, in conclusion, it is recommended to include 20ml/kg diet in diets for broilers for optimum productivity.

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Growth Response of Growing Pigs to Diets Containing Graded Levels of Cassava Plant Meal

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Abstract: The research evaluated the growth response of growing pigs to graded levels of cassava plant meal (CPM) based diets. Twenty growing pigs (Large White x Hampshire) of initial average weight of 20.00 ± 0.5 kg and of different sexes were randomly allotted to five experimental diets containing 0, 25, 50, 75 and 100 % of maize replaced with CPM given as T1, T2, T3, T4 and T5 respectively. The study lasted for eight weeks. Results showed that there was no significant difference ($p \geq 0.05$) across dietary treatments for average daily weight gain and feed conversion ratio. However, the final weight of pigs in T3 (50 % replacement) was highest compared to other dietary treatments. Significant differences ($p \leq 0.05$) exist for average daily feed intake across dietary treatments. Feed conversion ratio, feed intake and weight gain values of T3 compared favourably with T1. It can be concluded that cassava plant meal could completely replace maize in the diets of growing pigs without significant decrease in their growth performance.

Keywords: Cassava plant meal; maize; pigs; feed intake; weight gain

DESCRIPTION OF PROBLEM

The importance of pig production as cheap source of animal protein particularly in the humid tropic of Nigeria is constrained by the escalating cost of feed ingredients. The need to reduce the high cost of feeding which usually makes up 70 – 80 % of the total cost of production (Longe, 2006) led to a continuous search for least-cost alternative feedstuffs as suitable replacement for conventional feed ingredients. Cassava and its products have received attention from swine nutritionist. However, cassava root meal is deficient in essential amino acid such as methionine, cysteine and tryptophan **(**Montagnac*et al.,* 2009; Omede*et al.,* 2018**).**The need to improve the nutritional profile of cassava meal as replacement for maize informed the development of composite cassava plant meal (unpeeled roots + leaves + tender cassava stem) as livestock feedstuff for all classes of pigs (Akinfala and Tewe, 2001). This was in an attempt to balance the high crude protein, bulk, minerals and vitamins of leaves and tender stem with the energy-rich component of the roots. Previous studies have confirmed the suitability of cassava plant meal (CPM) as good substitute for maize (Akinfala and Tewe 2004; Akinfala *et al*., 2013) in the diets of pigs. However, these studies did not provide information on the variety of cassava used, age and the length at harvest of the cassava stems. This research was carried out to evaluate the growth performance of growing pigs fed graded levels of standardized cassava plant meal diets.

MATERIALS AND METHODS

The experiment was carried out at the Swine Unit of the Teaching and Research Farm as well as the Poultry Meat Laboratory of the Department of Animal Sciences, Obafemi Awolowo University, Ile – Ife. The cassava roots (TMS 30572) aged 24 months were purchased from a commercial farm at Ile-Ife while the cassava leaves were harvested from the plant stem and the tender stems were harvested at 5 cm, usually 6 to 7 nodes from the top of the plant. All the cassava components were harvested between April and June 2017. The fresh roots (unpeeled cassava root) were washed and chopped into small pieces, sun-dried on a concrete floor for an average of 5 – 6 days depending on the intensity of the sunlight, milled and packed into sacks. Also, the fresh cassava leaves and tender stems were sun-dried for about 5-6 days and 9-10 days respectively after harvesting, milled and packed into separate sacks. The composite cassava plant was mixed in line with the procedure of Akinfala and Tewe (2001) but at a higher ratio of 3:1 so as to have a comparable minimum crude protein content of 10 % as maize. The pigs were randomly allotted to five dietary treatments of 0, 25, 50, 75 and 100 % replacement of

maize with cassava plant meal given as T1, T2, T3, T4 and T5 respectively. Each treatment consists of four pigs and each animal served as replicate in a Completely Randomised Design. The percentage composition of experimental diet is shown in Table 1. Water and feed were offered *ad libitum* throughout the experimental duration. The pigs were weighed at the beginning of the experiment. Data were collected on daily feed intake, weight gain and feed to gain ratio was evaluated. Data were subjected to one-way Analysis of Variance using SAS 9.1® and means were separated using Duncan's new multiple range test. The experiment was conducted between June and August, 2017 and lasted for eight (8) weeks.

Table 1: Gross composition of experimental diets

Ingredients (%)	T1	T2	T3	T4	T5
Maize	50.00	37.50	25.00	12.50	-
Cassava plant meal	-	12.50	25.00	37.50	50.00
Groundnut Cake	10.00	10.00	10.00	10.00	10.00
Soybean meal	8.00	8.00	8.00	8.00	8.00
Palm Kernel Cake	25.00	25.00	25.00	25.00	25.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	1.50	1.50	1.50	1.50	1.50
Oyster shell	3.00	3.00	3.00	3.00	3.00
*Premix (Vitamin-Mineral)	0.25	0.25	0.25	0.25	0.25
Salt	0.25 100.00	0.25	0.25	0.25	0.25
Total		100.00	100.00	100.00	100.00

*Grower Premix supplied kg/diet: vitamin A 10,000,000 IU; vitamin D 32,000,000 IU; vitamin E 8,000 IU; vitamin K 2,000 mg; vitamin B1 2,000 mg; vitamin B2 5,500 mg; vitamin B6 1,200 mg; vitamin B12 12 mg; biotin 30 mg; folic acid 600 mg; niacin 10,000 Mg; pantothenic acid 7,000 mg; choline chloride 500,000mg; vitamin C 10,000 mg; iron 60,000 mg; Mn 80,000 mg; Cu 800 mg; Zn 50,000 mg; iodine 2,000 mg; cobalt 450 mg; selenium 100 mg; Mg 100,000 mg; anti-oxidant 6,000 mg.

RESULTS AND DISCUSSION

Table 2 shows the proximate composition of the experimental diets fed to growing pigs. The crude protein values ranged from 18.88 to 20.30 % and increases with increased inclusion level of cassava plant meal in the diets. The crude protein value falls within the range recommended by NRC (2012) but higher than the range recommended by Olomu (2011) and Aduku (2012) for growing pigs in the tropics. Also, the crude fibre content of the diets ranged from 5.36 to 6.88 % and increased with increasing inclusion level of cassava plant meal in the diets. The crude fibre values were lower than the value reported by Akinfala and Tewe (2001; 2004) who fed whole cassava-based diets to growing pigs but fall within the range recommended by Adesehinwa (1997) for growing pigs in the tropics. The values obtained for metabolizable energy fell within the range recommended by Olomu (2011) but lower than the value recommended by NRC (2012) for growing pigs in the tropics. The variations obtained from the study may be due to increase in the proportion of low energy components (cassava leaves and tender cassava stem) with increase inclusion level of CPM to replace maize in the diets. Growth performance of growing pigs fed graded levels of cassava plant meal-based diets is shown in Table 3. There was no significant difference ($p>0.05$) in the average daily weight gain and feed conversion ration across dietary treatments. The average daily feed intake differed significantly ($p<0.05$) across dietary treatments with T1 having the least value while T5 had the highest. The data obtained on average daily weight gain indicates that T3 (50 % replacement) had the highest value while T5 had the least. The result obtained on feed conversion ratio showed no significant difference ($p>0.05$) but T3 (50 % replacement) had a better value of 3.31.

Table 2: Proximate composition and metabolizable energy of experimental diets

Parameters	T1	T2	T3	T4	T5	SEM	*P*
Dry Matter	85.86	85.63	85.38	85.26	85.51	0.63	0.10

Crude Protein	18.88	19.25	19.45	19.87	20.30	0.30	0.70
Crude Fibre	5.36[b]	5.52[b]	6.20[ab]	6.34[ab]	6.88[a]	0.21	0.04
Ash	5.09[b]	5.68[ab]	6.33[ab]	6.68[ab]	7.55[a]	0.34	0.04
Ether Extract	5.75	5.38	5.03	4.99	4.87	0.19	0.71
NFE	52.78	50.80	49.37	48.38	46.91	0.95	0.39
ME (kcal/kg)	2895.24	2836.30	2752.37	2684.14	2660.77	24.72	0.17

[a,b,c,] means in the same row having different superscripts differ at p <0.05; SEM: Standard Error of Means

Table 3: Growth performance of growing pigs fed experimental diets

Parameters (kg/pig)	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**	***P***
Initial weight	20.00	19.88	20.00	19.88	20.00	0.33	0.10
Final weight	42.97	42.17	43.13	41.78	41.73	0.39	0.75
Average daily weight gain	0.410	0.398	0.413	0.391	0.388	0.01	0.32
Average daily Feed Intake	1.37[b]	1.41[ab]	1.38[b]	1.45[a]	1.47[a]	0.01	0.01
Feed to gain ratio	3.34	3.54	3.31	3.71	3.79	0.08	0.07

[a,b,c,] means in the same row having different superscripts differ at p <0.05; SEM: Standard Error of Means

Conclusion and Application

Findings from this study showed that:

1. graded levels of cassava plant meal could completely replace maize in the diets of growing pigs and;
2. there were no deleterious effects on their growth performance.

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Effect of Different Number of Rope as Environmental Enrichment on Behavioural Response of Growing Pigs

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Abstract: Despite the provision of food and shelter, pigs in barren housing still display an inherent motivation to explore. However, in such cases, the behaviour is directed towards pen-mates and pen components. Therefore, this study was carried out to determine the effect of different number of rope as environmental enrichment on behavioural response of growing pigs. Thirty-six pigs were allotted into four treatments of three replicates with 3pigs per replicate in a completely randomized design. Pigs in group 1, 2 and 3 were given 1, 2, 3 number of ropes respectively as enrichment while the control had no enrichment. Behavioural observations were monitored by CCTV and recordings were made for 6 hours/day (09:00-12:00 and 15:00 - 18:00) and 3days/week. At the end of the experiment average feed intake, average weight gain and FCR was measured, behavioural observations; enrichment interaction, pen manipulation and pen-mate manipulation was observed. Behavioural data was analyzed using repeated measures. Result showed that rope does not have significant effect ($p>0.05$) on performance of growing pigs across the treatments. However, as the number of rope increases, pen-mate manipulation, pen manipulation and general activities decreases with significant difference ($p<0.05$) across the treatments while the enrichment use increases, with Rope 3 having 18.22, 23.43, 27.76 and 30.59 respectively. Time of observation also have significant difference ($p<0.05$) on behaviour of pigs with pigs interacting more with enrichment at 15:00-18:00. Conclusively, the more the number of enrichment device the better, as this elicit the appropriate stimulus that divert the attention of pigs from pen-mate and pen components.

Keywords: Behaviour, Environmental enrichment, Rope, Pen-mate manipulation, Pen manipulation

DESCRIPTION OF PROBLEM

As the world population and per capita incomes rise in developing countries, there is increased need for animal protein. In Nigeria for example, food supply is not equally distributed and a large percentage of the population especially children, do not have access to balance diet that will ensure proper physical health and development (Bender and Smith, 1997).

Production of pigs has therefore been advocated as a short-term measure to alleviating animal protein deficit and by 2019, it is expected that the demand for pork will increase by approximately 24% over the base period of 2007-2009, primarily as a result of increased demand in developing countries (OECD/FAO, 2010).

The pig has evolved in semi-woodland areas, where it had spent 75% of their time in activities such as burrowing, foraging and exploring (CIWF, 2012), despite many generations of genetic selection, provision of food, water and shelter in modern pig production system, there are still inherent need for pigs to perform exploratory and foraging behaviours (Arey, 1993).

In barren environments, typified by concrete flooring and lack of rooting materials, the pig still displays an inherent motivation to explore. However, in such cases, the behaviour is directed at the limited number of substrates available, namely pen-mates (Scott *et al.,* 2006a; Beattie *et al.,* 2000) and pen components (Scott *et al.,* 2007) and therefore been implicated in the development of adverse behaviours, such as tail biting, fighting, gnawing on the cage bars, nosing and ear-chewing in the pig pens (Scott *et al.,* 2006b). In view of these, there has been a lot of discouragement to pig farming in Africa due to the loss incurred by the farmers as the effect of these adverse behaviours, these includes reduction in animal performance, unwanted death of animals, reduction

in price of an injured pig due to fighting, cost of repairing of pen after damages caused by the pigs, cost of individual pen for mature male pigs and so on which out weight the cost when compared with small ruminant production and this is why the Scientific Veterinary Committee of the European Commission adopted a directive of providing the pigs with materials(enrichment) for investigation and manipulation, which may be bedding material or earth floors suitable for rooting. The term environmental enrichment is used to describe the changes (modifications or additions to the environment) that are designed to improve the living conditions of the animals by allowing them to express a wider range of natural behaviours (CCAC, 2014).

Studies have suggested that environmental enrichment can improve the welfare of growing pigs through the provision of substrates for foraging, exploratory and manipulatory behaviour (Beattie *et al.*, 2000; Petersen *et al.*, 1995).

The characteristics of objects, which were found to maintain a pig's attention, were ingestible, destructible, deformable, chewable and odorous (Van de Weerd *et al.*, 2003) and suggested that these might be best suited to satisfy exploratory and foraging motivations.

The use of rooting materials, such as straw, in slatted systems can cause difficulties for slurry management and it is therefore important to establish whether alternative forms of environmental enrichment, such as hanging objects, can be equally effective (Scott *et al.*, 2006a).

As an alternative therefore, the use of a rope is suggested (Jensen and Pedersen, 2007). Knots can be made in the rope so that the pigs would have more trouble breaking it (TerBeek, 2007). This can also be chewed by the pigs and when presented as a hanging object it's suitable for slatted or concrete floors. For optimum pig production in Africa use of enrichment must also be adopted but it will not be possible if indigenous research that validates the claim has not been done which is what this research aims to achieve.

MATERIALS AND METHOD

This experiment was carried out at the Piggery unit, Teaching and Research Farm, University of Ibadan, Ibadan, Oyo State, Nigeria.

A total of thirty-six (36) crossbreeds (Large White X Landrace) growing pigs of about 8-10Kg were used for this study, these animals were allotted randomly into four treatments with three replicates and three (3) pigs per replicate in a Completely Randomized Design (CRD). Feed and water was provided twice a day at the hours of 08:00 and 14:00 daily throughout the period of the experiment which lasted for eight weeks.

Pigs in group one had 1 rope, group 2 had 2 ropes and group 3 had 3 ropes as enrichment while the control had no enrichment (Rope). The ropes were knotted at specific interval and hanged from the roof of the pen to the shoulder length of the animals. Behavioural observations were monitored by the use of installed CCTV cameras attached to the pens and recordings were made for six hours a day and three days a week between the hours of 09:00-12:00 and 15:00 - 18:00. After the recordings, the behavioural parameters were counted from the recordings and recorded as percentage of observation.

Data collected includes performance characteristics; average feed intake, average weight gain and feed conversion ratio was calculated, and behavioural observations; enrichment interaction, pen manipulation and pen-mate manipulation.

Behavioural data obtained from this experiment was analyzed using repeated measures analysis of variance (ANOVA) procedure of SAS (2010) and performance data was analysed using one-way analysis of variance while means were compared using Duncan multiple range test and below is the ethogram used in generating behavioural data.

Table 1: Behavioural Ethogram

CATEGORY	DEFINITION
Enrichment use	
Nosing substrate	Movement of snout along or close to substrate

Chewing Substrate	Substrate in mouth (with/without visible chew)	Source:
Rooting substrate	Displacing substrate with circular movements of the mouth/nose	Trickett
Pen manipulation	Nose or mouth in contact with pen sides or floor	*et al.*,
Penmate manipulation		2009
Nosing	Rubbing the body of pen mate with the snout, mostly directed to back, shoulders belly of flank and around the soft tissue between the limbs	
Biting	Nibbling, sucking or chewing ears, legs, feet or tails	
Rubbing	The resistance encountered when one pig is moved in contact with another pig (including mounting)	
Chasing	The pursuit of one pig by another, the act of running and following a pig	
General activity		
Feeding	Head in feeder or very close to feeder (includes nosing feeder)	
Drinking	Mouth at drinker	
Inactive	Standing or lying down and performing none of the above behaviours	
Other	None of the above categories or impossible to assess what a pig is doing	

RESULTS AND DISCUSSION

Performance: From table 2 below it was observed that there was significant difference ($p<0.05$) in the final weight and average weight gain across the treatments although the feed conversion ratio do not differ significantly ($p>0.05$). This indicated that, the provision of rope as an environmental enrichment device do not elicit stimulus that enhance conversion of feed to muscle. Although the influence of environmental enrichment on productive performance have yielded conflicting results, the result of this study is in support of the work of Blackshaw *et al.,* (1997) who found no improvement in the productivity of pigs when provided with enrichment although contrary to the work of Gracner *et al.,* (2013).

Table 2: Performance of grower pigs environmentally enriched with different number of ropes

	ROPE				
	CONTROL	1	2	3	
PARAMETERS					SEM
Initial Weight (Kg)	10.31	10.39	10.23	10.25	0.36
Final Weight (Kg)	19.27[a]	18.34[b]	19.02[a]	19.05[a]	0.42
Average Weight Gain (Kg)	8.96[a]	7.94[b]	8.79[a]	8.80[a]	0.30
Average Feed Intake (Kg)	29.88	28.66	30.95	29.93	1.65
Feed Conversion Ratio (Fcr)	3.36	3.62	3.52	3.40	0.21

[a,b] Means with different superscripts in the same row differ significantly ($p < 0.05$) SEM – Standard Error of Mean

Behavioural Response of Pigs to Different Number of Rope used as Environmental Enrichment: The behavioural observation of pigs presented with different number of environmental enrichments was as shown in

table 3. It was observed that as the number of enrichment device increases, the pen-mate manipulation, pen manipulation and general activities decreases with significant difference ($p<0.05$) across the treatments while the enrichment use increases as the number of enrichment device increased. The findings of this study suggest that providing animals with adequate number of enrichments will divert their attention from performing adverse behaviour and according to Scott *et al.*, (2007) exploratory behaviour of pigs in barren environment or sty with inadequate objects is redirected towards pen-mates and pen components according to Guy *et al.,* (2002).

Table 3: Behavioural Response of Pigs to Different Number of Rope used as Environmental Enrichment

		ROPE			
(% of observation)	CONTROL	1	2	3	SEM
PENMATE MANIPULATION	28.93[a]	25.23[b]	21.58[c]	18.22[d]	0.84
PEN MANIPULATION	41.13[a]	33.29[b]	26.42[c]	23.43[d]	1.16
GENERAL ACTIVITIES	29.94[a]	29.58[b]	28.4[c]	27.76[d]	0.65
ENRICHMENT USE	0.00[d]	11.9[c]	23.59[b]	30.59[a]	1.92

Means with different superscripts in the same row differ significantly ($p < 0.05$) SEM – Standard Error of Mean

Behavioural Response of Pigs to Time when Rope is used as Environmental Enrichment: The result of behavioural response of pigs to time when rope is used as environmental enrichment is as shown in table 4; from the table it was observed that at 09:00-12:00 the pen-mate manipulation, pen manipulation and general activities was significantly higher ($p<0.05$) when compared with 15:00-18:00 but on the contrary the enrichment use at 09:00-12:00 was lower when compared with 15:00-18:00. The finding of this study indicated that pigs prefer to interact more with enrichment device in the latter hour of the day. Although Trickett *et al.*,2009 use interval of four hours interval recordings over a 24hours recording, it was recorded that time affects enrichment use.

TABLE 4: Behavioural Response of Pigs to Time when Rope is used as Environmental Enrichment

(% of observation)	09:00-12:00	15:00-18:00	SEM
PENMATE MANIPULATION	22.20[a]	21.75[b]	0.45
PEN MANIPULATION	27.86[a]	26.16[b]	0.51
	29.43[a]	28.33[b]	0.43

GENERAL ACTIVITIES			
ENRICHMENT USE	20.96^{b}	23.31^{a}	0.69

[a,b] Means with different superscripts in the same row differ significantly ($p < 0.05$) SEM – Standard Error of Mean

CONCLUSION AND APPLICATION

From the findings of this study, it can be concluded that environmental enrichment may not have significant effect on the growth of growing pigs. However, it is an important instrument in diverting their attention from pen-mate and pen component. Furthermore, it is inferred from this experiment that the more the number of enrichment (rope) the better as this elicit the appropriate stimulus that divert the attention of pigs from pen-mate and pen components.

Therefore, the application of this experiment is that; it will serve as enlightenment to pig farmers in Nigeria on the use of rope as environmental enrichment, as this will reduce the cost of reconstruction of pen components and adverse behaviour towards pen-mate. This is a strategy to reduce economic loss that could be incurred by the farmers through loss of animals and increase in cost of production from pencomponent renovation.

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Effect of lime (*Citrus aurantifolia* Swingle) on cassava (*Manihot esculentus* Crantz) fermentation

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Abstract: The effect of lime on cyanide and proximate composition of fermenting cassava was determined. The treatments contained 1 kg of peeled, washed and chopped cassava in a 5 L buckets treated with 0 g, 50 g, 100 g and 150 g of chopped lime for CTRL, Ca50, Ca100 and Ca150 respectively. The cassava was submerge in water and fermented for three days during which cyanide and proximate composition were analyzed daily. CTRL had the characteristic smell of fermented cassava, and the smell reduced proportionally to the concentration of lime, while Ca150 had the smell of kerosene. Percentage fermentation also reduced proportionally to the concentration of lime. CTRL had 100% fermentation while the percentage Ca50 and Ca100 has decreasing percentage fermentation with no fermentation in Ca150, which had 150 g/kg of lime. Cyanide concentration dropped significantly in Ca100 from Day 1. By Day 3, Ca50 had the lowest concentration of cyanide (0.331 µg). Nutrient composition was not influenced by lime. Thus, lime at 50 g/kg reduced the characteristic smell of fermented cassava and the cyanide content well below the WHO recommended level of 100 mg/kg without affecting the nutrient composition. Fermenting cassava with lime at 50 g/kg can reduce the characteristic smell and improve customer acceptability with minimal effect on percentage fermentation.

Keywords: cassava, fermented liquid feed, lime, poultry

INTRODUCTION

Government at all levels since the Goodluck Jonathan administration's Agricultural Transformation Agenda has made consistent proactive effort to improve agriculture as a way to empower Nigeria's teeming youth population, end poverty and unemployment by creating jobs though direct involvement in agricultural production and marketing and through the agriculture value chain (Ari *et al.,* 2016). However, the cost of livestock feeds, especially for those involved in the livestock transformation agenda to increase availability of animal protein is a matter of grave concern (Afolayan *et al.,* 2012). The cost of maize, an energy ingredient in livestock feeds formulation is of particular concern in this context.

Cassava has assumed a rising profile from its humble position in the post-independence era as a famine food stock to cash crop of international importance for use in livestock feeds, biofuel production and industrial raw material (Nweke *et al.,* 2002). It has been shown to have the highest carbohydrate yield per unit area of cultivated land after beetroot and sugarcane (Aro *et al.,* 2010). This potential of cassava could be of significant importance given the shortfall in the supply, and the attendant rising cost of maize, which also faces competition for use as food, feed, industrial raw material and a source of green energy production (Ibeto *et al.,* 2011).

The increasing awareness of farmers in the Nigerian livestock industry of the benefits of fermented feeds for pigs and poultry brings cassava quickly to mind as a choice ingredient for fermented liquid feeds. Niba, (2008) and Niba *et al.,* (2013) outlined the factors that influence fermented feed production to include the carbohydrate content of the fermenting medium, the temperature and the fermenting organism. Cassava has sufficient carbohydrate for the fermenting organisms to convert to lactic acid, the tropical temperature enhances fermentation without the need for sophisticated equipment employed by Uguru and Onainor, (2013). The dominating population of *Lactobacillus plantarum* in fermented cassava (Niba *et al.,* (2013) relegates the need for inoculation with fermenting organism (Uguru and Onainor, 2013) in which the feed was inoculated with *Pediococcus acidilacitici* and incubated for 24 h to make fermented liquid feed for broilers.

Lime has several proven health benefits occasioned by its rich phytochemical composition (Patil *et al.*, 2009). Women dealing on commercial scale cassava processing into *fufu* in Ebonyi State have been observed to add lime to fermenting cassava. Their reason is to reduce if not eliminate the characteristic smell of cassava, which some customers find obnoxious and unacceptable. Uguru *et al.* (2018) (in press) reported the tendency of the characteristic smell of fermented cassava fed to broilers influencing the taste of the meat thus making it unpalatable and giving it the lowest overall acceptability score among other treatment groups, which received varying levels of fermented cassava ranging from 25 - 75% of the maize component of the diet.

Thus, the objective of this study was to establish whether lime will affect the characteristic smell of fermented cassava. It also examined the effect of lime on the rate of fermentation of cassava, the rate of cyanide degradation, and the proximate composition of the cassava with particular reference to the crude protein content.

MATERIALS AND METHODS

Location of the study: The study was conducted at U-Bonny Diagnostic Laboratories, Mile 50, Mbukobe, Abakaliki. Abakaliki lies within 6.32°N 8.11°E; 65 m asl. It has a mean annual temperature and rainfall of 28°C and 2500 mm p.a. respectively, and relative humidity of 85% (Meteoblue, 2018).

Source and processing of cassava and lime: The cassava was purchased from farms around CAS Campus of Ebonyi State University, Abakaliki. The tubers were harvested early on the morning the experiment commenced and peeled, washed and cut into 10 cm chunks. The lime was purchased from Meat Market, Abakaliki also on the morning the experiment commenced. They were chopped into tiny portions with knife for use in the experiment.

Experimental design and procedure: The experiment consisted of four treatments and three replicates each replicate represented by a bucket. 1 L of water was poured into 5 L buckets each for the replicates. Then the chopped lime was weighed and added at 0 g, 50 g, 100 g and 150 g respectively for each of T1 through T4 designated as CTRL, Ca50, Ca100 and Ca150 respectively. Then the cassava was chopped into 10 cm chunks and 1 kg was added into each bucket. 2 L of water was added to submerge the cassava. The mixture was allowed to ferment for 3 days during which period a sample was collected and analyzed daily for cyanide and proximate composition. The rate of fermentation was determined by measuring the weight of the cassava that softened completely after the 3-day period and calculated against the initial weight of 1 kg that was soaked. The smell of the fermented cassava was also observed by smelling them after 3 days.

Analysis for cyanide concentration and proximate composition: The cyanide concentration in the fermenting cassava was determined by alkaline picrate method of Onwuka, 2005. The proximate composition was conducted according to the method of AOAC (2002).

RESULTS

Smell of fermented cassava and percentage fermentation: The characteristic smell of fermented cassava was very much evident in T1, which had no lime in the fermenting medium. The smell however reduced proportionally to the concentration of lime while the smell of lime became more evident. Ca150 which contained 150 g of lime per kg of fresh cassava soaked had the smell of kerosene. Percentage fermentation (Table 1) also reduced proportionally to the concentration of lime in the medium. CTRL fermented completely (100%) while the percentage Ca50 and Ca100has decreasing percentage fermentation. Ca150 did not ferment at all (i.e. 0% fermentation).

Cyanide composition: The result of mean total cyanide (n = 3) in the treatments is presented in Table 1.

Table 1: Mean total cyanide concentration (µg) in cassava (*Manihot esculenta* Crantz) fermented in water containing lime (*Citrus aurantifolia* Swingle) over a 3-day fermentation period

Period	CTRL	Ca50	Ca100	Ca150
Day 1	4.103	4.053	1.645	1.847
Day 2	0.822	1.088	0.744	2.7
Day 3	0.65	0.331	0.497	0.891

It can be observed from the results that concentration of cyanide even from Day 1 dropped significantly when the concentration of lime in the water increased to 100 g/kg of cassava. The reason for the drastic increase in cyanide concentration in Ca150, in which lime increased to 150 g/kg is not clear. By Day 3, the concentration of cyanide was lowest in Ca50, which contained lime at 50 g/kg.

Proximate composition: The result of the proximate analysis of the cassava (*Manihot esculenta* Crantz) fermented in water containing lime (*Citrus aurantifolia* Swingle) over a 3-day period is presented in Table 2.

Table 2: Proximate analysis of the cassava (*Manihot esculenta* Crantz) fermented in water containing lime (*Citrus aurantifolia* Swingle) over a 3-day period

Parameter	CTRL	Ca50	Ca100	Ca150
Moisture (Day 1)	65	64	64.5	63.5
Day 3	77	74	74.5	71
CHO (Day 1)	15.44	17.25	16.57	18.37
Day 3	13.55	14.56	13.50	21.62
Protein (Day 1)	11.56	10.75	10.93	10.13
Day 3	4.57	5.44	4.5	3.88
Lipid (Day 1)	5	5	5	5
Day 3	1.7	4	6	2.5
Ash (Day 1)	3	3	3	3
Day 3	3	2	1.5	1

The mean percentage crude protein of cassava was not significantly influenced by the addition of lime. All other parameters also appear not to have been affected by the addition of lime to the steep liquor.

DISCUSSION

The characteristic smell of cassava was apparently influenced by the phytochemical content of lime. This though has been established in practice by marketers of *akpu* in Abakaliki, the optimum concentration of lime in the steep liquor has not been established before now. A concentration of 50 g/kg of cassava as in Ca50 was adequate to eliminate the characteristic smell of fermented cassava. Lower concentrations should still be explored to determine what level will be optimum to further reduce the cost of replacing maize with fermented cassava in poultry diet.

The cyanide content in the samples containing 100 and 150 g/kg appear to have been increased by interaction with other phytochemicals in lime. Ca50 has the lowest concentration of lime, which shows that 50 g/kg will be most suitable for fermented cassava for feeding poultry.

The proximate composition of fermenting cassava was not influenced by the addition of lime in the steep liquor. Fermentation of cassava has been demonstrated to increase the protein content of cassava tubers meal but there is no evidence from this study that adding lime to the steep liquor can influence that.

CONCLUSION

From the results of this study, it can be seen that addition of lime at 50 g per kg of fermenting cassava reduces the characteristic smell of fermented cassava. The same concentration is also shown to reduce the cyanide content well below the WHO recommended level of 100 mg/kg without affecting the nutrient composition.

Implication: Lime can be added to the steep liquor of fermenting cassava to reduce the characteristic smell and make it more acceptable to a wider range of customers as well as eliminate the smell and taste in broiler meat (Uguru *et al.*, 2018). This will improve overall acceptability of meat of broiler raised on diets in which cassava is used as replacement for maize. The cumulative effect is that cassava can help reduce the cost of livestock feeds without the risk of cyanide toxicity if fermented.

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Water Quantity Requirement and Effect on Growth Performance of Large Fulani Ecotype Chicken Breeder Pullets

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Abstract: Water is a very important nutrient in poultry production but is rarely considered in indigenous chicken production particularly, under the scavenging system. Ninety (16 weeks old) Large Fulani Ecotype Chicken Breeder Pullets (LFECBP) were used to determine the effect of water intake on growth performance under intensive production system. The birds were randomly assigned to six treatments of *ad libitum* (4L) water supply, which was gradually reduced by 10% to give 3.6L, 3.2L, 2.8l, 2.4L and 2L. The different water quantity was supplied in 4litres bowl drinker type. Each treatment was replicated thrice. Respective same water quantity per replicate was provided away from reach of the birds to determine evaporative loss. Data were collected on body weight, weight gain, feed intake, water intake and feed conversion ratio (FCR) and analyzed. Final weight reduced ($p<0.05$) from 1500g/b to 1316.67g/b with reducing water quantity from 4L to 2L. Weight gain, water intake and feed intake reduced ($p<0.05$) from 10.42g/b/d to 6.25g/b/d, 320ml/b/d to 240ml/b/d and 141.19g/b/d to 139.71g/b/d, respectively with reduced water quantity. Best FCR was obtained with birds on 4L water quantity. This study concluded that LFECBP should have unlimited access to quality water for better performance.

Keywords: Water-intake, Large-Fulani-Chicken-Ecotype-Breeder-Pullets, Performance

DESCRIPTION OF PROBLEM

Water is an important requirement in poultry production and one of the most essential daily nutrients in domestic chickens (Amaral (2004); Tabler et al. (2013); Vanderklis and De Lange (2013)). It constitutes between 55 and 75% of a chicken's body and about 65% of the egg (Koelkebeck *et al*. 1999). Water serves as an essential solvent and plays vital roles in the operation and regulation of many physiological processes of animals which include body temperature, digestion and transportation of other nutrients, elimination of waste products of digestion and metabolism, regulation of osmotic pressure, reproduction, enzymatic and chemical reactions, lubrication of joints and organs among others (NRC (2000); Okine, (2001) Kumar (2007)). Livestock and poultry need quality water in good quantity for optimum performance. These roles therefore, underscore the importance of water in general performance of any poultry breed (indigenous and exotic), type (meat or egg type), physiological stage (chick, grower and adult) and species (fowl, guinea fowl, turkey etc.).

Approximately 80% indigenous chicken producers in tropical region live in fragile and marginal environments where there is inadequate/lack of quality potable water for both human and livestock consumption (Swatson, 2003). The location of the indigenous chickens, among other factors has made it more challenging for their integration to modern production system. Mwale and Masika (2009) reported that about 60% of indigenous chicken producers in rural areas do not offer water to chickens. They trust in the chickens' ability to scavenge for water. The chickens usually subsist on unpalatable and poor quality water from bathrooms and kitchens. Sometimes, the birds depend on detergent tainted waste-water. Understanding the effects of water intake on the growth performance of chickens in general and indigenous chickens in particular would help to elucidate the mechanisms of water requirement and enhance ease integration of indigenous chickens into modern production techniques and food safety.

Research has shown that Large Fulani Ecotype Chickens (LFEC) could easily be integrated into modern poultry production system (Tadelle *et al*. (2003); Bello *et al*., (2016)) for sustainable animal protein production and food security however, there is paucity of information on water requirement for LFECBP. This study therefore aims at determining quantity of water intake and effect on growth performance of LFECPB.

MATERIALS AND METHODS

The experiment was carried out at the poultry unit of Ogun-Osun River Basin Development Authority (ORBDA), along Federal University of Agriculture, Abeokuta (FUNAAB) Road, Odeda Local Government Area, Ogun State, Nigeria. The area is characterized by tropical climate with a mean annual rainfall of 1037mm, mean ambient temperature of 34^{o}c and relative humidity of 78% (Google Earth 2017). The vegetation represents an interphase between the tropical rainforest and the derived savannah.

Experimental birds and management

Ninety (90) Large Fulani Chicken Ecotype Breeder Pullets (16 weeks old) with an average weight of 1kg were randomly divided into six treatments with three replicates per treatment. On daily basis, birds in treatment one (control) were supplied with 4litres of clean water; birds in treatment two were supplied water that was 10% less than the control (3.6litres of water); birds on treatments 3, 4, 5 and 6 were supplied 3.2L, 2.8l, 2.4L and 2L water quantity of the control, respectively. The water supplied was from the ORBDA central supply system/line. It was administered to the birds using 4litre bowl capacity. The treatments were replicated thrice and each replicate contained 5 birds. Each replicate was also supplied with same water quantity at the front of the pen where the birds could not access to determine evaporative loss. The study lasted for 56 days.

Experimental diet

The birds were fed with commercial growers' mash diet at *ad libitum*. The diet contained crude protein (16%), fat and oil (5%), crude fiber (7%), calcium (1.6%), available phosphorus (0.45%), lysine (0.75%), methionine (0.36%), salt (0.30%) and metabolizable energy (2450Kcal/kg).

Data collection and analysis

Data were collected on body weight, weight gain, feed conversion ratio (FCR) and water intake and analyzed using one-way analysis of variance (ANOVA) in a completely randomized design (SAS. 2002). Significant differences among treatment means were separated using Duncan's multiple range test as contained in (SAS. 2002).

RESULTS AND DISCUSSION

The effect of water quantity on growth performance of LFECBP is shown in Table 1. Weight gain, water intake, feed intake and FCR varied significantly ($p<0.05$) with quantity water supply. LFECBP on *ad libitum* water (4L) recorded highest ($p<0.05$) weight gain (10.42g/b/d), water intake (320ml/b/d), feed intake (141.19g/b/d) and best FCR (13.54). This result is in consonant with the finding of Vanderklis and De Lange (2013) who reported that *ad libitum* water intake has significant influence on performance of broilers but depends on diet composition, feed form, intestinal health, stress and environmental condition. In this study, the only variable of the factors that influence water intake according to Vanderklis and De Lange (2013) is the environment and in this case, the quantity water supply gave easy access to the birds. LFECPB on 4L water supply could be said to have good access and this could be responsible for the result of weight gain, feed intake and FCR.

LFECBP on 3.6L *ad lib* water supply recorded similar ($p>0.05$) final weight and water intake with the control. This could be a pointer to water accessibility without physical and physiological restriction. Since water intake decreased with reduced quantity of water supply from 4 to 2L in this study, it therefore suggested that unlimited access to water should be created for the birds apart from the good quality and quantity water supply.

Weight gain, water intake and feed intake consistently decreased ($p<0.05$) with reducing water quantity supply from 4L (100% *ad lib*) to 2.8L (70% *ad lib*). Esmail (2013) reported that water intake is correlated with feed intake and any decrease in water consumption due to failure in the water supply, in adequate watering space or restricted access would result in reduced feed intake to a varying extent, depending on the age of the chickens

and the degree of water restriction. The opinion of Esmail (2013) therefore, gave credence to the finding of this study. In spite of reduction in quantity water supply, average daily water intake that was recorded in this study (320ml/b/d) was more than twice feed intake (141.19g/b/d). This result is consistent with the finding of Lacy (2002) who reported broiler consumes 4.5kg of feed and 8.2kg of water.

FCR reduced significantly ($p<0.05$) with reduced quantity water supply thus water intake (Table 1). FCR of the LFECBP in this study becomes poorer with reduced water intake. This observation suggests a positive correlation between water and feed intake but vary inversely with weight gain. Heck *et al*. (2005) reported that standard broiler breeder hen on restricted diet attained 2.2kg body weight which was less than experimental dwarf heavy broiler breeder (E) and Standard broiler breeder hens on ad libitum feeding which recorded 3.4kg and 5.4kg body weight, respectively in 24weeks. Similarly, Huang *et al*. (2011) reported that a 10% feed restriction resulted in a 3.5% reduction in water intake. It is therefore sufficed to say that water intake is positively correlated with feed intake in a steady condition. Accordingly, poor feed intake could impair weight gain and so result in poor FCR. The opinion of Heck *et al*. (2005) and Huang *et al*. (2011) therefore gave credit to the result of this study that LFECBP feed intake significantly decreased with reduced water intake and consequently results in poor FCR.

Table 1: Performance of Fulani ecotype breeder pullets on varying quantity of water supply

Parameter	Water Quantity Supply (Litres)						SEM
	4	3.6	3.2	2.8	2.4	2.0	
Initial weight (g/b)	916.67	983.33	953.33	966.67	976.67	966.67	23.93
Final weight (g/b)	1500.00^{a}	1466.67^{a}	1386.67^{b}	1316.67^{b}	1333.33^{b}	1316.67^{b}	18.89
Weight Gain (g/b/d)	10.42^{a}	8.63^{b}	7.74^{b}	6.25^{c}	6.37^{c}	6.25^{c}	1.75
Water intake (ml/b/d)	320^{a}	310^{a}	290^{b}	260^{c}	240^{d}	240^{d}	0.27
Feed intake (g/b/d)	141.19^{a}	140.82^{b}	140.48^{c}	140.24^{d}	140.00^{e}	139.71^{f}	0.05
FCR	13.54^{a}	16.32^{b}	18.15^{c}	22.44^{d}	21.98^{d}	22.35^{d}	19.13

$^{a-f}$: Means within the same row followed by different superscripts are significantly different ($p<0.05$); SEM: Standard Error of Mean; FCR: Feed conversion ratio

CONCLUSION AND APPLICATION

Based on the result of this study, it could be concluded that Large Fulani Ecotype Chicken Breeder Pullets should be placed on *ad libitum* water intake for good growth performance.

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Growth Performance of Broilers Fed Graded Levels of Full Fat Palm Fruit Meal Diets with or Without Enzyme

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Abstract: This study was conducted to evaluate the effect of feeding diets with graded levels of full fat palm fruit meal (FFPFM) with or without enzyme on the growth performance of broilers. A total of 180-day old chicks of Hubbard F15 breeds were assigned to 12 experimental diets (6 with enzymes and 6 without enzyme inclusion in diets) in a completely randomized design. The birds were fed graded levels of 0%, 10%, 20%, 30% 40% and 50% of FFPM as partial replacement for maize and palm kernel cake. Data was recorded for feed intake (g/day), weight gain (g/day), and feed efficiency for the period of the experiment that lasted for 56 days. Birds fed 40% FFPFM (with and without enzymes) performed better ($P<0.05$) in feed intake (486.51 g/d and 434.73 g/d respectively) when compared to others. In terms of weight gain, birds fed 40% FFPFM (with enzymes) and 50% FFPFM (without enzyme) (33.98 g/d and 34.21 g/d) performed better ($P<0.05$). For non-enzyme fortified diet birds on 50% FFPFM recorded (1.96 kg) higher ($P<0.05$) weight than those on 20% FFPFM (1.54 kg). The feed efficiency was best at 40% FFPFM inclusion for both enzyme and without enzyme inclusion/fortification (0.07). Thus, a 50% level of FFPFM supplementation in the diets of broilers with or without enzymes fortification can be tolerated without any adverse effect on their growth performance.

Keywords: Full Fat Palm Fruit Meal, Enzyme, Broiler Chickens, Growth Performance.

DESCRIPTION OF THE PROBLEM

Animal production industry is geared towards converting cheap and available feedstuffs into a more balanced animal protein. Feed accounts for over 75-80% of the total cost of production (Agbede and Aletor, 2003), and its insufficiency is due to stiff competition for feedstuffs between human, industry and livestock (Iyayi and Davies, 2005). Hence, a search for alternative feedstuffs that are readily available, cheap and beneficial nutritively becomes imperative in order to sustain the livestock industry particularly the fast growing and prolific monogastric species. Palm fruit meal (PFM) is one of such alternative (non-conventional) feedstuffs and is a by-product of palm kernel oil extraction. Palm fruit meal has been used both as protein and energy sources in laying hens (Perez *et al*., 2000; Odunsi *et al*., 2002), broilers (Ezeishi and Olomu, 2004), rabbits (Daudu, 2007), sheep and goats (Devendra, 2000) and cattle (Chin, 2007). Akpodiete *et al.* (2006) showed that PFM could replace up to 60% of protein in groundnut meal in diets of broilers, pullet chicks and growers thereby permitting incorporation of 28-38% of PFM. The crude protein content and gross energy ranges are 18.50 – 21.35% and 4.28 – 4.99 kcal/g (Sundu and Dingle, 2006).

Boateng *et al*. (2008) observed that feeding PFM up to 40% to broilers, depressed body weight gain and feed efficiency at levels beyond 30%. Reason adduced for this observation was reduction of dietary energy, and grittiness of such diets resulted in reduced feed intake (Duran *et al*., 2002; Hair-Bejo and Alimony, 2006). Also, Armas and Chicco, (2000) observed that the material (PFM) was fibrous, hence increase in the levels resulted in depressed digestibility of other nutrients in the diets. This study was hence conducted to determine the growth performance of broilers fed with full fat palm fruit meal diets with or without enzymes.

MATERIALS AND METHODS

Location: The experiment was conducted in poultry farm within the same community where the permanent site of the University of Uyo is located (Main Campus). The farm name is "Hatch Your Own" located at Ekamba Nsukara Offot, Uyo Local Government Area of Akwa Ibom State.

Experimental Design/Layout: Research was carried out using a completely randomized design. A total of one hundred and eighty (180) broilers chicks of Hubbard F15 strain were used. There were twelve (12) treatments each having three (3) replicates. Each treatment had fifteen (15) birds with five (5) birds per replicate.

Sources and processing of Experimental Materials: Ripe, fresh and selected palm fruits were purchased at Domita farms and from local farmers in Uyo Local Government Area. Other micro and macro ingredient were purchased from Ibadan. Palm fruit was processed into meal with aid of a hammer mill situated in the farm. This was done after the fruits had been separated from the bunch.

Experimental Diets: Twelve experimental (12) diets were formulated at the broiler starter and finisher stages. Six (6) diets were formulated with enzyme inclusion and the other six without enzyme inclusion in diets. Treatment one (T1) was control diet with no inclusion of full fat palm fruit meal (FFPFM) and enzyme. Treatment two (T2) had 10% FFPFM while T3, T4, T5 and T6 had 20%, 30%, 40% and 50% respectively of FFPFM with or without the recommended level of maxigram enzyme (100ppm). These are shown in Table 1 and 2.

Table 1: Ingredients composition of experimental starter diets with or without enzyme

Ingredients	**T1 (0%)**	**T2 (10%)**	**T3 (20%)**	**T4 (30%)**	**T5 (40%)**	**T6 (50%)**
Maize	58.45	48.45	38.35	28.45	16	13
Soybean meal	32.30	32.20	32.20	32.20	34.65	30.35
Palm fruit meal	0	10	20	30	40	50
Fish meal	5	5	5	5	5	5
Bone meal	3.45	3.45	3.45	3.45	3.45	3.45
Salt	0.20	0.20	0.20	0.20	0.20	0.20
Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20	0.20
Total	100	100	100	100	100	100
Nutrient composition (calculated)						
Crude protein	23.81	23.36	23.54	23.64	23.81	23.21
Crude fibre	3.74	4.80	5.87	6.94	7.94	8.90
Elther extract	3.85	8.92	13.99	19.07	24.04	29.40
ME (Kcal/kg)	2931.06	3226.14	3518.51	3819.74	4032.49	4569.50

Maxigrain enzyme = 100g/tonne of feed
T1: 0% FFPFM; T2:10% FFPFM; T3: 20% FFPFM; T4: 30% FFPFM; T5: 40% FFPFM and T6: 50% FFPFM

Table 2: Ingredients composition of experimental finisher diets with or without enzyme

Ingredients (%)	**T1 (0%)**	**T2 (10%)**	**T3 (20%)**	**T4 (30%)**	**T5 (40%)**	**T6 (50%)**
Maize	68.74	59.34	52.50	43.10	33.71	24.31
Soyabean meal	20.26	19.66	16.50	15.90	15.29	14.69
Palm fruit meal	0	10.00	20.00	30.00	40.00	50.00
Fish meal	5.00	5.00	5.00	5.00	5.00	5.00
Bone meal	5.00	5.00	5.00	5.00	5.00	5.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100
Nutrient composition (calculated)						
Crude protein	19.00	19.00	18.00	18.00	18.00	18.00
Crude fibre	3.24	4.28	5.23	6.28	7.32	8.37
Ether extract	3.84	8.92	14.01	19.08	24.16	33.87
ME (Kcal/kg)	2993.55	3296.42	3625.20	3928.07	4231.05	4533.92

Maxigrain enzyme = 100g/tonne of feed
T1: 0% FFPFM; T2:10% FFPFM; T3: 20% FFPFM; T4: 30% FFPFM; T5: 40% FFPFM and T6: 50% FFPFM

Management: The birds were raised on deep litter system using wood shavings, which were spread on the floor. Adequate sanitary measures were taken; wood shavings were changed duly, depending on wetness. Feeding troughs, drinkers and other equipment necessary for raising of the birds were properly cleaned daily. Feed and clean water was given *ad-libitum* throughout the experimental period. Vaccinations were administered at the required time.

Data Collection and Statistical Analysis: Feed intake was recorded daily while live weight was measured on weekly basis. All data collected were statistically analyzed using the analysis of variance procedure of (SAS, 1999) and significant differences between treatment means were assessed by Duncan's multiple range tests.

RESULTS AND DISCUSSIONS

The growth performance of broiler chickens fed full fat palm fruit meal diets with enzyme is as shown in Table 3.

Table 3: Growth performance of broiler chickens fed FFPFM diets with enzyme

Parameter	T1	T2	T3	T4	T5	T6	SEM
Initial body weight (g)	40.75	40.75	40.75	40.75	40.75	40.75	0.90
Daily feed intake (g)	176.40^{d}	245.45^{c}	303.05^{c}	406.55^{b}	486.51^{a}	395.86^{b}	20.69
Total weight gain (g)	1575.90^{ab}	1525.90^{b}	1559.30^{ab}	1685.90^{ab}	1902.60^{a}	1739.30^{ab}	151.41
Daily body weight (g/d)	28.14^{ab}	22.07^{b}	27.84^{ab}	30.11^{ab}	33.98^{a}	31.06^{ab}	2.70
Final body weight (g)	1616.70^{ab}	1276.70^{b}	1600.00^{ab}	1726.70^{ab}	1943.30^{a}	1780.00^{ab}	151.48
Feed efficiency	0.16^{a}	0.09^{b}	0.09^{b}	0.08^{b}	0.07^{b}	0.08^{b}	0.01

^{ab} Means with different superscripts are significantly different ($p<0.05$) within the rows

The highest daily feed intake (486.51 g/day/bird) was obtained for broiler fed diets with 40% FFPFM with enzyme which was significantly higher than those on control diet (176.40 g/day/bird) without FFPFM, also for those on T2, T3, T4 and T6 (245.45, 303.05, 406.55 and 395.86 g/day/bird respectively). The intake of feed increased as the FFPFM level increased, from T1 – T5, but decreased for those on T6. Increase in intake across the treatments may be due to lower metabolizable energy content of the diets and enzyme fortification. As a result of this, the birds needed to increase their level of intake to meet up with their energy requirement (Ezeishi and Olomu, 2004).

The values for total weight gain, daily weight gain and final body weight of the broiler ranged from 1525.90g – 1902.60g, 22.07g – 33.98g and 1276.70g – 1943.30g respectively. For all the parameters afore-mentioned, broilers on T5 performed better ($P<0.05$) than those on T2. However, birds on control (T1) did not perform differently ($P>0.05$) to those fed FFPFM diets fortified with enzyme (T2, T3, T4, T5 and T6 diets). The result obtained here is in agreement with the report of (Boekholt *et al.*, 1994) who stated that increased energy consumption promotes better weight gain. The birds fed enzyme (T4, T5 and T6) were numerically higher than control. Moreover, another reason for this increase, numerically over the control, as reported by (Viveros *et al.*, 1993), is that the improvement in digestibility by including enzyme might result in better nutrient absorption. The feed efficiency varied significantly ($P<0.0$) across the treatment with birds on T5 having the best value and thus could be observed in the final body weight and change.

Table 4: Growth performance of broiler chickens fed full fat palm fruit meal without enzyme

Parameters	T1	T2	T3	T4	T5	T6	SEM
Initial body weight (g)	40.75	40.75	40.75	40.75	40.75	40.75	0.09
Daily feed intake (g)	123.20^{d}	116.11^{d}	227.40^{c}	345.37^{b}	434.73^{a}	373.45^{b}	16.56
Total weight gain (g)	1859.30^{a}	1759.30^{ab}	1502.60^{b}	1769.30^{ab}	1822.60^{a}	1915.90^{a}	87.49
Daily body weight (g/d)	33.20^{a}	31.42^{ab}	26.83^{b}	31.59^{ab}	32.55^{a}	34.21^{a}	1.56
Final body weight (g)	1900.00^{a}	1800.00^{ab}	1543.30^{b}	1810.00^{ab}	1863.30^{a}	1956.70^{a}	87.49
Feed efficiency	0.28^{a}	0.27^{a}	0.12^{b}	0.09^{b}	0.07^{b}	0.09^{b}	0.02

^{ab}Means with different superscripts are significantly different ($P<0.05$)

The performance in terms of growth of broilers chickens fed full fat palm fruit meal diets without enzyme is presented in Table 4.

Birds fed T5 recorded the highest daily feed intake (434.73 g/bird/day), which was significantly higher than other treatments. The least value was obtained for birds on T2 (116.11 g/bird/day), which was similar (P>0.05) with control T1 (123.20 g/bird/day). Birds on T6 recorded a lowered (P<0.05) intake when compared with those on T5 but similar to those on T4. These observations agree with findings of (Sundu and Dingle, 2006) who stated that feed intake of birds fed palm kernel meal-based diet was usually higher than that of maize-based diets. The total weight gain (TWG), daily body weight gain (DBWG) and final body weight (FBW) values ranged from 1502.60 – 1915.90 g, 26.83 – 34.21 (g/d), and 1543.30 – 1956.70 g respectively. The values for birds on T1, T5 and T6 diets were significantly different (P<0.05) from those on T3 for all the weight parameters (TWG, DBWG and FBW) measured. From T1 – T3, the values decreased while from T3 – T6, the values tended to increase with increase in FFPFM in diets. The results obtained in this study is in agreement with report of (Lesson *et al.*, 1996) which stated that weight gain of poultry birds placed on palm kernel meal-based diets with up to 40% replacement could compete favourably with that of maize-based diets.

The feed efficiency was similar (P>0.05) for birds on T1 and T2 (0.28 and 0.27 respectively) but different from (P<0.05) those on T3 – T6 (0.07 – 0.12).

CONCLUSION AND APPLICATION

1. The findings of this study proved that feeding full fat palm fruit meal with enzyme up to 50% replacement level had no negative consequence on the performance of broilers.
2. Birds on treatment 5 (40% FFPFM with enzyme) provided the best value for body weight. However, without enzyme inclusion in their diets, birds on treatment 6 (50% FFPFM) performed well though similar with those on treatment 5.
3. It is recommended that 40 – 50% FFPFM with or without enzymes can replace maize for efficient production in broiler production.

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Performance of Broiler Chickens Fed Diets containing Four Varieties of *Sorghum bicolor* Supplemented with Maxigrain® Enzyme

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Abstract: A study was carried out to evaluate the effects of feeding four varieties of *Sorghum bicolor* with Maxigrain ® enzyme supplementation on growth performance of broiler chickens in Kaduna state, Northern guinea Savannah of Nigeria. Five diets were formulated for the broiler starter phase namely T_1 – Maize without 0.01 % Maxigrain ® enzyme supplementation, T_2 –Samsorg-14 supplemented with 0.01 % Maxigrain ® enzyme, T_3 –Samsorg-40 supplemented with 0.01 % Maxigrain ® enzyme, T_4 –Samsorg-17 supplemented with 0.01 % Maxigrain ® enzyme and T_5 –KSV-15 supplemented with 0.01 % Maxigrain ® enzyme in replacement for maize (T_1) on the performance of broiler chickens. . Two hundred and twenty-five (225), five days old Arbor acre chicks were randomly distributed into five dietary treatments in a completely randomized design (CRD) with each treatment having forty-five (45) birds per treatment and birds were allotted into three (3) replicates of 15 birds in each replicate. At the starter phase the result showed that birds in T_1 and T_4 were significantly ($P<0.05$) higher than birds fed T_2, T_3 and T_5 in terms of final weight, daily weight gain and feed conversion ratio. The feed cost/kg gain was best in birds fed T_1, T_2 and T_4 and were significantly ($P<0.05$) better than those of birds in T_3 and T_5. At the finisher phase birds in T_1 and T_4 had significantly ($P<0.05$) higher final weight and weight gain. Birds fed T_4 had the best Feed conversion ratio and feed cost/kg gain. In conclusion total replacement of Samsorg-17 (T_4) for maize (T_1) in broiler chicks' diet had no negative impact on performance at the starter phase; therefore Samsorg-17 supplemented with 0.01 % Maxigrain ® enzyme can be incorporated in the diets of broiler chicks at 100%.

Keywords: Broiler chicks, Sorghum varieties, Maxigrain® Enzyme, Growth Performance.

INTRODUCTION

Cereal grains are the major sources of energy in poultry diets in the tropics (10). Common cereals used in tropical countries include maize and guinea corn (sorghum) and to a less extent, millet and wheat (9). Sorghum is an indigenous cereal crop of Africa; it has the ability to tolerate drought, soil toxicities and temperature extremes effectively than other cereals. It is cultivated worldwide in warmer climate and can be grown on poor soil and in drier conditions than maize (9). Sorghum grain is probably the next alternative to maize in poultry feed (6) but farmers have the notion that sorghum has tannin and has lower energy (2650 kcal/kg) compared to maize (3300kcal/kg). Tannin content in the pericarp is one of the most important factors affecting the feeding value of sorghum grain and adversely affecting its metabolizable energy and protein utilization in poultry (13).

Exogenous enzymes have been used extensively in the diets of poultry to improve productive performance and nutrient utilization (7; 8; 1). Studies showed that the use of protease and xylanase in sorghum-based broiler diets have the potential to increase protein and starch digestibility (3). Maxigrain ® enzyme is a cocktail enzyme which has a number of benefits ranging from optimizing the use of non- conventional feed ingredients, improving weight gain in broilers, improve litter quality and dropping consistency, improving feed conversion ratio (FCR), reduces levels of Di-calcium Phosphate (DCP) incorporation in the feed substantially.

For the above reasons the objective of this research was designed to determine the effect of Maxigrain ® enzyme supplementation on four sorghum varieties on the performance of broiler chickens and improving the value of sorghum for optimum productivity.

MATERIALS AND METHODS

Location of study: The experiment was conducted at the Poultry Unit, Department of Animal Science Teaching and Research farm, Ahmadu Bello University, Zaria, Kaduna State, which is within the northern Guinea savannah zone of Nigeria on latitude $11^0$14`44 N and longitude $7^0$33'65 E at an altitude of 610m above sea level. The climate is relatively dry, with a mean annual rainfall of 700-1400mm (11).

Experimental birds and feed ingredients: Two hundred and twenty – five Abor- Acre broiler chicks were obtained from Zamfy Farms, Ilemono, Kwara State, Nigeria. The sorghum grains used for this study were obtained from Samaru and Giwa markets in Kaduna State. While other feed ingredients were purchased in Rebson Feed Mill, Samaru, Zaria.

Experimental design and management of experimental birds: At the starter phase two hundred and twenty-five (225) five days old broiler chicks of mixed sexes were used. The birds were weighed at the beginning of the experiment and allotted into five different dietary treatments after four days in a completely randomized design (CRD). The birds were housed in deep litter pens; each treatment group had total number of forty-five (45) birds in three replicates of 15 birds per pen. Routine vaccination and medications were given as at when due. Feed and water were provided ad- libitum.

Experimental diets: Five diets were formulated as follows; T_1 – Maize without 0.01 % Maxigrain ® enzyme supplementation, T_2 –Samsorg-14 supplemented with 0.01 % Maxigrain ® enzyme, T_3 –Samsorg-40 supplemented with 0.01 % Maxigrain ® enzyme, T_4 –Samsorg-17 supplemented with 0.01 % Maxigrain ® enzyme and T_5 – KSV-15 supplemented with 0.01 % Maxigrain ® enzyme as presented in Table 1.

Data collection: Growth parameters were measured and calculated, these included final body weight, daily weight gain, daily feed intake, feed to gain ratio and feed cost per kg gain.

Table 1: Composition of the experimental broiler starter diets supplement with Maxigrain® Enzyme (5 days - 4 weeks)

Ingredients (%)	**Dietary Treatments**				
	T_1 (Control)	**T_2 (Samsorg-14)**	**T_3 (Samsorg-40)**	**T_4 (Samsorg-17)**	**T_5 (KSV-15)**
Maize	51.00	0.00	0.00	0.00	0.00
Sorghum	0.00	51.00	51.00	51.00	51.00
Palm oil	2.00	2.00	2.00	2.00	2.00
Soyabean cake	15.60	15.60	15.60	15.60	15.60
Groundnut cake	27.00	27.00	27.00	27.00	27.00
Limestone	0.50	0.50	0.50	0.50	0.50
Bone meal	3.00	3.00	3.00	3.00	3.00
Common salt	0.25	0.25	0.25	0.25	0.25
Vitamin premix*	0.30	0.30	0.30	0.30	0.30
Synthetic lysine	0.20	0.20	0.20	0.20	0.20
Synthetic methionine	0.15	0.15	0.15	0.15	0.15
Total	**100**	**100**	**100**	**100**	**100**
Calculated analysis					
Maxigrain® enzyme	0.00	0.01	0.01	0.01	0.01
ME (Kcal/kg)	2981	2952	2941	2989	2935
Crude protein (%)	23.05	23.17	23.49	23.36	23.57
Ether extract (%)	5.83	5.46	5.60	5.27	6.03
Crude fibre (%)	4.03	4.81	3.98	3.98	5.37
Calcium (%)	1.19	1.18	1.18	1.18	1.18

Available phosphorus (%)	0.58	0.59	0.59	0.59	0.59
Lysine (%)	1.20	1.25	1.24	1.26	1.24
Methionine (%)	0.50	0.48	0.48	0.48	0.48
Methionine + cysteine (%)	0.83	0.83	0.87	0.86	0.91
Cost/kg feed (N)	78.76	76.26	76.26	76.26	89.01

* Biomix broiler starter premix supplied the following per kg diet: Vit. A, 1,000 I.U; Vit. D_3, 2000 I.U, Vit. E, 5.0mg; Vit. K, 2mg; Vit. $B_1$1.8mg; VitB_2, 5.5mg; Niacin, 27.5mg; Pantothenic acid, 0.5mg Vit.B_6, 0.30mg; Vit. B_{12}, 0.015mg; Folic acid, 0.75mg; Biotin 0.6mg; Choline Chloride,3000mg; Copper,3mg; Iodine, 1mg; Iron,20 mg; Manganese, 40mg; Selenium,0.2mg; Zinc,30mg; Antioxidant, 1.25mg, ME= Metabolizable Energy.

Statistical Analysis: All data obtained from the study were subjected to analysis of variance (ANOVA) using general linear model procedure of SAS (2008). Significant levels of differences among treatment means were determined using the Tukey`s test (14) to separate the means.

RESULTS AND DISCUSSION

Table 2: Performance of Broiler Chickens Fed four *Sorghum bicolor* varieties Supplemented with Maxigrain® enzyme (5 days - 4weeks)

Parameters	Treatments					
	T1	T2	T3	T4	T5	SEM
Initial weight (g / bird)	102.20	102.20	102.20	102.20	102.20	102.20
Final weight (g / bird)	1111.11^{a}	1023.81^{b}	755.56^{c}	1068.26^{a}	800.00^{c}	32.44
Daily weight gain (g / bird)	36.03^{a}	32.91^{b}	23.33^{c}	34.50^{a}	24.92^{c}	1.16
Daily feed intake (g / bird)	63.13^{a}	60.32^{a}	55.99^{b}	60.52^{a}	53.01^{b}	1.78
Feed conversion ratio	1.75^{a}	1.83^{a}	2.41^{c}	1.75^{a}	1.99^{b}	0.06
Feed cost / kg gain (N)	138.09^{a}	139.81^{a}	184.04^{b}	133.71^{a}	176.83^{b}	4.73
Mortality (%)	0.00^{a}	2.22^{b}	0.00^{a}	0.00^{a}	0.00^{a}	0.99

$^{a,b,c.}$ Means on the same row with different superscripts are significantly (P<0.05) different. SEM = Standard error of means.

T1- Control 0% sorghum supplemented with 0% Maxigrain® enzyme, T2- Samsorg-14 supplemented with 0.01g/kg Maxigrain ® enzyme, T3- Samsorg-40 supplemented with 0.01g/kg Maxigrain ® enzyme, T4- Samsorg-17 supplemented with 0.01g/kg Maxigrain ® enzyme, T5- KSV-15 supplemented with 0.01g/kg Maxigrain ® enzyme.

Table 2 presents the effect of feeding broiler chicks four varieties of sorghum supplemented with 0.01 % Maxigrain ® enzyme. The results showed that there were significant (P<0.05) differences in all the growth parameters measured at the starter phase. The birds in T_1 (maize-based diet) and T_4 (Samsorg-17 supplemented with 0.01 % Maxigrain ® enzyme) had similar performance and were significantly (P<0.05)
better than other dietary treatments in terms of final body weight, daily weight gain, daily feed intake, feed conversion ratio and cost /kg gain. The feed intake and feed conversion ratio of birds in T_1 and T_4 were similar to that of T_2 (Samsorg-14 supplemented with 0.01 % Maxigrain ® enzyme), while birds in T_3 (Samsorg-40 supplemented with 0.01 % Maxigrain ® enzyme) and T_5- (KSV-15 supplemented with 0.01 % Maxigrain ® enzyme) had the least values. The result above agreed with the reports of (2) and (8) that Live-weight changes between birds fed maize-based diet and sorghum-based diet supplemented with enzyme were similar for broiler chicks at the starter phase.

Birds in T_1 had similar feed intake and feed conversion ratio with birds in T_2 and T_4 whose diets were supplemented with 0.01% Maxigrain® enzyme, this is in agreement with the findings of (12) and (2) that when birds were fed sorghum diets supplemented with multi-enzymes containing xylnase, phytase and protease, it reduced the negative effect of anti-nutritional factors such as phytate and polyphenols, thus enhancing feed

intake, nutrient digestibility and bird performance. It might also be due to high levels of anti-nutritional factors such as polyphenols, phytate and kafirins present in the sorghum grains (4); (16) which made it difficult to access by digestive proteases and the enzyme used due to γ-kafirins present in the grains (5). It might also be due to lack of tannase in the enzyme used.

Mortality was significantly ($P<0.05$) higher for birds in T_2 compared to birds fed other dietary treatments, this might be due to high oxalate present in the diet which could not be degraded by the enzyme used since it does not have the specific enzyme to target the substrate oxalate.

CONCLUSION

The replacement of Samsorg-17 at 100 % supplemented with Maxigrain ® enzyme at 0.01% for maize as an energy source did not compromise the growth performance of broiler chicks; in addition, the cost of production was reduced by 3.17 % compared to the maize-based diet.

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Effect of Moringa (*Moringa oleifera*) Leaf Meal on Feed Utilization and Growth of Broiler Chicken Fed Growers Mash

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Abstract: Poultry production is facing a challenge of increased cost of feed due to high prices of protein and energy sources which subsequently affect the profitability of the industry. This study was aimed at evaluating the growth performance of broiler chicken fed graded level of inexpensive and non-conventional *Moringa oleifera* leave meal (MLM) in commercial grower mash feed. The Moringa leaf was air dried and milled and added to the commercial grower mash at the level of 0%, 10%, 20% and 30% inclusion level per 5kg of grower mash. Diet 1 (control) contains the commercial starter mash. Fifty day-old broiler chickens were procured from day-old chicken market in Ibadan and grouped into five groups with 2 replicates per group. Birds were managed under the dip litter system for a period of 28 days. Weekly weight gain and feed intake were recorded throughout the period. Statistical analysis was done using SAS analytical package. The results showed that addition of MLM improved crude protein, crude fibre, ash, and dry matter contents of all the diets. Final weight gain increased with increased inclusion of MLM. Feed consumption was highest at 30% MLM inclusion level. Feed efficiency did not show any difference between diets. Increasing the levels of MLM up to 30% significantly reduced feed cost and increase profitability. It was therefore concluded that inclusion of MLM in grower mash feed at 30% inclusion level produced significant weight gain in broiler chicken with a reasonable reduction on the cost of feeding.

Keywords: *Moringa oleifera*, Grower Mash, Broiler, Economic Analysis, Profitability

DESCRIPTION OF PROBLEM

The rising cost of feeds and feedstuff in the livestock industry is a major source of concern for the industry and it has remained a serious obstacle to meeting animal protein in the developing countries like Nigeria. Cost of feeding has been estimated to account for up to 70% of the total cost of production in broiler production (1). Maize accounts for the largest proportion of about 50-55% of poultry diet (2) while protein source accounts for between 20 and 25% of poultry diet depending breed and age. The escalating rise in the cost of maize and other protein source used for broiler feed is as a result of unfavorable production conditions and the tough competition between man and other livestock species for these feed ingredients (3). In poultry production today, the cost of producing starter mash for broiler chicks is the most expensive followed by layer mash (for egg production) while the least cost is associated with the grower mash. The cost variation is basically as a result of energy and protein-based ingredient used for the feed composition. Production cost can, however, be highly reduced if grower mash, the cheapest of all feed category, could be fortified with inexpensive non-conventional feedstuff like *Moringa oleifera* leaf meal (MLM). *Moringa oleifera* is a widely grown tree crop in West, East, and South Africa and in tropical Asia (4). Leaves of Moringa tree are the preferred part for use in animal diets as leaf meal (5). Researchers have conducted studies on the effect of this leaf meal on the growth performance of layer chicks (6) and on broilers' performance (7,8). Yameogo et al. (9) reported that, on a dry matter basis, *Moringa oleifera* leaves contain 27.2% protein, 5.9% moisture, 17.1% fat, and 38.6% carbohydrates. Like it has been reported for most non-conventional feedstuffs, regarding anti-nutritional factors, Makkar and Becker (10) mentioned that the concentrations of anti-nutritional factors (tannins, trypsin and amylase inhibitors, lectins and cyanogenic glucosides, glucosinolates, and saponins) were either undetectable or negligible in moringa leaves, twigs, and stems. The aim of this study is to evaluate the growth performance of broiler chicken fed graded level of moringa leave meal in commercial grower mash feed.

MATERIALS AND METHODS

The study was carried out at the academic research farm of Aquatech College of Agriculture and Technology, Ibadan, Nigeria during the early dry season (October-November) of the year. The Commercial grower mash

(CGM) used for the study was sieve to remove larger particle which was further milled to enable the chicks consume the feed without any left over. The fresh *Moringa oleifera* leave used as additive in the feed was obtained from the Horticultural garden of Aquatech College of Agriculture and Technology, Ibadan. The leaves were air dried until crispy and milled for addition into the broiler diet according to the treatments. The Moringa Leaf Meal (MLM) was added to the grower mash at the rate of 10%, 20% and 30% of 5kg of commercial grower mash. Fifty day-old broiler chicken with an average weight of 45g were sourced from a commercial hatchery in Ibadan and were randomly distributed into five groups of 5 chicken per replicate and replicated once. Brooding was carried out using charcoal as a source of heat. The groups were labelled as treatment 1 (0% MLM/ Kg of CGM), treatment 2 (10% MLM/ Kg of CGM), treatment 3 (20% MLM/ Kg of CGM), treatment 4 (30% MLM/ Kg of CGM) and control (CBS). All vaccination schedules and management procedures were followed. Clean drinking water and feed were provided *ad libitum* to the chicken and the experiment lasted 28 days.

Weekly weight gain of the chicks was carried out with the aid of a sensitive weighing scale (accuracy of 0.05g). Feed consumption was determined by subtracting the weight of feed left over in the morning from the weight of feed given the previous morning. Feed Conversion Ratio (FCR) was calculated by dividing the feed intake by the weight gain (feed intake/weight gain). The Feed Efficiency (FE) which is the inverse of FCR was calculated by dividing the weight gain by feed intake. Average Daily Weight gain (ADG) was also calculated by subtracting the initial weight from the final weight gain and dividing by the number of days on the feed.

Data obtained were subjected to analysis of variance (ANOVA) using SAS software and mean were separated by Duncan multiple range test at $p<0.05$ significant level.

RESULTS AND DISCUSSIONS

The result of the proximate analysis of the experimental diets and the control diet (commercial broiler starter) are as shown in Table 1. The addition of Moringa Leave Meal (MLM) at varying levels increased the proximate contents of the experimental diet when compared to the commercial broiler starter (CBS) with respect to Crude Protein (CP). Melesse *et al*. (6) reported that use of MLM in the diet of Rhode Island Red chicks produced significant ($P < 0.05$) increase in feed and crude protein intake due to the presence of readily available protein in MLM, which is convenient for monogastric animals. However, higher values than the CBS were obtained from other constituents. The result showed the nutrient contribution of MLM was in line with the study of Yameogo *et al*. (9) who reported that, on a dry matter basis, Moringa oleifera leaves contained 27.2% protein, 5.9% moisture, 17.1% fat, and 38.6% carbohydrates.

Table 1: Composition of experimental diets and the control diet

Constituents	Control diet (CBS)	0% MLM/ Kg of CGM	10% MLM/ Kg of CGM	20% MLM/ Kg of CGM	30% MLM/ Kg of CGM
Crude Protein	20.89	14.77	17.97	18.04	18.97
Crude Fat	4.10	4.02	4.06	4.11	4.59
Crude Fibre	4.88	5.00	5.27	5.59	6.33
Ash	5.55	4.10	6.16	6.41	6.73
Dry matter	88.47	78.38	92.70	93.11	94.68

Table 2 presented the means for the weekly body weight gain, feed consumption and Feed Conversion Ratio (FCR). Final weights and Average daily weight gain obtained in the study were increasing as the level of MLM addition in the feed increases. The highest weight of 497.70g was recorded in MLM inclusion level of 30%. Total feed intake also increased with increasing level of MLM at 1747.20g, 1888.32g, 1952.72g and 1985.20g in 0%, 10%, 20% and 30% inclusion level respectively. This could be attributed to the protein content of the MLM where Mallese et al (6) concluded that inclusion of MLM in amounts of up to 6% in the diet of growing chicks to replace expensive conventional protein sources has no negative effects on the chicks. Kakengi et al. (11) also opined that addition of 10% and 20% Moringa oleifera leaf meal to the laying hen diet, as a substitute for sunflower seed meal, significantly ($P < 0.05$) increased feed intake and dry matter feed intake. Moringa leaf is usually considered as a source of plant protein with protein content ranging from 15% to more than 30% DM. The feed conversion ratio was better at 0% (4.32) inclusion level followed by 30%, 20%, and 10%. The results

of this study was in disagreement with the findings of Olugbemi et al. (8) where they found that an addition of 5% MLM to cassava-based broilers' diet (20% and 30%) had no significant (P > 0.05) effect on weight gain, feed conversion ratio, final body weight, and feed cost per kilogram of weight gain when compared to a diet free of cassava and free of MLM, a diet containing 20% cassava and 0% MLM, and a diet containing 30% cassava and 0% MLM.

Table 2: Mean separation for feed intake and growth performance

Parameters (g)	0% MLM/ Kg of CGM	10% MLM/ Kg of CGM	20% MLM/ Kg of CGM	30% MLM/ Kg of CGM
1 Day	40.10[a]	41.40[a]	42.90[a]	42.70[a]
7 Days	103.60[ab]	103.60[ab]	88.20[b]	120.40[a]
14 Days	133.70[b]	118.10[c]	128.5[b]	159.20[a]
21 Days	319.70[b]	314.20[b]	326.60[b]	356.20[a]
Final Weight (FW at 28 Days)	444.50[b]	464.50[ab]	484.00[a]	497.70[a]
Average Daily Weight Gain (ADG)	15.88[c]	16.58[b]	17.29[a]	17.78[a]
Total Weight Gain (TWG)	404.40 [b]	423.10 [ab]	441.10 [a]	455.00 [a]
Total Feed Consume (TFC)	1747.20	1888.32	1952.72	1985.20
Average Daily Feed Intake (ADI)	62.40	67.44	69.74	70.9
Feed Conversion Ratio (FCR)	4.32 [a]	4.46 [a]	4.43 [a]	4.36 [a]
Feed Efficiency (FE)	0.23	0.22	0.22	0.23
Mortality	0.00	0.10	0.00	0.00

Means with same letters are not significantly different (P>0.05).

Since this study was geared toward reduction of production cost in broiler production, a cost analysis of the experimental diet was done against the conventional broiler starter to determine the profitability as presented in Table 3. The economic benefit of using commercial broiler starter was still better with a net revenue of N314.3 compared to the experimental diets M(0), M(10%), M(20%) and M(30%) having a net revenue of N50.33, N133.40, N125.67 and N221.78 respectively. Although feed cost per bird was reduced, the weight gain in control diet compensated for the high feed cost. This was due to the varying level of protein content in the feeds. Zanu et al. (12) noticed that partial replacement of fish meal with MLM decreased the feed cost and also decreased the net revenue for broilers due to a reduction in weight gain. Also, Adeniji and Lawal (13) examined the economic benefit of MLM in the diet of grower rabbits to replace groundnut cake. They found that increasing the levels of MLM up to 100% replacement significantly (P<0.05) reduced feed cost. At levels of 60%, 80%, and 100%, replacement, a significant (P<0.05) reduction in the cost of feed consumed was recorded.

Table 3: Economic benefit of inclusion of MLM in grower mash for broilers

Parameter (NGN)	Control diet	MLM dietary levels			
	CBS	M (0%)	M (10%)	M (20%)	M (30%)
Feed cost/kg diet	156	120	120	120	120
Feed cost/ bird	309.70	209.67	226.60	234.33	238.22
Production cost/ bird at 4 weeks	585.70	449.67	466.6	474.33	478.22
Selling price/ bird	900	500	600	600	700
Net revenue/bird	314.3	50.33	133.40	125.67	221.78

CONCLUSION AND APPLICATION

The result of this experiment shows that inclusion of MLM to grower mash increased the protein level and subsequent effect on the growth performance of broilers. Treatment D with 30% inclusion of MLM to 5kg commercial grower mash produced the highest growth in broiler chicken. Regarding economic benefits, the levels of inclusion of MLM that can be expected to be cost-effective is 30% inclusion level. However, more research should be done on the effect of *Moringa oleifera* inclusion in poultry feed at above 30% inclusion level.

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Effects of Varied Feeding Frequencies on the Growth Performance and Carcass Characteristics of Growing Rabbits in Rainy Season

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Abstract: This study was carried out to assess the effects of varied feeding frequencies on the growth performance and carcass characteristics of growing rabbits in rainy season. Thirty (30) grower rabbits of mixed breeds and sexes with an average weight of 820g were used for the study. Individual animals were weighed and randomly allotted to three treatments with ten replicates per treatment in a completely randomized design (CRD). The animals were fed conventional rabbit feed. Animals in Treatment 1, 2 and 3 were fed once, twice and thrice daily respectively. The same quantity of feed was fed daily to the rabbits but was divided according to the number of times they were fed. Clean water was provided at feeding period. The experiment lasted for 8 weeks between June and August. Result shows that there was no significant difference ($P>0.05$) in the mean value of initial, total and average body weights of the experimental animals. However, total feed consumed was significantly higher ($P<0.05$) in treatment 1 than in other treatments. Final live and slaughter weights were significantly higher ($P<0.05$) in treatments 2 and 3. From the result of the study, it is concluded that during rainy season, rabbits should be fed their ration twice daily (i.e. morning and evening) instead of once daily. This is because of the significantly higher ($P<0.05$) final live weight and slaughter weight as well as the higher numerical value of the total weight gain and low feed intake recorded from this study.

Keywords: Carcass Attributes, Feeding frequencies, Growing Rabbits, Growth performance, Rainy Season

INTRODUCTION

In order to tackle the problem of inadequate animal protein consumption among people in developing countries, rearing of micro livestock such as rabbit is a possible solution. Olabanji *et al*., (2007) noted that rabbit meat is white meat with excellent protein quality that is better compared to other meats, low in total as well as saturated fat and cholesterol. Increased rabbit production is one way of meeting the animal protein requirements of the Nigerian populace (Iyeghe-Erakpotobor *et al*., 2002). Increased production can be ensured through proper nutrition and feeding.

A number of environmental and climatological factors affect the performance of livestock positively or otherwise. For instance, environmental factors such as seasons of the year and temperature exerts some influence on feed intake (Kubena *et al.,* 1972) and growth of the livestock.

Regulating feed consumption in some micro-livestock, rather than feeding *ad libitum,* has been reported in some studies to improve the efficiency of feed utilization and ultimately lead to reduction in feed and production cost thereby producing lean quality meat at cheaper prices (Mahmud *et al.,* 2008 and Jalal and Zakaria 2012). It is therefore worthy to study the growth implication on rabbits when they are fed their ration at varying frequencies, especially during the rainy season when it is widely reported that animals consume more feed (Bhatt *et al.,* 2002; Teixeira *et al.* 2013).

This study therefore aimed at evaluating the effect of feeding frequencies on growth performance and carcass characteristics of weaner rabbits during rainy season.

MATERIALS AND METHOD

The research was carried out in the Rabbitry unit of the Teaching and Research farm of Adeyemi College of Education Ondo, Ondo State Nigeria. Thirty (30) weaner rabbits of mixed breed and sexes were used for the

study. Individual animals were weighed and randomly allocated into three (3) treatment groups and replicated ten (10) times each. The animals were fed conventional rabbit feed. Animals in Treatment group 1 were fed once daily in the morning, Treatment group 2 were fed twice daily (i.e. morning and evening) while Treatment group 3 were fed thrice daily (i.e. morning, afternoon and evening). The same quantity of feed was fed daily to the experimental animals but was divided according to the number of times they were fed. Clean water was provided at feeding periods. The animals were allowed two weeks for adaption and the experiment lasted for 8 weeks between June and August in 2018.

Data on daily feed intake was collected by subtracting the weight of left-over feed from that of feed given. Weekly weight gains and final weight gain was recorded. Data on carcass and organ attributes was collected after slaughtering the animals. Parameters measured included slaughter weight, eviscerated weight, weight of thigh, loin ribs, neck shoulder, head, limbs, tail and pelt. Parameters measured for organ attributes include weight of livers, kidney, lungs and trachea, pancreas, gut with content, kidney fat and heart. Data collected were analysed using Analysis of Variance (ANOVA) and means were separated using Duncan's Multiple Range Test (DMRT) of the Statistical Package for Social Sciences (SPSS) version 23.

RESULTS

Table 1: Effects of Varied Feeding Frequencies on Growth Performance of Grower Rabbit During Rainy Season

Parameters	T1	T2	T3	SEM	SIG
Initial body weight (g)	826.67	813.33	820.00	5.77	0.70
Final body weight (g)	1340.00	1500.00	1460.00	43.56	0.34
Total weight gain (g)	533.33	700.00	560.00	35.78	0.08
Average weight gain (g)	9.64	12.44	11.79	0.77	0.34
Total feed consumed (g)	3090.00^{a}	1536.67^{b}	1063.33^{c}	306.47	0.42
Average feed consumed (g)	54.88^{a}	27.44^{b}	18.99^{c}	5.42	0.59
Feed conversion Ratio	5.99^{a}	2.02^{b}	1.67^{b}	0.73	0.09

^{abc} *Mean values carrying different superscripts along the same row differ significantly (P>0.05)*

SEM: Standard Error of the Mean

The table above indicates that there is no significant difference (P>0.05) in the mean values of initial body weight, final body weight, total weight gain and the average weight gain of the experimental animals. However, on the average feed consumption/consumed, T_1 (54.88kg) is significantly higher (P<0.05) than T_2 (2.02kg) and T_2 (2.02kg) than T_3 (18.99kg). For feed conversion ratio, T_1 (5.99kg) is significantly higher (P<0.05) than T_2 (2.02kg) and T_3 (1.67kg) respectively.

Table 2: Effects of Varied Feeding Frequencies on the Carcass Characteristic Grower Rabbit During Rainy Season

Parameters (g)	T1	T2	T3	SEM	SIG
Final live weight	1.28^{b}	1.45^{a}	1.52^{a}	0.04	0.69
Slaughter weight	0.77^{b}	1.05^{a}	1.01^{a}	0.05	0.68
Dressed weight	587.70	505.40	559.23	17.92	0.68
Eviscerated weight	481.93	452.73	473.50	6.76	0.24
Trunk weight	289.33	252.20	294.10	10.31	0.06
Head	113.07^{a}	90.73^{c}	88.00^{b}	3.31	0.10
Limb	94.13^{a}	77.40^{c}	88.00^{b}	2.48	0.18
Tail	2.03^{c}	4.77^{a}	3.13^{b}	4.18	0.08
Neck	20.53	19.43	20.73	1.09	0.09
Thigh	200.67^{a}	166.93^{c}	186.23^{b}	5.10	0.83
Lion	178.67	167.93	177.57	3.55	0.29
Forequarter	279.60^{a}	241.50^{b}	272.47^{a}	7.10	0.22

Shoulder	90.40[a]	87.53[b]	75.11[b]	3.55	0.43
Carcass Length	29.00	27.33	27.67	0.53	0.18

[abc] *Mean values carrying different superscripts along the same row differ significantly (P>0.05)*
SEM: Standard Error of the Mean

The result on the table 2 above shows that there is significant difference (P<0.05) in the final live weight of the experimental animals. T_3 (1.52kg) and T_2 (1.47kg) are significantly higher (P<0.05) than the animals in T_1 (1.28kg). Likewise, the slaughter weight of the experimental animals was significantly different (P<0.05) with animals in T_2 (1.05kg) and T_3 (1.01kg) been significantly higher (P<0.05) than animals in T_1 (0.77kig). For the weight of head, the mean value in T_1 (113.07kg) is significantly higher (P<0.05) than that of other treatments while T_2 (90.73kg) been significantly lowest (P<0.05). The result of the limbs follows similar pattern. The forequarter of the animals in T_1 (279.60kg) and T_3 (272.47kg) are significantly higher (P<0.05) than animals in T_2 (241.50kg). The weight of the shoulder the experimental animals reveal that T_1 (90.400kg) are significantly higher (P<0.05) than T_2 (87.53kg) and T_3 (75.11kg). However, the dressed weight, eviscerated weight, truck weight, neck, lion and the carcass length show no significant difference (P>0.05) among the treatments.

DISCUSSION

The reduced feed intake with increase in feeding frequencies observed in this study is in line with the previous works on broiler chickens (Oyedeji and Atteh, 2005; Benyi *et al.*, 2010 and Lanhui *et al.*, 2011) and calves (van den Borne, 2006). This is however contrary to the reports of Jang *et al.* (2009) and Jalal and Zakaria, (2012) who recorded increase in feed intake of birds restricted at 70 and 85% of *ad libitum* feeding and higher feed intake in feed restriction groups than the control which were fed *ad libitum.* Significant (P<0.0) reduction in feed consumed among rabbits of Treatments 2 and 3 could be ascribed to the limited feed available to the animals while higher feed consumption among rabbits of Treatment 1 could be related to the availability of excess feed. The similar (P>0.05) weight gain of rabbits in Treatments 1, 2 and 3 of this study is in line with the previous works by Oyedeji and Atteh (2005) who reported no significant (P>0.05) difference in the weight gain of broiler chickens subjected to various feeding manipulations but differs from the report of Jalal and Zakaria, (2012) who reported higher (P<0.01) weight gain in broiler chickens fed *ad libitum.* Higher feed conversion ratio of rabbits in Treatment 1 is in agreement with the reports that broiler chickens have higher feed conversion ratio when fed *ad libitum* (Jang *et al*., 2009; Khetani *et al*., 2009) and in pigs (Campbell *et al*., 1983).

Final live weight and slaughter weight in rabbits fed twice and three times daily were higher (P<0.05) than those of animals fed *ad libitum*. This contradicts the reports of Benyi *et al.* (2011) and Zhan *et al.* (2007) who recorded lower weight gains and market weights in feed-restricted versus *ad libitum* fed birds but congruent with the findings of Mahmood *et al.* (2005) and Mahmud *et al.* (2008). The similar dressed weight, eviscerated weight, weights of trunk neck and loin as well as carcass length recorded in this study is in line with the report of Latorre *et al.* (2008).

CONCLUSION

From the result of the study, it is concluded that during rainy season, rabbits should be fed their ration twice daily (i.e. morning and evening) instead of once daily. This is because of the significantly higher (P<0.05) final live weight and slaughter weight as well as the higher numerical value of the total weight gain and low feed intake recorded from this study.

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Feeding value of defatted cashew kernel reject as protein source in broiler diets

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Abstract: This study was carried out to determine chemical composition of two grades of defatted cashew kernel (DCK) and assess the performance characteristics of broiler chickens fed diets containing the two grades of the cake. The study used 210-day old Arbor Acre broiler chicks which were stabilized on commercial diets (23% CP and 2900kcal/kgME) for 2 weeks before introducing them to the seven experimental diets. The experiment was laid out in a 2 x 3 factorial arrangement which consisted of a control without DCK, Treatments 2, 3, 4 and 5, 6, 7consisted of 33.33%, 66.67% and 100% replacement of groundnut cake (GNC) with grade I and grade II DCK,.. The study lasted for a period of eight weeks. Data were collected on body weight gain (BWG), Total feed intake (TFI),Feed conversion ratio (FCR) and Feed cost. The results of proximate composition of DCKshowed nosubstantial difference in Crude Fibre, Crude Protein and Gross Energy contents compareto GNC. The performance traits measured in terms of BWG, TFI and FCR were significantly different ($P<0.05$) across the treatments with birds on DCK showing superior performance than birds on the control diet, with 17.72% and 13.35% higher BWG. Fat deposition was notably ($P<0.05$) higher in birds on DCK diets. Economically, the use of DCK reduced the heightened cost of production by 9.1%. It was concluded that grade I DCK could completely and favourablyreplace GNC in diets of chicken in in order to improve growth performance, feed efficiencyand to reduce the cost of feed per unit egg.

Keywords: Defatted cashew kernel, chemical constituent, feeding value, performance, broilers

INTRODUCTION

In Nigeria, the feeding potentials of cashew kernel reject meal CKRM, as animal feed ingredient has been grossly untapped. Industrially, about 30-35% cashew kernel is often discarded either as broken or scorched kernels during processing for failure to meet export or local requirement grade. Nevertheless, these rejects have high nutritional profiles for use as plant protein source for animals and are considerably available to support the expensive conventional plant protein. Scanty works have been reported on its feeding potential for monogastric animals (Ojewola*et al.,* 2004*;* Akande *et al.,* 2015*;* Carlose *et al.,*2015*).*

Cashew ranks third in world production of edible nuts with the estimated global production of 4,439,960 metric tons and Nigeria- thehighest producer in Africa-ranked third on a global scale (FAO2013). FAO records also show that both production and yield of groundnut, have continue to drop since 2006 in Nigeria whereas cashew nut has continued to enjoy a consistent rise in production.

The growing interest in cashew may be partly ascribed to the supposed dual role of the kennel which found application in the confectionery industry as an important source of lipids and protein (Yahaya, *et al* 2012). The nut yields two important oil; the edible Cashew kernel oil (Achal, 2002) and Cashew nut shell liquid with wide industrial applications (Ojeh 1985). Now, the defatted cake is being considered as livestock feed. Different grades of cashew kernel reject are industrially accessible however; these grades have not been differently tested to indicate their suitability in diets of broiler chickens. This study intends to compare two different grades as replacement for groundnut cake.

Experimental Station: The experiment was carried out at the Poultry Unit, Teaching and Research Farm, Obafemi Awolowo University Ile- Ife, Osun State, Nigeria.

Collection and Processing of Test Ingredients: One hundred and forty kilogram each of grade I and grade II cashew kernel reject were purchased from Vallency Cashew Processing LTD Ibafo, Ogun State. Both grades were milled separately using a milling machine. The milled cashew kernel rejects were thereafter loaded into muslin cloth and then mechanically pressed using an oil screw press machine for 6hours per loading to facilitate oil extraction. Both oil and cake were preserved for subsequent use and analysis.

Experimental Animals and Management: A total of 210-day old Abor Acre broiler chicks were procured from a reputable farm for this study. The chicks were stabilized for 2 weeks on commercial diets 23%CP and 3000kcal/kg. All routine vaccination and necessary medications were applied. Birds were weighed and randomly allotted to the 7 dietary treatments. Feed and water were offered *ad libitum* for six weeks in a deep litter house.

Experimental Diets: Seven experimental diets were formulated for the study. The gross composition of experimental diets for broiler starter and finisher phase are as shown in Table 1 below.

Table 1: Experimental Diets for Broiler Finisher

DCRM	**Control**	**Grade I**	**Grade I**	**Grade I**	**Grade II**	**Grade II**	**Grade II**
Level of replacement	**0%**	**33.33%**	**66.67%**	**100%**	**33.33%**	**66.67%**	**100%**
Maize	60.00	57.50	55.00	53.00	57.50	55.00	53.00
Cashew kernel cake	-	12.50	25.00	37.00	12.50	25.00	37.00
Ground nut cake	30.00	20.00	10.00	0.00	20.00	10.00	0.00
Fixed Ingredient	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Analysis %							
Crud Protein	21.70	21.50	21.35	21.20	21.50	21.35	21.20
ME(kcal/KG)	3005.81	3012.82	3004.95	3000.31	3012.82	3004.95	3000.31
Calcium	1.24	1.35	1.28	1.26	1.35	1.28	1.26
Phosphorus	0.45	0.48	0.44	0.41	0.48	0.44	0.41
Lysine	0.90	0.77	0.68	1.63	0.77	0.68	1.63
Methionine	0.59	0.55	0.49	0.44	0.55	0.49	0.44
Crude Fibre	3.11	2.51	1.98	1.52	2.51	1.98	1.52

ME= Metabolizable Energy, DCRM –defatted cashew reject meal, FI (fishmeal=2%, wheat offal=2%, palm kernel cake=2%, bone meal=2%,oyster shell=1%, Meth.=0.25%, Lys.=0.2%, Prem.=0.25%, Salt=0.3%),

Data Collection: On weekly basis, measured feed was given to experimental birds and at the end of each week, feed remnant was weighed back. Feed intake was calculated by the difference between the measured feed at the beginning of the week and the remnant at the end of the week. Records of weight gain, feed intake, and feed to weight gain ratio were kept on treatment basis. The economic implication was determined by current prices of feed ingredients

Statistical analysis: Data collected were subjected to analysis of variance using the procedure of SAS (2009) while significant differences in means were separated using Duncan's multiple range tests.

RESULTS AND DISCUSSION

Chemical constituentsof the Two Grades of Defatted Cashew Kernel: The proximate composition of both grades of defatted cashew kernel rejects meal and groundnut cake is as shown in Table 2. The results of chemical screening of both grades have shown that their nutrient profilesarequite suitable, and comparable to groundnut cake and were adequate to meet the requirement of broilers as demonstrated in the performance traits. However, higher ether extract showed that extraction method of oil from kernel need to be improved upon. Notably, the higher crude fibre in grade II may not support adequate utilization by young chicks. The determined nutrient content of the DCRM obtained in this study was slightly at variance with the findings of Fetuga*et al*., (1974) but

closely related to the findings of Ojewola*et al*., (2004). Various factors ranging from the processing method, length of storage and varietaldifference could be responsible for such variation.

Performance of Broiler Chicken Fed Two Grades of Defatted cashew kernel (DCK): Table 3 showed the performance traits of broiler chickens fed two grades of DCK at varying inclusion levels. All performance traits measured showed significant differences (P<0.05) across the treatments. Nevertheless, the results reveal that there was no significant interaction effect in terms of inclusion level and grades of DCK across all the treatments. The BWG of birds on both grade I and II DCK had superior performance than birds on the control diet with 17.72% and 13.35% increase, respectively. Conversely, an earlier experiment involving broiler chickens fed different levels of reject cashew kernels showed that there were no significant differences (P > 0.05) across treatments with respect to all the parameters tested except in the cost of feeding (Oddoye, *et al.,* (2012).Feed conversion was significantly better in birds fed grade I DCK compared to birds on grade 2 DCK and control diets. This was reflected in better utilization of DCRM than in birds fed the control diet. In lieu of the total feed intake TFI, it was observed that inclusion levels of DCK in the diets did not follow a definite pattern, meaning that different inclusion levels of DCK had no deleterious effect on performance traits of birds. No mortality was recorded throughout the experimental period.

Table 2: Performance of broilers fed two grades of DCK at varying inclusion levels.

Parameter	**Control**	**Grade I**			**Grade II**						
Treatment	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**		**P-Value**		
Replacement	0%	33.33%	66.67%	100%	33.33%	66.67%	100%	SEM	G	L	G x L
IBW(g/bird)	236.11	236.11	238.89	230.56	238.89	230.50	233.33	1.24	0.86	0.25	0.16
FBW(g/bird)	2026.50	2280.50	2431.00	2521.90	2311.00	2339.70	2251.60	37.56	0.01	0.05	0.25
BWG(g/b)	1790.40	2044.40	2192.10	2291.30	2072.10	2109.20	2017.40	37.95	0.01	0.04	0.25
TFI(g)	4779.80	4765.30	4942.60	4977.60	4923.90	5217.90	5173.60	44.14	0.04	0.02	0.76
DFI(g/b/d)	113.81	113.46	117.68	118.51	117.24	124.24	123.18	1.05	0.04	0.02	0.76
FCR	2.67	2.35	2.26	2.17	2.38	2.48	2.59	0.04	0.01	0.05	0.21
Abd. fat	0.62	1.06	1.74	2.05	1.17	1.88	2.27	0.14	0.01	0.03	0.04
Mortality	0	0	0	0	0	0	0	-	-	-	-

IBW-Initial Body Weight, FBW-Final Body Weight, BWG-Body Weight Gain, Total Feed Intake, DFI-Daily Feed Intake, FCR-Feed Conversion Ratio. G= grade, L= level G x L = grade and level interaction SEM: Standard Error of Means; a,b,c: Means within the same row with different superscripts differs significantly(p<0.05)

Cost benefits of using DCK in diets of broilers: As at the time of this study, cost per kilogram of GNC, DCK grade I and grade II costs ₦ 180, ₦100 and ₦85.719 (Nigeria Naira), respectively. From the Table, cost of feed per kilogram for diets containing both grades of DCKweresubstantially lower with 12.43% and 15.83% reduction than that of the control diets. To produce 1 ton of broiler feed using GNC and DCK, the farmer will expend about ₦185,000 and ₦165,000 respectively. This implies that the farmer will be able to save as much as ₦20,000 from every tonnage of feed produced using DCK. Farmers will be able to cut about 9.1% cost with the use of DCK in place of GNC in broiler diet.

Table 3: Economic implications of feeding broilers with diets containing two grades of DCK

Parameters	**Control**	**Grade I**	**Grade II**	**SEM**	**P-Value**
BWG(g/bird)	1790.42^{b}	2175.94^{a}	2066.85^{a}	37.95	0.01
TFI, kg	4.78^{b}	4.91^{b}	5.11^{a}	44.14	0.04
Cost/kg of test ingredients (₦)	180.00^{a}	100.00^{b}	85.71^{c}	20.81	0.04

Cost of feed / kg (₦)	185.64[a]	165.11[b]	160.21[b]	25.99	0.05
Cost of feed consumed / bird (₦)	884.30[a]	810.69[c]	818.67[b]	15.88	0.04

a,b,c: Means within the same row with different superscripts differs significantly($p<0.05$)

CONCLUSION

Defatted cashew kernel was nutritionally superior to GNC. It adequately supportrequirement of broiler chickens for growth at lower cost. Edible Oil obtained in addition to oil cake for animal feed is suggestive of a prospective enterprise in cashew kernel processing.

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Egg Qualities of Laying Hens Fed Diets Supplemented with Varying Levels of Copper (II) Oxide

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Abstract: This study aimed to determine the egg qualities of layers fed diets supplemented with varying levels of Copper (II) oxide (CuO). One hundred and sixty Harco black pullets (15 weeks of age) were purchased from a reputable farm and acclimatized for 2 weeks in battery cages and afterwards divided into four treatments of dietary CuO supplementation (0, 100, 200 and 300 mg CuO per kg diet) for 8 weeks. Each treatment consisted of 40 birds which were further sub-divided into four replicates of 10 birds each. Afterwards, three eggs per replicate were collected for internal and external egg qualities analysis. Data obtained were subjected to ANOVA appropriate for a Completely Randomized Design. Inclusion of dietary CuO had no significant ($P>0.05$) effect on all egg qualities measured except the shell thickness and albumen height. Comparable means (0.29 mm, respectively) for shell thickness recorded at 0 and 100 mg CuO supplementation were significantly ($P<0.05$) higher than 0.26 mm recorded at 300 mg CuO supplementation. In addition, statistically similar means for albumen height (0.71, 0.68 and 0.72 mm) were observed at 100, 200 and 300 mg CuO, respectively which were significantly lower than 1.20 mm recorded in the control. Hence, the inclusion of CuO in layers diets led to the reduction of egg shell thickness and albumen height.

Keywords: Copper (II) oxide, Egg, Layering hens, Quality, Varying levels.

INTRODUCTION

Copper is an essential trace mineral that can be added to poultry diets using mineral premixes and other organic sources. Dietary copper when ingested is stored in the liver and binds to metallothionein for improved cellular detoxification in livestock (1). Over the years, several authors have stressed the importance of trace elements on the reproductive performance of laying birds as well as the quality of produce with focus on the effects of both the element's deficiency and surplus (2). The deficiency of copper in hens contributes to several problems such as reduction in feed intake, decreased egg production, worsened quality of eggshells and increased embryonic mortality (3; 4; 5). This has led to the maximum tolerable level of 300 mg Copper per kg of poultry diet being set by the National Research Council (6). However, dearth information exists on the attending effect of copper supplementation on egg quality.

Hence, this study was aimed to investigate the internal and external quality of layers fed varying levels of dietary copper (II) oxide.

MATERIALS AND METHODS

Experimental site: The experiment was carried out at the Poultry Unit of the Teaching and Research Farms of the Federal University of Technology Akure, Ondo State, Nigeria.

Experimental birds and management: A total number of one hundred and sixty Harco black pullets (15 weeks of age) were purchased from a reputable farm in Akure, Ondo State, Nigeria. The birds were acclimatized for 2 weeks in battery cages and afterwards divided into four experimental treatments of dietary copper (II) oxide supplementation (0, 100, 200 and 300 mg CuO per kg diet). Each treatment consisted of 40 birds which were further sub-divided into four replicates of 10 birds each. The birds were fed dietary copper (II) oxide for 8 weeks. Afterwards at age 32 weeks, three eggs per replicate were collected once a week for internal and external egg

qualities analysis. Birds were supplied water and feed *ad libitum.* The composition of experimental diet is presented in Table 1. Also, medications and routine vaccination were given to the birds as at and when due.

Table 1: Composition of Experimental Diet

Feed ingredient	Quantity (%)
Maize	49.50
Soyabean meal	22.70
Wheat offal	10.50
Palm kernel meal	5.00
Bone meal	2.00
Limestone	9.33
Methionine	0.25
Lysine	0.20
Layers' premix	0.25
Salt	0.27
TOTAL	**100.00**
Calculated analysis	
Crude protein (%)	16.89
Metabolisable Energy (kcal/kg)	2616.84
Crude fibre (%)	3.98
Calcium	4.06
Phosphorus	0.45
Lysine	1.01
Methionine	0.45

Data Collection

External egg qualities: Egg weight was measured using Mettler top-loading sensitive scale; egg length and width of each egg was evaluated using venier callipers. While the width of each of the eggs was determined by measuring the distance between two ends of the egg at the widest cross-sectional region using venier calipers, the length was measured as the distance between the broad and narrow ends of the eggs.

The thickness of individually air-dried shell was measured to the nearest 0.01 mm using a digital micrometer screw gauge; the shell weight was evaluated by air drying the eggs in the crates and the relative shell weights were calculated by relating the weight of shell to the weight of the egg.

Internal egg qualities: The albumen and yolk height: the eggs were determined by gently breaking the eggs and the maximum albumen and yolk height measured with tripod spherometer; the albumen weight was determined by calculating the difference between the egg weight and the sum of weight of yolk and dry egg shell expressed as a percentage of the whole egg. The yolk weight was measured using Mettler top loading weighing balance

Statistical analysis: Data obtained were subjected to Analysis of Variance (ANOVA) appropriate for a Completely Randomized Design, using SAS 2008 (version 9.2 version). Significant differences among treatment means were separated using Duncan's Multiple Range Test as contained in the same package.

RESULTS AND DISCUSSION

Table 2 and 3 shows the external and internal egg qualities of laying hens fed diet supplemented with varying levels of Copper (II) oxide. The inclusion level of dietary CuO had no significant ($p>0.05$) effect on all egg external qualities measured except the shell thickness. Comparable means (0.29 mm, respectively) for shell thickness were recorded at 0 and 100 mg CuO which were significantly ($P<0.05$) higher than 0.26 mm recorded at 300 mg CuO inclusion. This agrees with the report of (7) that the egg shell thickness decreased significantly ($P<0.05$) with copper supplementation in diet. Also, (8) and (9) observed reduction in egg shell thickness with

increasing dietary copper supplementation in hens' diet. The reduction in shell thickness could be attributed to less nutrient retention and nutrient availability through the intestines during shell formation. In addition, the effects of CuO supplementation on albumen height differ significantly (P<0.05) with statistically similar means (0.71, 0.68 and 0.72mm) observed at 100, 200 and 300 mg CuO, respectively which were significantly lower than 1.20 mm recorded in the control. This is in line with the findings of (10) and (11) that reported significant decrease in albumen height of eggs from laying hens fed diets supplemented with varying levels of Copper.

Table 2.0: External egg qualities of laying hens fed diet supplemented with copper oxide

	Level of Dietary Copper (mg)			
Parameters	**0**	**100**	**200**	**300**
Egg weight (g)	51.51±0.95	52.13±0.70	50.90±0.75	51.51±0.64
Egg length (mm)	4.04±0.06	4.12±0.05	4.08±0.05	4.01±0.04
Egg width (mm)	2.86±0.05	2.82±0.05	2.78±0.04	2.82±0.04
Shell weight (g)	4.80±0.15	4.76±0.08	4.67±0.09	4.90±0.09
Shell membrane (g)	1.06±0.04	1.07±0.04	1.01±0.03	1.00±0.03
Shell thickness (mm)	$0.29±0.01^{a}$	$0.29±0.01^{a}$	$0.28±0.01^{ab}$	$0.26±0.00^{b}$
Shell+Membrane (g)	5.87±0.17	5.83±0.10	5.68±0.11	5.90±0.08

Mean ± standard error ab: Means on same row with different superscripts differ significantly (P<0.05)

Table 3.0: Internal egg qualities of laying hens fed diet supplemented with copper oxide

	Level of Dietary Copper (mg)			
Parameters	**0**	**100**	**200**	**300**
Egg Weight (g)	51.51±0.95	52.13±0.70	50.90±0.75	51.51±0.64
Albumen Height (mm)	$1.20±0.50^{a}$	$0.71±0.02^{b}$	$0.68±0.02^{b}$	$0.72±0.02^{b}$
Albumen Weight (g)	12.70±1.01	14.39±0.60	13.72±0.79	13.54±0.63
Albumen Length (mm)	6.66±0.33	6.61±0.10	6.73±0.13	6.73±0.12
Yolk Height (mm)	2.18±0.52	1.76±0.03	1.79±0.02	1.76±0.03
Yolk Weight (g)	12.38±0.49	12.87±0.28	12.04±0.27	12.80±0.14
Yolk Length (mm)	2.75±0.14	2.92±0.06	2.88±0.04	2.93±0.03
Yolk Index (mm)	0.59±0.02	0.61±0.02	0.62±0.01	0.60±0.01

Mean ± standard error ab: Means on same row with different superscripts differ significantly (P<0.05)

CONCLUSION

From this study, the inclusion of high Copper (II) Oxide in layers diets resulted in the reduction of egg shell thickness and albumen height which may invariably affect hatchability, transportation and acceptability of the eggs by consumers.

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Influence of raw and processed sesame seed meals on growth performance of broiler chickens

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Abstract: One hundred and ninety-five (195) day old broiler chicks (Arbor Acre) were used to determine the effect of substituting soybean meal with raw and differently processed sesame seed meals (SSM) on growth performance of broiler chickens. The birds were fed five different diets with soybean meal (SBM) substituted with raw- (T2), cooked- (T3), germinated- (T4) and germinated cum cooked- sesame seed meal (T5). The raw and processed sesame seed meals were incorporated at 50% of SBM of the control diet (T1). Data collected were on the proximate composition of raw and processed sesame seed meals, initial and final body weight, feed intake, weight gain and feed conversion ratio. Data collected were analysed using One Way Analysis of Variance (ANOVA). The proximate composition of differently processed sesame seed meal showed that processing method reduced crude protein content which ranged from 20.4% to 21.2% versus 22.5% in the raw sesame seed meal. Processing by germination cum cooking slightly (P=0.011) improved final body weight (FBW) and weight gain (WG) of broiler chickens when compared to those fed raw SSM diet (1237.5g FBW, 1164.1g WG in germinated cum cooked SSM group vs 997.2 FBW, 947.2g WG in the raw SSM). However, chickens fed control diet had the highest FBW (1455g) and WG (1401.6g). It was concluded that germinated cum cooked sesame seed meal can effectively replace soybean meal at 50% in broilers diet.

Keywords: Broiler, Soybean meal, Sesame seed meal, Growth performance, andProximate composition.

INTRODUCTION

The increasing cost of feed resources in livestock production has been identified as a serious impediment to meeting the demand for animal protein particularly in developing countries (Adejinmi, *et al*., 2000). However, the ever-increasing cost of poultry feeds with concomitant increase in cost of poultry products (meat and eggs) make it necessary to explore the use of alternative feed ingredients that are cheaper, locally available and of low human preference (Agbede*et al*., 2002; Tuleun*et al*., 2009). Poultry production relies mainly on the expensive maize and soybean as the major source of energy and protein respectively. Cheaper and available feedstuff may be considered as a replacement for expensive feed resources. Sesame (*Sesamumindicum L*) otherwise known as benniseed is a drought tolerant crop adapted to many soils (Ram *et al*., 1990). Seasame seed is rich protein and minerals like potassium, phosphorous, magnesium calcium and sodium. Sesame has a crude protein content that ranges between 18-25% (Bonchani*et al*., 2010; Nzikou*et al*., 2009; Olomu, 2011). The amino acid composition of the protein is similar to that of soybean meal with the exception of lower lysine (Mamputu and Buhr, 1991) and higher methionine in sesame (Olomu, 1995; Dipasa, 2003). Sesame seed meal has been considered a viable substitute for soybean meal in feeding poultry. The impending difficulty to the use of sesame seed meal is the presence of anti nutritional factors (tannins, phytic acid, and oxalates). The ingestion of these anti nutrients could be deleterious to performance and health status of the birds. However, their effects can be mitigated by using one or a combination of different processing techniques. In the present study, an attempt was made at evaluating effects of cooking, germination and using the combination of the two earlier mentioned methods on growth performance of broiler chickens fed diets containing raw and processed sesame seed meals at 50 percent replacement for soybean meal in the control diet.

MATERIALS AND METHODS

Experimental site: The experiment was conducted at the Teaching and Research Farms, LadokeAkintola University of Technology, Ogbomoso, Oyo state, Nigeria.

Source of sesame seed: Sesame seeds were purchased from a local market inKogi State. The processing methods used were cooking, germinated and germinated cum cooking. Furthermore, the method of Makinde and Akinoso (2013) was adopted for cooking. The idea of germination was first use in the present study.

Experimental animals and management: 195 broiler chicks (Arbor Acre) were used for the study, the birds were randomly divided into 5 treatment groups of 39 birds per treatment. Each treatment was replicated thrice at 13 birds per replicate. Routine management, vaccination and medication were observed throughout the experiment.

Formulation of Experimental Diets: The experimental diets were Control (T1, which was corn-soybean meal-based diet), roasted RSSM (T2), cooked CSSM (T3), germinated GSSM (T4) andgerminated cum cooked GCSSM (T5). Feed and water were supplied *ad libitum*. Soybean meal was replaced at 50% in the raw and processed sesame seed meals. The ingredients composition of broiler starter diets is shown in Table 1. The finisher diets contained 44% maize, 28% SBM (Control)[while those of raw and processed SSM were at 14%], 20.65% corn bran, 4.1% fishmeal (72%CP), 1.1% bone meal, 1.5% limestone, 0.25% salt, 0.25% Vitamin premix and 0.15% methionine (only for Control) . These diets contained 2901.29 to 3321.43 ME kcal/kg and 17.99 to 20.94% CP.

Table 1: Gross composition of broiler starter diets

Ingredients	**T1 Control**	**T2 (RSSM)**	**T3 (CSSM)**	**T4 (GSSM)**	**T5 (GCSSM)**
Maize	59.20	59.20	59.20	59.20	59.20
Soybean meal	32.00	16.00	16.00	16.00	16.00
Sesame seed meal	0	16.00	16.00	16.00	16.00
Corn barn	1.15	1.30	1.30	1.30	1.30
Fixed ingredients*	7.50	7.50	7.50	7.50	7.50
Methionine	0.15	0	0	0	0
Total	100	100	100	100	100
Calculated Analysis					
Energy (MEKcal/kg)	3055.28	3507.14	3534.90	3534.90	3534.90
Crude Protein (%)	22.13	19.66	18.75	18.75	18.75

*Fixed ingredients: fishmeal (72% CP) 4.5%, Bone meal 1%, limestone 1.5%, salt 0.25%, vitamin premix 0.25%.

Table 2: Proximate composition of differently processed sesame seed meal

Parameters	**RSSM**	**CSSM**	**GSSM**	**GCSSM**
Crude protein	22.50	21.20	21.20	20.40
Crude fibre	9.20	9.60	9.60	8.50
Ash	12.30	15.40	15.40	12.20
Ether extract	9.00	9.90	9.90	9.80
Nitrogen free extract	47.00	43.90	43.90	49.10
Dry matter	95.40	94.80	91.70	94.30

Proximate analysis: The raw and differently processed sesame seed meals and experimental diets was subjected to proximate analysis using the method of AOAC, (2005).

Table 3: Growth performance of broiler chickens fed differently processed sesame seed meals

Parameters (g/bird)	**T1 Control**	**T2 (RSSM)**	**T3 (CSSM)**	**T4 (GSSM)**	**T5 (GCSSM)**	**SEM**	**P-value**

Initial body weight	48.81	50.00	48.81	47.52	53.75	0.94	0.451
Final body weight	1455.0[a]	997.2[b]	926.6[b]	1099.6[b]	1237.5[ab]	83.2	0.011
Weight gain	1401.6[a]	947.2[b]	913.8[b]	1052.1[b]	1164.1[ab]	82.5	0.012
Feed intake	3454.3	2599.5	2666.0	3098.5	3348.7	297.3	0.224
FCR	2.50	2.76	2.94	2.89	2.85	0.22	0.659

Means with different superscripts on the same row are significantly different (P<0.05).

Statistical analysis: Data collected was subjected to One-Way Analysis of Variance (ANOVA) using SAS (1999). Significant means were separated by Duncan option of the same statistical package. A probability of (P<0.05) was considered significant.

RESULTS AND DISCUSSION

The proximate composition of differently processed sesame seed meal is shown in Table 2: high dry matter contents were recorded in raw and processed sesame seed meal. Highestcrude protein (CP) was in the raw SSM and lowest CP was observed in germinated plus cooked sesame seed meal. Processing had effect in lowering the crude protein content of sesame seed meal.

The results for the growth performance of broiler chickens are shown in Table 3. The final body weight and weight gain were significantly affected by dietary treatment. FBW and WG were highest in the control while lowest FBW and WG were observed in the raw and cooked SSM. There was slight improvement in the FBW and WG in those feds germinated cum cooked SSM group.

The proximate composition of germinated cum cooked sesame seed meals showed a CP of 21.4%. The result agreed with the findings of Yakubu and Alfred, (2014) who recorded a relatively close value of20.26% CP in toasted white sesame. Raw sesame seed meal had a CP of 22.50% which was not too far from the observation of Olaiya, (2014) that reported 26.51% CP. The processing methods could have been responsible for the reduction in the crude protein content of the processed sesame seed meal.

The slight improvement in the final body weight of the broiler chickens fed germinated plus cooked over other processing methods agreed with the findings of Al Harthi and El Edeek (2009) who supplemented phytase and probiotics in SSM. Also, Olaiya and Makinde, (2014) reported that heat treatment is better method of processing to eliminate the anti-nutritional factors in sesame seed meal. Agbulu*et al,* (2010) also showed a significant difference influenced by dietary treatment when processed sesame seed meal was compared with raw in feeding broiler. It was concluded that germinated cum cooked SSMwas the best processing method and therefore, it is recommended that the combined method can be used to improve the utilization of sesame seed as a partial replacement for soybean meal in broilers diet.

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Haematology and Carcass Characteristics of Broiler Chickens Fed Graded Level of Wood Charcoal

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Abstract: An eight-week feeding trail was conducted in a completely randomized design to evaluate the effects of diet containing graded levels of wood charcoal (WC) on Haematology and Carcass characteristics of broiler chicken. 180 chicks were randomly allotted into five dietary treatments groups of T_1 (0% WC), T_2 (2.5%WC), T_3 (5.0%WC), T_4 (7.5%WC) and T_5 (10.0%WC) with each treatment comprising three replicates of twelve birds per replicate. At seven weeks, two birds per replicate were bled through the jugular vein for blood sample haematological analysis. Then at the end of eight weeks two birds per replicate of similar weight were slaughtered and bled very well for carcass analysis. The result revealed that live weight, slaughtered weight, eviscerated weight and dressed weight were significantly difference ($p<0.05$) among the treatments. However, plucked weight, thigh, wing and breast weight were not significantly influenced ($p>0.05$) by the diets. Birds fed 7.5% WC recorded the highest value (20.83%) and lowest value was recorded in 0%WC (18.00%) of breast weight. While birds fed 2.5% WC had the best thigh weight (12.90%). The haematological parameters were not significantly influenced ($p>0.05$) by the diets except for Haemoglobin and Basophil count with the highest haemoglobin value in T_4(10.60g/dl) and the lowest value in T_2(8.33g/dl). Birds on T_3 had significantly ($P<0.05$) highest basophil value (1.00%). Based on this result, it can be concluded that WC can be incorporated into broiler diet up to 10% without any deleterious effect on haematology and carcass characteristics of broiler chicken.

Keywords: Wood charcoal, Broiler, Feeding trial, Haematology, Carcass characteristics.

INTRODUCTION

In Nigeria and indeed many other countries, various feeds and additives are incorporated into poultry diets to ensure maximum productivity. According to (1), in poultry sector, feed remains the most important component of the cost of production. Hence, efforts are continuously made to seek for ways to minimize cost of feed. Health of the gut is one of the major factors governing the performance of birds and thus, the economics of poultry production and the profile of intestinal micro flora play an important role in the gut health (1). Charcoal has enormous absorptive properties, acts curatively on the gastro intestinal tract, absorbing gases such as hydrogen sulphide and ammonia, bacteria toxins as well as mycotoxins produced by fungi (2).

Charcoal is not digested in the gastro intestinal tract and it binds various substances through physical interactions regardless of whether they are ionized or not. By binding of ammonia, charcoal protects the intestine against alkalization. The mineral contained in charcoal form bases with water lower the surface tension of the digesta and emulsify fat, thereby supporting liver function and enabling digestion and assimilation (5). This study thus sought to evaluate haematological parameters and carcass characteristics of broiler chickens fed graded levels of wood charcoal based-diets.

MATERIALS AND METHODS

The study was conducted at the Teaching and Research Farm of Federal College of Animal Health and Production Technology, Moor Plantation Ibadan, Oyo State Nigeria. Ibadan is located on longitude $03^0$51E, latitude $07^0$23N and altitude 650", in the humid zone of rain forest belt 0703.25 of

south western Nigeria. Ecologically it is in the rainforest zone experiencing mean annual rainfall of 1220 mm and mean temperature of 26^0C with two seasons- the dry and wet season. A total number of one hundred and eighty birds were weighed and randomly allotted into five dietary treatments and replicated three times with twelve birds per replicate in a completely randomized design. Charcoal was milled to powder which was later incorporated into the experimental diets as follows; T_1: control diet (0% WC), T_2 (2.5% WC), T_3 (5% WC), T_4 (7.5% WC), T_5 (10% WC).

At seven weeks, six birds were randomly selected from each replicate and 3mls of blood was taken with hypodermic needle and syringe via jugular vein which was put into Ethyl Diamine Tetra Acetic Acid (EDTA) bottle as anticoagulant and the bottles were gently shaken to ensure proper mixing of blood with EDTA to prevent coagulation. Blood samples were analyzed according to routinely available clinical methods. The following parameters were analyzed which include, Red Blood Count (RBC), Haemoglobin (Hb), Packed Cell Volume (PVC), White Blood Count (WBC), Platelet and Basophil, Eosinophil. Also, six birds of mean weight close to the average group weight were randomly selected from each replicate, fasted overnight (12 hours) in order to empty their crops. The birds were slaughtered by severing their neck with a sharp knife and blood allowed to bleed. After bleeding, the carcasses were scalded in hot water, de-feathered, eviscerated and dressed. The internal organs (Liver, heart, gizzard, lungs, intestine and oviducts) were removed through silt made between the end of the keel bone and the rectum. The fully-dressed weights of the carcasses were recorded. The carcass parts such as thighs, drumstick, wings, neck, gizzard, heart, lungs, back, breast muscle and head were cut and weighed. The weight of carcass and internal organs were expressed as the percentage of the live weights of the birds. All data obtained were subjected to analysis of variance using (8).

RESULTS AND DISCUSSION

Results of the haematological parameters of broilers fed diets containing graded level of WC is as shown in table 1. All parameters measured were not significantly ($p>0.05$) influenced by the dietary treatments except haemoglobin (Hb) and basophil. Packed cell volume ranged from 26.00 – 32.00%, Hb, 8.33-10.60g/dl, lymphocytes, 65 – 70.33%, Heterophil, 22.67 – 29.00% and Monocytes, 3.33 – 4.00% respectively. The significant values of these haematological parameters across the dietary treatments coupled with values of PCV, Basophil and RBC which fell within the recommended for normal range of chicken (6) was an indication of adequate nutrition for these birds. (3) and (7) linked with lower values of these parameters to inadequate nutrition.

Table 1: Effect of diet containing graded level of wood charcoal on haematological indices of broiler chicken

Parameter	T1 (0%)	T2 (2.5%)	T3 (5%)	T4 (7.5%)	T5 (10%)	SEM (±)	*Normal Range
PCV (%)	31.00	26.00	30.67	32.00	30.00	0.96	24.50−45.20
HB (g⁄dl)	10.17^{ab}	8.33^{b}	10.07^{ab}	10.60^{a}	9.600^{ab}	0.31	7.40−13.10
RBC ($x10^6$⁄ul)	3.40	2.81	3.19	3.41	3.42	0.13	1.45−4.10
WBC ($x10^6$⁄ul)	18.57	18.62	18.95	17.42	16.20	0.49	9.20−31.00
PLATELET ($x10^6$)	175.67	135.67	180.33	128.00	430.67	8.63	140−480
LYMPH (%)	65.00	65.67	70.33	67.67	68.00	1.23	42.90−81.20
HETERO (%)	29.00	23.33	22.67	26.67	24.67	1.42	15.60−43.90
MONO (%)	3.33	3.84	2.67	3.33	4.00	0.21	0.06−0.94
EOS (%)	2.67	3.33	4.00	3.67	3.67	0.34	2.00−9.00
BASO (%)	0.00^{b}	0.00^{b}	1.00^{a}	0.67^{a}	0.00^{b}	0.16	0.36−1.32

^{a},^{b}: mean of different superscripts are significantly different ($p<0.05$); *: normal range of haematological indices; PCV – Packed cell volume, Hb – Haemoglobin, RBC –Red blood cell, WBC – White blood cell, LYMPH –

Lymphocyte, HETERO- Heterophil, MONO- Monocytes, EOS –Eosinophil, BASO – Basophil. (Mitruka and Rawnsley, 1977).

Table 2 shows the results of carcass evaluation of broiler chicken fed diets containing graded level of wood charcoal. Significant ($p<0.05$) difference were recorded in mean values obtained for live weight, head and gizzard while all other parameters were not significant ($p>0.05$) affected when fed with wood charcoal. The highest value obtained of live weight (2316.67g) was obtained in birds that were fed with 2.5 % wood charcoal while the lowest was live weight (1866.67g) for birds that were not fed with wood charcoal. There was no significant ($p>0.05$) differences across the dietary treatment in Plucking weight, Thigh, Head, Liver, Heart and Spleen. The highest Plucking weight (95.67%) diet containing 2.5% wood charcoal while the lowest value for plucking weight (87.77%) and eviscerated weight (83.43%) were obtained from birds fed diet containing 2.5% wood charcoal which was not significantly ($p>0.05$) difference from those fed the diet containing 7.5% wood charcoal with respective values of 65.83% and 82.54% in the same order. These values were significantly ($p<0.05$) higher than those fed 0%, 5.0% and 10.0% of wood charcoal. The highest Eviscerated and Dressed weights were obtained in birds fed diet containing 2.5% wood charcoal and the diet containing 7.5% wood charcoal was indicated that birds on these two diets produced more edible meat than others. This was a result of better utilization of the nutrient in the diet containing 2.5% wood charcoal and containing 7.5% wood charcoal with no anti-nutritional factors. This result agreed with report of (4) who reported that wood charcoal prevented fatness and improved growth performance of broiler chicken. The highest gizzard weight was obtained in birds fed diet containing 10% wood charcoal and similarly Kidney weights obtained at 0% and 10.0% wood charcoal. This could be linked to the roles of these organs in elimination of metabolic wastes and toxins from the body. This result agrees with the gizzard functions which are primary organs of bio transformation in animals.

Table 2: Effects of Diet Containing Graded Level of Wood Charcoal on Carcass Characteristics of Broilers Chicken

Parameters (%)	T1 (0%)	T2 (2.5%)	T3 (5.0%)	T4 (7.5%)	T5 (10.0%)	SEM (±)
Live weight (g)	1866.67^{b}	2316.67^{a}	2183.33^{a}	2100.00^{a}	2283.33^{a}	50.71
[1]Slaughtered⁄weight	96.47^{b}	98.57^{a}	96.67^{ab}	97.60^{ab}	97.77^{ab}	0.28
[1]Plucked⁄weight	94.60	95.67	90.87	91.31	87.77	1.19
[1]Eviscerated weight	80.23^{ab}	83.43^{a}	78.69^{b}	82.54^{ab}	80.07^{ab}	0.70
[1]Dress weight	65.97^{b}	68.37^{c}	63.40^{a}	65.83^{b}	66.17^{ab}	0.51
[1]Breast weight	18.03	20.20	19.60	20.83	19.67^{ab}	0.34
[1]Wings weight	8.57	8.43	8.27	8.63	8.47	0.13
[1]Thigh weight	12.07	12.90	12.00	12.37	12.47	0.15
[1]Back weight	13.03	12.50	11.60	11.53	12.67	0.23
[1]Neck weight	6.30	6.00	6.13	5 .80	5.67	0.11
[1]Head weight	2.90^{a}	2.43^{ab}	2.43^{ab}	2.60^{ab}	2.10^{b}	0.10
[1]Shank weight	4.33	4.30	4.67	4.80	4.27	0.12
[1]Drum weight	11.63	12.03	11.20	11.43	11.43	0.15
[1]Gizzard weight	2.57^{a}	2.07^{b}	2.83^{a}	2.53^{ab}	2.93^{a}	0.10
[1]Liver weight	1.93	1.57	1.57	1.67	1.87	0.06
[1]Kidney weight	0.59	0.52	0.49	0.65	0.57	0.03
[1]Lungs weight	0.71	0.65	0.62	0.74	0.75	0.02
[1]Spleen weight	0.07	0.07	0.10	0.09	0.07	0.01
[1]Heart weight	0.31	0.45	0.44	0.49	0.48	0.03

^{abc}: mean along the same row with different superscripts are significantly different ($p<0.05$),

[1]: Expressed as % of live weight

CONCLUSION

Based on the result of this study, it was concluded that haematological indices revealed no deleterious effects on the haematological parameters of the broiler chicken. The carcass characteristics showed that using wood charcoal as feed additives does not have any negative effects on the primer cuts of the chicken.

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Performance of Broiler Chickens Influenced by Stocking density, Protein and Energy Levels and Season

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Abstract: This study was carried out to assess the effect of stocking density, protein and energy levels, and season on the growth performance of broiler chickens. In a 6x3x2 factorial arrangement using completely randomized design, six diets with three metabolisable energy (ME kcal;/kg) and two crude protein (%) levels combination: 3106.00 and 23.00 (control, diet 1); 3112.00 and 21.70(Diet 2); 2928.00 and 23.40 (Diet 3); 2933.00 and 21.90 (Diet 4); 3227.00 and 23.10 (Diet 5); 3230.00 and 21.80 (Diet6), were formulated. Three stocking densities (birds per m^2):10, Low SD (LSD);12, Recommended SD (RSD); and 14, High SD (HSD), were used in Late Wet Season (LWS), August-November) and Late Dry Season (LDS, February-April). In a seven-week feeding trial, 576 one-week old broilers were assigned to the respective diets and stocking densities. Final Live weight (FLW, g), Total Feed Intake (TFI, g), Feed Conversion Ratio (FCR) and Live weight per m^2 (LW/m^2, kg), were assessed. Data were analyzed using descriptive statistics and ANOVA at$_{\alpha\ 0.05}$. The FLW of birds on HSD was lower than those on RSD and LSD, birds on diets 4, 5 and 6 had similar and higher FLW. The TFI was higher during LWS; birds on diet 4 had similar TFI as those fed diets 1 and 5. The FCR was better during LDS and on LSD and RSD. Birds fed diets 5 and 6 had better FCR. LW/m^2 increased with stocking density. Broiler performance can be optimized during late dry season at stocking 14birds/m^2 with diet containing 3106 ME (kcal/kg) and 23.0% crude protein. The corresponding stocking density, dietary energy and protein during LWS should be 12birds/ m^2; 2933ME (kcal/kg) with 21.92% crude protein.

Keywords: Performance, Stocking density, Protein, Energy, Season.

INTRODUCTION

Broiler chickens are meat type chickens that have been specially bred for marketing at an early age. They possessed excellent prospects such as quick growth rate, rapid turnover of capital, and better feed conversion ratio. Like any other living organisms, broilers must be provided with optimal environmental conditions and feed in order to achieve their genetic potential for growth (Feddes *et al*., 2002). The combination of high ambient temperature (AT) and relative humidity (RH), as obtained in the humid tropics, continues to cause major environmental distress in poultry, reduces production efficiency, increase endogenous heat production and overloads the birds' thermo-regulatory mechanism (Ajakaye *et al*., 2010).

Broilers exposed to excess heat decrease feed intake to reduce heat production and maintain homeothermy, resulting in slower growth, reduced muscle yield and higher feed conversion ratio (Ryder et al, 2004). The significance of stocking density on broiler production has long been established and several studies had been conducted to study the effect of stocking density on broiler production and performance (Skrbic *et al*., 2009). However, majority of these studies were not always conclusive and had produced variable conclusions (Feddes *et al*., 2002; Skrbic *et al*., 2009).

The recommended amounts of energy and protein in broiler breeding guide books is very high and providing them increased feed prices which are not economically viable for poultry units (Ebrahim *et al*., 2013). Adjustment of energy and protein levels of diet produced variable effect on the performance of the birds (Kamaran *et al*., 2008; Nogueira *et al*., 2013). Changes in the physical environment and the development of

more productive genotypes called for constant research into the effects of the physical environment and diets on the growth performance of broilers.

MATERIALS AND METHODS

The experiment was conducted at the poultry unit of the Teaching and Research Farm, University of Ibadan, Nigeria. The periods of the experiment were August to November (Late wet season (LWS) with an average temperature of 25.44ºC and relative humidity of 83.52% and February to April (Late dry season (LDS) with an average temperature and relative humidity of 27.77ºC and 74.34% respectively.

The experiment design was a complete randomized design (CRD) in a 6^x3^x2 factorial arrangement. Six diets with three metabolisable energy (ME kcal;/kg) and two crude protein (%) levels combination; 3106.00 and 23.00(control, diet 1); 3112.00 and 21.70 (Diet 2); 2928.00 and 23.40 (Diet 3); 2933.00 and 21.90(Diet 4); 3227.00 and 23.10(Diet 5); 3230.00 and 21.80 (Diet 6), were formulated. Three stocking densities (birds per m^2); 10, Low SD (LSD); 12, Recommended SD (RSD); and 14, High SD (HSD), were used.

For each season, five hundred and seventy-six (576) one-week old *Arbor-acre* broilers were assigned to the three stocking densities and six diets interaction at the rate of eight (8) birds per interaction unit with four replicates each. Birds were housed in an open side house. Thermo hygrometers were placed at strategic points to monitor temperature and relative humidity. Vaccination and medication were administered as recommended by the hatchery operator. Feed and water were provided ad libitum. Records of feed intake and birds' weight were taken weekly, while mortality record was taken daily.

Data generated were subjected to analysis of variance using General Linear Model (GLM) Of SAS software 9.2 (SAS 2008). Significantly different means were separated using Duncan Multiple Range (DMR) test, with level of significance set at $p<0.05$.

RESULTS AND DISCUSSION

Table 1: Effects of stocking density, protein and energy levels, and season on growth performance of Broiler chickens

Main effect		FLW(g/bird)	TFI(g/bird)	FCR	LW/m^2(kg)
Season	LDS	2225.72	4568.50^b	2.06^a	25.11
	LWS	2210.97	4756.60^a	2.16^b	25.57
	SEM	13	24.91	0.01	0.34
Stocking density(bird/m^2)				2.10^a	21.68^c
	10(LSD)	2241.17^a	4680.79	2.09^a	25.79^b
	12(RSD)	2253.25^a	4695.05	2.09^a	28.86^a
	14(HSD)	2157.11^b	4608.81	2.14	
	SEM	13	24.91	0.01	0.34
Diet	1	2195.54^b	4681.62^{ab}	2.41^b	25.50
	2	2168.42^b	4661.62^{ab}	2.16^b	25.11
	3	2184.00^b	4640.41^{ab}	2.13^b	25.19
	4	2231.22^{ab}	4784.15^a	2.14^b	25.11
	5	2287.24^a	4657.54^{ab}	2.04^a	25.60
	6	2243.66^{ab}	4549.95^b	2.03^a	25.55
	SEM	13	24.91	0.05	0.34
Interaction					
Season x SD(P-valve)		0.03	NS	0.02	0.03
Season x Diet(p-valve)		0.0001	<0.0001	0.02	0.0035
SD x Diet(p-valve)		NS	NS	NS	NS
Season x Diet SD(valve)		NS	NS	NS	NS

a,b,: Means on the same column with different superscripts are significantly different($p<0.05$).
LD: Late Dry; LW: Late wet. SEM: Standard Error of Mean, SD: Stocking Density; FCR: Feed Efficiency Ratio; D1- Recommended protein & energy; D2- Lower protein & Recommended energy; D3- Recommended protein & lower energy; D4- Lower protein & lower energy; D5- Recommended protein & higher energy; D6- Lower protein & high energy; FLW- Final live weight; TFI- Total Feed Intake; WG- Weight Gain; FCR- Feed Efficiency Ratio; LW/m^2- Live Weight/metre squared

Table1 shows the growth performance of broiler chickens as influenced by stocking density, protein and energy levels (diets) and season. There was no significant difference in the final live weight (FLW) of the birds between the season ($P>0.05$). The FLW of birds on stocking density (SD) 14birds/m^2 Higher Stocking Density (HSD) was lower ($P<0.05$) than that of birds on SD 10 birds/m^2, Lower Stocking Density (LSD) and 12birds/m^2, Recommended Stocking Density (RSD) that were similar. The FLW of birds on diets 4, 5 and 6 were similar and higher than the values for birds on diets 1, 2 and3. The total feed intake (TFI) was significantly higher during late wet season (LWS) than late dry season (LDS). Birds on diet 4 had similar TFI as those on diets 1 and 5. The Feed Conversion Ratio (FCR) was better during LDS and on LSD and RSD. Birds fed diets 5 and 6 had better FCR than those on diets 1-4. There were no significant effects of season and diet on Live weight per meter squared (Lw/m^2), however Lw/m^2 increased with stocking density ($P<0.05$). There were significant interactive effects of Season x SD and Diet x Season on growth performance of broiler chickens.

The lower feed intake during LDS was in agreement with the observation of Abu-Dieyeh, (2006), and its due to the fact that high ambient temperature causes hyperthermia in the body, which reduces the activity of the appetite centre in the medulla oblongata and animals react by reducing physical activity and spend less time eating (Laszlo *et al*.,2011). The similarly high intake of diets with higher energy (diets 1 and 5) and that with lower energy agrees with the submission of Richards, (2003) that broilers selected both for rapid weight gain and muscular mass deposition do not properly regulate voluntary feed intake according to energy level as they showed compulsive appetite in an *ad libitum* program. The similarity in FLW of birds on diets 4, 5 and6 agrees with the observation of Mbojiorgu *et al*. (2011) that found no difference on performance variables of broiler chickens when dietary energy to protein ratio of the feed was changed by decreasing the crude protein content.
The higher FCR during LWS agreed with the observation of Rajkumar *et al*. (2011) that FCR was more in winter than summer, due to high energy requirements for the basal metabolism of the birds. The better FCR observed for RSD and LSD over HSD was in consonance with the finding of Hassanein, (2011) who observed better feed conversion at lower stocking densities.
The better performance of birds on LSD and RSD during LDS over those on LSD during LWS must have been due to the aggressiveness of the birds during LWS and the fact that over spacing leads to a lot of exercise, which tends to reduce feed conversion since much of the energy will be used in moving about (Malden *et al*., 2001). Higher TFI and FLW by chickens on Diets 1, 5 and 6 during LDS agreed with the results of Kamran *et al*. (2008) and it's based on the fact that increase dietary metabolisable energy is one of the possible ways to meet the birds' energy requirement and partially overcome growth depression under hot climate. The TFL and FLW were more on diet with lower energy and protein (diet4) during LWS which agreed with the submission of Kamran *et al*. (2008) that reduction in dietary crude protein and metabolisable energy lead to increase in feed intake.

CONCLUSION

Season, stocking density and energy and protein level affect broiler growth performance parameters either singly or interactively. Broiler growth performance can be optimized in the in the tropic at stocking density of 14birds/m^2 and on diet containing 3106 ME(kcal/kg) and 23% crude protein during starter phase and 3230 ME (kcal/kg) and 20% crude protein for finisher phase during late dry season. The corresponding stocking density,

dietary protein and energy content during late wet season should be 12birds/m^2; 2933ME (kcal/kg) with 21.92% crude protein for starter and 3045ME (kcal/kg) with 19.14% crude protein for finisher phase.

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Growth response of Japanese Quails (*Coturnix coturnix* Japonica) to graded levels of ascorbic acid as supplement in the diets

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Abstract: A four-week trial was carried out to evaluate the growth performance of Japanese quails (*Coturnix coturnix japonica*) fed diets supplemented with ascorbic acid (AA). Four diets were formulated with Diet 1 (Control) containing 0%AAwhile Diets 2, 3 and 4 were supplemented with 200 mg/kgAA, 300mg/kgAAand 400 mg/kgAA respectively. A total of One hundred and twenty (120) two weeks old Japanese quails were allotted to four dietary treatment groups of 30 quail birds each with three replicates of 10 birds per pen in a Completely Randomized Design. The diets were formulated to be isonitrogenous (24%CP). The birds were raised in cages under high ambient temperatures of 32.9 to 36.1°C for four weeks. Water and feed were offered *ad libitum.*The effect of treatments on growth performance were found to be insignificant (P>0.05). Daily feed intake was higher (P<0.05) for quails fed 400mg/kgAA than those fed other dietary groups whiledaily weight gain was not affected (P>0.05). Results of this study indicate that quails appeared to exhibit some level of natural resistance to heat stress and therefore, dietary supplementation of quail diets with AA was not necessary and not economically advantageous.

Keywords: ascorbic acid, growth performance, quails, supplement

INTRODUCTION

The importance of animal protein in both human and animal nutrition cannot be overemphasised. Over the years, there has been a significant gap between the production and supply of animal protein to feed the evergrowing population. To halt this negative trend, efforts are been directed towards boosting the livestock industrywith micro-livestock having prolific tendency, short gestation period, short generation interval and rapid growth (1). Among the micro-livestock animals is the Japanese quail (*Cortunix cortunix japonica)*. Japanese quails arehardy birds that thrive in small cages and cheap to produce. They have less feed requirement of about 20- 25gfeed per day compared to chicken that requires 120 -130g per day (2). The Japanese quail attainsmarket weight of 140 - 180g between 5- 8 weeks of age and, a high rate of egg production between 180- 250 (3) and 200- 300 eggs in their first year of lay (4).

Economic losses in heat-stressed poultry birds such ashigh morbidity and mortality, immune suppression, poorFCR and reduced growth rate are well known (5). The maximum temperature associatedwith satisfactory poultry performance isapproximately30°C at high relative humidity (6). Ambienttemperatures above 32°C are considered to have adetrimental effect on the performance of poultry (7). In quails the ambient temperature is between 18-30°C. However, with the optimal temperature around 21-27°C, cooling is required when temperatures exceed 30°C (8).

To reduce the heat stress in poultry, provision of cleanand cool drinking water, reducing the number of birds percage, feeding during the cooler times of day, and addition ofelectrolyte supplements to their drinking water are being practiced (9). This study therefore evaluates the growth performance of Japanese quails fed diet supplemented with ascorbic acid (AA).

MATERIALS AND METHODS

This study was conducted at the Poultry Unit of Animal Science Department, Ahmadu Bello University, Zaria, Nigerialocated at latitude 110 9' 45'' N and longitude 70 38' 8''E, at an altitude of 610m above sea level (10). Themeteorological data during the study period (March) was obtained as follows; Ambient temperature 32.9 to 36.1°C, Relative humidity 40.63 to 65.00 %, Rainfall 91.55mm (Samaru weather meteorological center, IAR, Zaria). The ascorbic acid used in this study was obtained from a Commercial Livestock Industry in Ibadan, Nigeria while the quail chicksused were purchased from the National Veterinary Research Institute (NVRI) Vom, Jos.

Experimental design: Four diets were formulated with diet 1 (control) containing 0%AAwhile diets 2, 3 and 4 contained 200, 300 and 400mg/kgAA respectively. A total of one hundred and twenty (120) Japanese quail birdsof two-weeks old were allotted to four dietary treatment groups of 30 quail birds each with three replicates of 10 birds per pen in a completely randomized design. The diets were formulated to be isonitrogenous (24%CP). The birds were raised in cages for four weeks. All management procedures were followed. Feed and water were provided *ad-libitum*. The quail birds were allowed an adjustment period of two weeks before the initial weight and growthperformance data were taken. They werethen weighed weekly to determine weekly weight gain. Data collected were used to compute daily feed intake and daily weight gain. The percentage composition of experimental diets is shown on Table 1.

Statistical analysis: Experimental data were subjected to analysis of variance (ANOVA) using SAS (11) software. Means were separated with Duncan multiple range test at 5% level of significance.

Table 1: Percentage Composition of Japanese quail starter - grower Diets (2-6wks).

Ingredients, %	**Control**	**200AA**	**300AA**	**400AA**
Maize	50.00	50.00	50.00	50.00
Soya bean Meal	10.00	10.00	10.00	10.00
G.N.C	30.00	30.00	30.00	30.00
Fishmeal	2.00	2.00	2.00	2.00
Wheat Offal	4.00	4.00	4.00	4.00
Bone meal	2.00	2.00	2.00	2.00
Limestone	1.10	1.10	1.10	1.10
Salt	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.20	0.20	0.20	0.20
Ascorbic acid, mg/kg	0.00	200	300	400
Total, %	100	100	100	100
Determined Nutrients, %				
ME (Kcal/Kg)	2818	2818	2818	2818
Crude protein	24.34	24.34	24.34	24.34
Crude fibre	4.15	4.15	4.15	4.15
Avail. P	0.48	0.48	0.48	0.48
Calcium	1.10	1.10	1.10	1.10
Lysine	1.21	1.21	1.21	1.21
Meth. + Cystine	0.85	0.85	0.85	0.85
Ether Extract	4.44	4.44	4.44	4.44
Cost/Kg, N	87.25	90.25	90.37	87.37

*****Biomix premix provide per kg of diet: Vit.A, 10,000i.u; Vit,D3, 2000i.u; Vit.E, 23mg; Vit.K, 2mg; Calcium Pantothenate, 7.5mg; Vit.B12,0.051mg; Folic acid,0.75mg; Choline chloride,300mg;Vit.B1,1.8mg;Vit.B2,5mg; Manganese,40mg; Iron, 20mg; Zinc, 30mg; Copper, 3mg; Iodine,1mg; Cobalt,0.2mg.

RESULTS AND DISCUSSION

Figure 1 shows the growth response of quail chicks fed diets supplemented with graded levels of ascorbic acid. There were no significant differences ($P>0.05$) in all the parameters measured except average daily feed intake. Quail chicks fed diet containing 400mg/kgAA consumed significantly ($P<0.05$) more feed compared to those fedother diets. Average daily feed intake also increased with increase in the level of AA in the diets.FCR was not influenced by the dietary treatments ($P>0.05$).

Ascorbic acid plays important roles in cellular anti-oxidant defenses, not only by reacting with all oxygen species to form dehydroascorbyl, a particular inert radical, but also by transferring radical equivalents from lipid phases to aqueous compartment (12). Ascorbate participates in the regeneration of reduced glutathione from oxidized form in the cytoplasma and allows tocopherol regeneration through a non-enzymatic reaction (13).

The non-significant difference observed in the weight gain of quail chicks as the AAlevels increased in the diets can be attributed to the natural ability of quails to withstand heat stress. Tuleun *et al*. (14) reported that there were no significant differences in the performance of quails fed diet supplemented with graded levels of AA from 0-200mg/kg. Similarly, (15) reported thatAA did not affect body weight gain and feedconversion ratio in chickens under conditions ofnatural summer temperature. As observed in this study, there is an improvement in feed consumption of quails as the AA levels increased in the diets. Ali *et al.*(16)had earlier reported that the addition of antioxidants, AAto thediet may scavenge the free radicals generated byheat stress, leading to improved feed consumption. In the same vein, (17) also reported thatchickens under heat stress will choose a feed supplemented with vitamins if the feed is identifiablethrough the use of colour and will reverse their selection when the environmental temperature rev rts to normal.

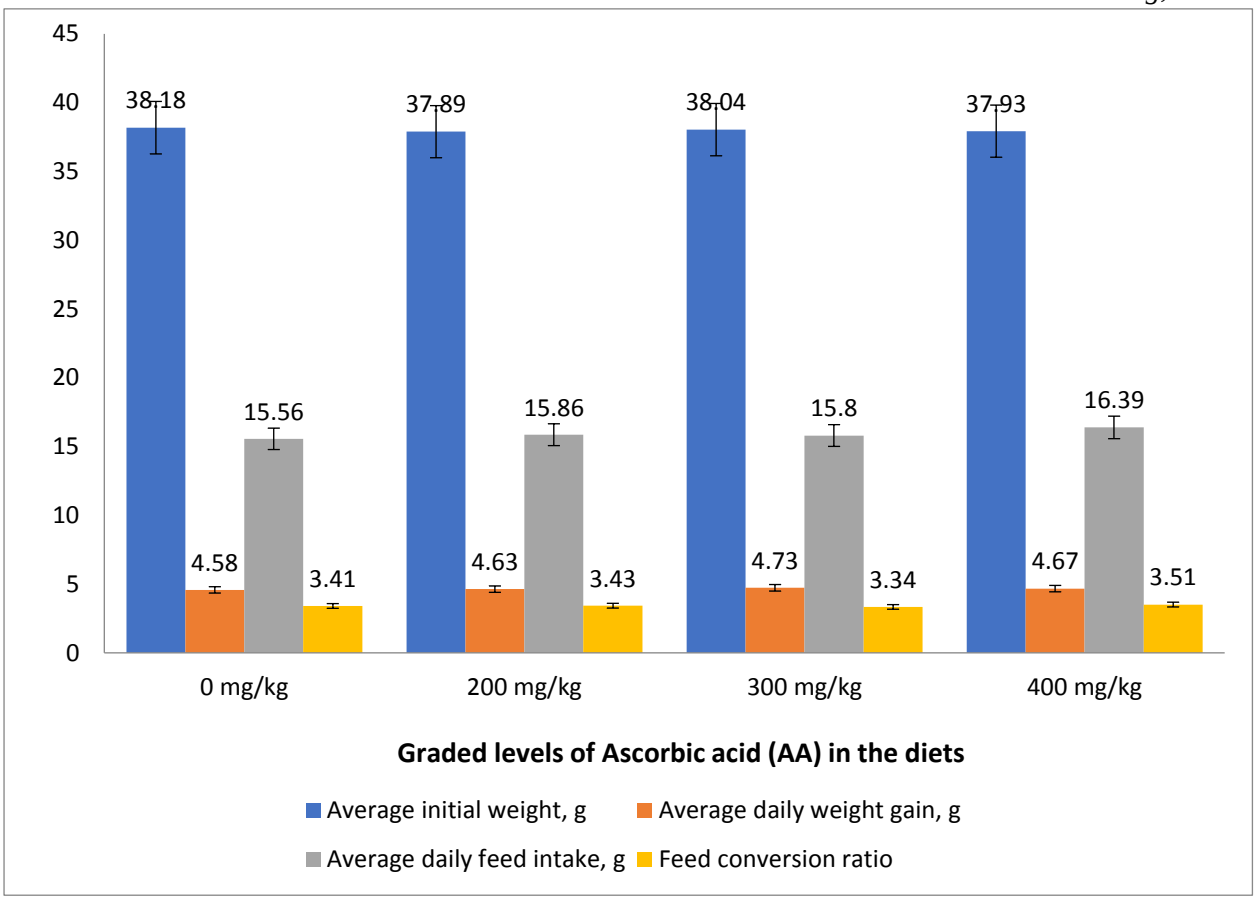

Figure 1: Effect of Ascorbic acid on growth Performanceof Japanese quails (2-6weeks)

Conclusion and Recommendation

Based on the result obtained in this study, it was concluded thatdietary supplementation of quails diet (2-6weeks) with AAduring heat stress condition may not be necessary as their effects were not observed on growthparameters studied.

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Growth and Serum Biochemical Indices of Broiler Chickens fed *Parkia biglobosa* Pulp supplemented with Exogenous Enzyme

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Abstract: One hundred and eighty-nine (189) day old broiler chickens of Marshal strain were used to determine the effects of supplementing dietary Parkia biglobosa with exogenous enzyme on the growth performance, haematological parameters and serum enzymes. The control diet was corn soybean meal based-diet without P. biglobosa pulp. The other 6 different diets contained P. biglobosa pulp added at 5%, 10%, 15% without exogenous enzyme for diets T1, T2, T3, respectively while exogenous enzyme was added at the rate of 0.04g/kg to diets T4, T5, T6. Data collected were analysed using One Way- and factorial- Analysis of Variance.The final body weight (FBW) and Weight gain (WG) showed an improvement for broiler finishers fed 15% P. biglobosa pulp with exogenous enzyme supplementation (1525.93g, 965.74g) when compared to their counterparts fed 15% P. biglobosa pulp meal without the exogenous enzyme (1342.92g, 802.92g). Finisher broilers fed control diet had a superior FBW and maximum WG (1824.91g, 1154.86g). The serum alkaline phosphatase (ALP) was higher in broilers fed 5% and 10% P. biglobosa pulp with exogenous enzyme (T4,48.47IU/L and T5, 45.76IU/L) than those fed similar diets without exogenous enzyme (T1,23.36IU/L and T2 36.99IU/L). It was concluded that at5% P. biglobosa pulp can replace maize without adverse effects on the growth performance, haematological and serum enzymes values when supplemented with endogenous enzyme. Feeding 15% P. biglobosa pulp require exogenous enzyme supplementation to achieve improved growth performance.

Keywords: Broiler chickens, *P. biglobosa pulp*, Exogenous enzyme, Growth performance and Serum enzymes.

INTRODUCTION

Maize is a common feedstuff of choice as a source of energy and it is expensive due to the competition between man and animal as a food ingredient, thereby increasing cost of production (Bawa*et al*., 2008). Its proportion in monogastric diets ranges from 50-70%. Poultry farmers are interested in the total cost of production and final returns after sales, therefore there is a need to intensify research for alternative sources of energy in poultry diets to cut cost of production. *Parkia biglobosa* know as African locust bean is a tropical tree which is native to Africa and widely distributed in the savanna region (Adewusi, 1992). *P. biglobosa* is a legume forest tree crop belonging to the family Mimosaceae which provides to West African population, a range of products used in food and traditional medicines (Dahouenon-Ahoussi*et al*., 2012). The fruit pulp of *P. biglobosa* contains higher level of carbohydrate 67.30%, than the seed 49.49%.The pulp is also sweet to taste indicating the presence of sugar thus a good source of energy. The pulp has an attractive yellow colour which is due to the presence of phytonutrients, possibly carotenoids which are important precursors of retinol (Vitamin A), which improves laying performance and immune function of laying hens under heat stress condition. The pulp is also high in vitamin C and Calcium which is highly beneficial in fighting infections and bone formation. The high fibre content of the pulp is a major problem to the utilization of *P. biglobosa* pulp by monogastric animals who find it difficult to tolerate high fibre. However, exogenous enzymes can be used to reduce the problem of digesta viscosity and low digestibility of nutrient caused by high fibre content in feed ingredient. There is however, limited scientific information on the utilization of *P. biglobosa* pulp aided by exogenous enzymes for broiler

chickens. The present study evaluated the growth performance, haematological parameters and serum enzymes of broiler chickens fed *P. biglobosa* pulp with or without exogenous enzymes.

MATERIALS AND METHODS

Experimental site: The experiment was conducted at the Teaching and Research Farms, Ladoke Akintola University of Technology, Ogbomoso, Oyo state, Nigeria.

Source of *P. biglobosa* pulp: *P. biglobosa* pulp was collected within the local environment of Ogbomoso, Oyo state Nigeria. The pericarp of the fruit was removed, after which the fruit was sundried and pounded in pestle and mortar, then sieved to separate the pulp from the seed and stored in plastic containers.

Experimental animals and management: One hundred and eighty-nine (189) day old unsexed commercial broiler (Marshal strain) chicks were randomly divided into 7 treatment groups of 27 birds per group. Each treatment group was replicated thrice at 9 birds per treatment. Normal experimental procedure was used for the study. Medication and vaccination were routinely done as at when due. Feed and water were supplied *ad libitum.*

Formulation of experimental diets: Seven (7) experimental diets were formulated for this study. The control diet does not contain *P. biglobosa* pulp while other 6 diets contained *P. biglobosa* pulp. Diets in T1, T2, T3 contained 5%, 10%, 15%*P. biglobosa* pulp without exogenous enzyme while dietary *P. biglobosa* pulp in T4, T5, T6 were supplemented with commercial enzyme (Polyzyme™) at 0.04g/kg. Polyzyme™ contained the following enzymatic activities; xylanase, phytase, cellulose, Beta-glucanase, pectinase, amylase, protease, α-galactosidase, β-galactosidase, lipase and mannase. The ingredients composition of broiler starter diets areas follows:58.5% corn, 3% corn bran, 30.9% soybean meal, 4.5% fishmeal (72%), 0.8% bone meal, 1.5% limestone, 0.1% lysine, 0.2% methionine, 0.25% vitamin premix and 0.25% salt with following nutritional values of 2892.12 to 3024.39 ME kcal/kg, 21.47 to 21.81%CP. The composition of the finisher diets is shown Table 1.

Statistical analysis: All data collected were subjected to One Way- and factorial- Analysis of Variance using SAS (1999). Significant means were separated by Duncan options of the same software package. A probability of ($P<0.05$) was considered significant.

RESULTS AND DISCUSSION

The growth performance at finisher broilers phase (3-6 weeks) are shown in Table 2. The final body weight, weight gain and feed conversion were significantly affected by dietary treatment. FBW and WG were highest in broiler chickens fed control diet. Finishers fed 15% *P. biglobosa* pulp with enzyme supplementation (T6) had improvement in FBW and WG than those fed 15% *P. biglobosa* pulp without enzyme supplementation.FBW was poorest for broiler finishers fed with 15% inclusion of *P. biglobosa* pulp without enzyme (T3). Feed conversion ratio was best for broilers fed control diet while the poorest was recorded for broilers in T2 (10% inclusion of *P. biglobosa* pulp without enzyme inclusion).

The serum enzymes and haematological parameters were not significantly influenced by dietary treatment except for alkaline phosphatase. Broiler finishers fed 5% *P. biglobosa* pulp supplemented with exogenous enzymehad the highest ALP. However, enzyme supplementation to 15% *P. biglobosa* pulp significantly lowered the serum ALP relative to those fed 15% *P. biglobosa* pulp without enzyme. Generally, feeding *P. biglobosa* pulp to broiler finishers significantly elevated serum ALP than those in the control.

The improvement in FBW and WG of broilers fed dietary *P. biglobosa* pulp at 15% may be due to better utilization of the nutrients in the pulp aided by the use of exogenous enzymes addition. Bawa*et al* (2008) suggested that increased digestibility of nutrients and partial degrading of cell wall of feed as reason for increased feed intake on enzymatic diet. There was significant increase in the WBC of broilers fed enzyme supplemented *P. biglobosa*pulp diets. This indicated the animals on these diets were actively protected from infections. The

pulp is also high in vitamin C and Calcium which could have contributed to fighting infections and bone formation. The high serum ALP activity is an indicator of good bone formation.

Table 1: Composition of broiler finisher diets

Ingredients	Control T1	T2	T3	T4	T5	T6
	←		*P. biglobosa* pulp inclusion level			→
	0%	5%	10%	15%	5%+Enz	10%+Enz
15%+Enz						
Maize	44.95	39.95	34.95	29.95	39.95	34.95	29.95
Parkia pulp	-	5.00	10.00	15.00	5.00	10.00	15.00
Corn barn	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Soybean meal	28.00	28.00	28.00	28.00	28.00	28.00	28.00
Fixed ingredients*	6.60	6.60	6.60	6.60	6.60	6.60	6.60
Total	100	100	100	100	100	100	100
Calculated analysis							
Energy (KcalME/Kg)	28.93.98	2849.89	2805.80	2761.71	2849.89	2805.80	2761.71
Crude protein %	20.69	20.77	20.66	20.54	20.77	20.66	20.54

*Fixed Ingredients: 4.5% fish meal (72%CP), 0.8% Bone meal, 0.5% limestone, 0.1% lysine, 0.2% methionine, 0.25% premix, 0.25% salt.+Enz = Exogenous enzyme addition

Table 2: Growth performance of broiler finisher (3-6 weeks) fed *P. biglobosa*pulp with or without enzyme supplementation (g/bird)

parameters	Control	T1	T2	T3	T4	T5	T6		P-value	SEM	ENZ	Parkia
		←	*P. biglobosa* pulp			inclusion levels		→				
	0%	5%	10%			15%	5%	+Enz 10%				
		+Enz	15%+Enz									
Initial BW	642.96	641.67	608.52	540.00		598.52	569.26	569.19	0.097	26.53	0.392	0.088
Final BW	1824.91^{a}	1678.89^{ab}	1502.59^{c}	1342.92^{d}		1681.30^{ab}	1588.33^{bc}	1525.93^{bc}	0.0002	47.82	0.051	0.002
Weight gain	1154.86^{a}	1037.22^{ab}	913.15^{bc}	802.92^{c}		1060.19^{ab}	1019.07^{ab}	965.74^{b}	0.005	49.58	0.045	0.030
Feed Intake	3180.8	3294.3	4183.7	3179.8		3355.2	3326.0	3511.7	0.125	243.87	0.484	0.224
FCR	2.76^{b}	2.9^{b}	4.59^{a}	3.98^{ab}		3.22^{b}	3.28^{b}	3.67^{ab}	0.043	0.37	0.211	0.098

Means along the same row with different superscripts are statistically significant (P<0.050).*FCR= Feed Conversion Ratio, BW=Body Weight,Enz = Enzyme, Parkia = *P. biglobosa* pulp levels, Int = Interaction effect of exogenous enzyme and *P. biglobosa* pulp level.

Table 3: Haematological parameters and serum enzymes of broiler chickens fed *P. biglobosa* pulp with or without enzyme supplementation.

Parameters	Control	T1	T2	T3	T4	T5	T6	P-value	SEM	ENZ	Parkia	Int
		←		*P. biglobosa* pulp		inclusion levels		→				
	0%	5%	10%	15%	5%+Enz	10%+Enz	15%+Enz					
RBC (x10^{6}/µl)	2.48	3.02	2.94	3.06	2.82	3.18	2.84	0.946	0.44	0.869	0.944	0.832
WBC(x10^{3}/µl)	15.35	15.95	16.03	14.55	17.18	16.67	15.85	0.059	0.52	0.031	0.050	0.789

Hb(g/dl)	8.23	8.90	9.07	9.10	9.40	9.07	8.73	0.937	0.70	0.939	0.945	0.827
ALT (IU/L)	45.62	49.32	28.61	51.82	38.61	58.01	48.50	0.410	9.23	0.540	0.754	0.142
AST (IU/L)	2.89	4.64	4.32	2.83	2.51	2.56	6.60	0.489	1.55	0.976	0.691	0.162
ALP (IU/L)	23.0^{d}	29.63^{c}	36.99^{b}	44.62^{a}	48.47^{a}	45.76^{a}	22.57^{d}	<0.0001	1.96	0.263	0.007	<0.0001

Means along the same row with different superscripts are statistically significant (P<0.050). RBC-Red blood cells, WBC- White blood cells, Hb=Haemoglobin, ALP= Alkaline phosphatase, ALT=Alanine aminotransferase, AST= Aspartate aminotransferase.Enz = Enzyme, Parkia = *P. biglobosa* pulp levels, Int = Interaction effect of exogenous enzyme and *P. biglobosa* pulp level.

It was concluded that at 5% *P.biglobosa*pulp could sufficiently replace maize in broiler diet with comparable performance with the control. Furthermore, feeding 15%*P. biglobosa*pulp diet to broiler finishers required exogenous enzyme supplementation for improved performance.

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Growth and Production Performances of Laying Guinea Fowl (*Numida meleagris*) Fed Diet Containing Oyster Shell as the Main Calcium Source

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Abstract: The dietary calcium source to laying guinea fowl in the wild are largely through scavenges. An 84-day feeding trial carried out to evaluate the performance and haematology responses of 75 Pearl laying guinea fowl (28 – 32 weeks of age) to diets in which dietary calcium was sourced mainly from Oyster shell at graded levels of 2.5%, 3.0%, 3.5%, 4.0% and 4.5%. Growth and hen day production performances and haematology indices were monitored. The average daily feed intake (ADFI) was significantly higher in birds fed 3.0% Ca^{2++} (65.8±0.99 g) and similar to others except those on 4.5% Ca^{2++} with the least value (62.1 ±0.01 g). The feed conversion ratio (FCR) was best in laying guinea fowl fed 4.5% Ca^{2++} (2.98±0.09) and poorest in those on 2.5% (3.31±0.15%). Average daily weight gain (ADWG), hen day production, internal and external qualities indices of egg and all the haematology indices namely, packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC), neutrophils, eosinophils and monocytes were not affected by the dietary treatments ($p>0.05$). The study showed that oyster shell as the main source of dietary calcium at 3.0% gave the optimum performance in laying guinea fowl.

Keywords: Dietary Calcium, Oyster Shell, Laying Guinea Fowl, Performance, Haematology.

INTRODUCTION

Guinea fowl are varieties of poultry that has not been given the necessary attention for improved production indices as obtained for other species like chicken [1]. The nutrient requirements of guinea fowl are however, been assumed to be the same as that of the chicken as regards the major nutrients [2]. Laying guinea fowl was documented to averagely consume 53 g of feed containing 15% crude protein [3]. Feeding of guinea fowl is an area that has attracted the attention of nutritionists in recent times particularly the peculiarity of its eggshell thickness makes its calcium requirement of research interest. However, in the wild, guinea fowl feed on large proportion of calcium when on free range, which contributes to the hardness attributable to its eggshell. Recent studies showed that 3.25% - 3.75% dietary calcium and 0.35% or 0.40% available phosphorous will be adequate for Pearl Grey guinea fowl [4]. Oyster shell is one of the credible dietary calcium sources for the feeding of farm animals. Therefore, this study evaluated the influence of oyster shell on growth and production performances and haematology of laying guinea fowl (*Numida meleagris*)

MATERIALS AND METHODS

A total of 75 Pearl laying guinea fowls at point-of-lay (POL), aged 28 – 32 weeks old were collected from the Kainji Lake Research Institute, New Bussa, Nigeria, transported to the Teaching and Research Farm of the Faculty of Agricultural Sciences, Ekiti State University, Ado Ekiti for the study. The birds were raised on floor in cages with dimension 2 m x 4 m x 4 m constructed using wire mesh. The birds were divided into 5 treatment groups of 15 birds each in a completely randomized design trial. They were fed experimental diets in which oyster shell was the main source of calcium at graded levels of 2.5%, 3.0%, 3.5%, 4.0% and 5.0% (Table 1). Each treatment group was further divided into three replicates of 5 birds each. Body weight and feed intake were measured every week throughout the experimental period. The experimental feeds and water were given *ad libitum* throughout the trial.

Data collection: The ADWG and ADFI were recorded from each replicate on weekly intervals. Weekly BWG was then calculated by subtracting the weight at the end of the previous week from the current weight of the birds. Feed conversion ratio was calculated as feed to dozen egg produced.

At the end of 5th week, 2 birds of average weight from each replicate were selected and blood was collected from the wing vein into well labeled sample bottles containing ethylene diamine tetra acetate (EDTA) as anti-coagulant. The samples were immediately transported to the laboratory for analyses. The haematology indices namely, packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC), haemoglobin, (Hb) and the differentials were analyzed as described by Sastry [5]. The feed samples were analyzed for proximate as described by AOAC [6].

Statistical analysis: All the data was subjected to one-way ANOVA statistical analysis at 5% probability ($p<0.05$) using SAS [7]. Means were separated using Duncan's Multiple Range Test of the same software.

RESULTS AND DISCUSSION

Table 1 Composition of experimental diets fed laying guinea fowl (%)

Ingredients	Calcium inclusion levels (%)				
	2.5	**3.0**	**3.5**	**4.0**	**4.5**
Maize	51.56	51.56	51.60	51.66	51.72
Wheat offal	12.00	9.50	7.00	5.00	3.00
PKM	5.00	6.00	7.00	8.00	8.50
SBM	12.00	11.13	11.21	11.48	11.65
GNC	9.00	9.94	9.89	9.13	8.97
Fish meal	2.00	2.00	2.00	2.00	2.00
Oyster shell	7.14	8.57	10.00	11.43	12.86
Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
*Premix	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00
ME Kcal/kg (Calc.)	2626.52	2622.85	2620.06	2612.90	2601.60
CP (%)	17.98	17.79	17.57	17.18	16.94
Ca (%)	2.69	3.15	3.69	4.19	4.69
P (%)	1.23	1.22	1.21	1.23	1.21

*Supply the following per kg of diet: vit. A, 10,700 iu; vit. D3, 2,900 iu; vit. E, 15 iu; vit. K, 2.2 mg; B1, 1.6 mg; B2, 4.0 mg; Niacin, 1.5 mg; Pantothenic acid, 11.5 mg; vit. B6, 2.0 mg; vit. B12, 0.01 mg; Folic acid, 1.0 mg; Biotin, 0.03 mg; Chloride, 150 mg; Mn, 70 mg; Fe, 25 mg; Zn, 4.5 mg; Cu, 25 mg; Co, 0.2 mg; Se, 0.2 mg; Anti-oxidant, 125 mg.

Table 2: Performance of guinea fowl fed diet with oyster shell as main calcium source

Parameters	Calcium inclusion levels (%)				
	2.5	**3.0**	**3.5**	**4.0**	**4.5**
Average daily feed intake (g)	64.3 ±0.22 ^{ab}	65.8±0.99^{a}	63.5 ±3.45 ^{ab}	64.4 ±0.85 ^{ab}	62.1±0.01^{b}
Average daily weight gain (g)	19.6 ±0.55	20.5 ±0.20	20.1 ±3.33	20.5 ±0.46	**20.7 ±0.05**
FCR	3.31 ±0.15 ^{b}	3.22 ±0.08^{ab}	3.17 ±0.19^{ab}	3.17^{a}±0.19^{ab}	**2.98±0.09** ^{a}
Egg production 9%)	48.1±12.5	38.1±0.41	37.7 ±1.37	36.1 ±0.82	44.8 ±0.40
Egg weight (g)	37.6 ±2.65	40.2 ±1.73	38.8 ±0.58	39.8±1.86	38.1 ±1.00
Egg mass (g)	78.6 ±2.35	75.5 ±3.22	73.8 ±3.45	90.8 ±3.33	73.7^{a}±0.19

a,b, c, means with different superscripts in the same row differs significantly (p<0.05)

Table 3: Haematology of guinea fowl fed diet with oyster shell as main calcium source

	Calcium inclusion levels (%)				
Parameters	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**
PCV (%)	41.3±3.76	44.7±4.48	39.0±4.36	36.0±3.06	40.7±0.67
Hb(g/L)	7.01±2.45	11.5±3.65	10.5±2.52	11.0±2.89	3.89±1.78
WBC(10^{-6}/L)	51.4±2.53	51.7±2.32	51.1±2.44	51.3±2.22	51.2±2.51
RBC(x10^{-12}/L)	2.28±0.23	2.33±0.25	2.42±0.32	2.02±0.18	2.40±0.30
Neutrophils (%)	35.7±1.20	34.0±3.06	28.7±4.67	35.3±2.91	30.3±3.18
Lymphocytes (%)	44.0±2.31	50.0±5.03	53.3±6.96	44.7±2.91	50.3±2.33
Monocytes (%)	8.67±0.67	8.00±1.15	8.67±0.67	8.00±0.11	10.0±1.16
Eosinophils (%)	11.7±1.67	8.00±1.55	9.33±1.76	12.0±1.16	9.33±0.67

The growth and production performances of the laying guinea fowls are presented in Table 2. The average feed intake (ADFI) and feed conversion ratio (FCR) were both significantly affected ($p<0.05$) by the dietary calcium levels. Birds fed 3.0% dietary calcium showed significantly higher ($p<0.05$) ADFI (65.8±0.99 g) which was similar to data obtained from those on 2.5% (64.3±0.22g), 3.5% (63.5±3.45g) and 4.0% (64.4 ±0.85) dietary calcium. The best ($p<0.05$) FCR was recorded by birds on treatment with 4.5% dietary calcium while those on 2.5% calcium (3.31±0.15) was poor ($p<0.05$). The ADWG and production performance parameters such as egg weight, egg mass and hen day production were not significantly affected ($p<0.05$) by the dietary calcium levels. The observed increase in ADFI perhaps was due to the birds eating to meet its calcium need for egg production, which was found similar in this trial. The observation indicated that consumption of dietary calcium above 3.0% was of no significant benefit in term of production. However, previous findings showed that increase in dietary calcium did not translate into improved egg production [8, 4]. The haematology indices were not affected by the dietary calcium. The values recorded differ and were higher than those reported by Uko and Ataja [9] and might be due to environmental issues and management practices. It can be concluded that dietary calcium of 3.0% sourced exclusively from oyster shell support adequate production and growth performance in laying guinea fowls.

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Effect of Phytogenic Supplemented Goat Blood-Rumen Content Mixture Based- Finisher Diets on the Growth and Blood Parameters of Broiler Chicken

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Abstract: Highly priced conventional feedstuffs have led to the desire to find cheaper alternative feedstuffs; enhancement of the utilization of goat blood /rumen content mixture by poultry, and the effect of phytogenic supplemented Goat Blood-Rumen Content Mixture(GBRCM) based-diets is the thrust of this study. A total of one hundred and twenty 5 weeks old broiler chickens were allotted to three experimental diets in a completely randomized design (CRD) to evaluate the effect of feeding phytogenic supplemented goat blood-rumen mixture (GBRCM) based-diets on the growth, haematological parameters and serum biochemical component of broiler chicken. Each group (treatment) was replicated four times with ten birds per replicate and the experiment lasted for five weeks (35 days). The parameters evaluated were; body weight gain, feed intake, feed conversion ratio, protein intake, protein efficiency ratio, blood parameter. The results revealed that birds fed phytogenic supplemented diets had significantly ($P<0.05$) higher body weight gain, feed intake, superior feed conversion ratio, protein intake and protein efficiency ratio than birds fed the unsupplemented diet and the control diet. There was no significant ($P>0.05$) difference on the body weights and feed intake of the birds fed the control diet (T_1) and the test diet (T_2) among the treatments. The haematological and serum biochemistry indices revealed that there were significant ($P<0.05$) differences among the treatments, except white blood cell count where no significant ($P>0.05$) difference existed. The (GBRCM) based-diet supplemented with phytogenes can be included up to 10% in the broiler diets without any adverse effect on performance.

Keywords: Goat Blood-Rumen Content Mixture (GBRCM), Phytogenic Plant, Rosemary and Broilers.

INTRODUCTION

The high cost of feeds and therefore the cost of poultry products have made researchers to concentrate on the use of cheaper and locally available alternative agro-by products especially those that have no nutritional value to mankind (Oladunjoye and Ojebiyi, 2010). The need to maximize the economic and environmental disposal of slaughterhouse by-products (NAVN, 1994) also stimulated a renewed interest in the investigation of slaughterhouse by-products for possible use as protein feedstuffs in livestock feeds (Mohammed *et al*., 2011). Incorporation of such products in feed would help in alleviating the problem of the scarcity of feed supply that is having a negative effect on livestock industry most especially monogastric animal production (Onu *et al*., 2011).

The use of phytogenic substances will reduce the use of antibiotic growth promoters (AGPs) in poultry diets (Umit *et al*., 2011) due to their antimicrobial properties (Kamel, 2001) and ensure greater productivity in poultry, increase feed palatability, nutrient utilization, stimulate appetite, increase the flow of gastric juice and gives piquancy to tasteless food (Daizak, 1989).

MATERIALS AND METHODS

Source and Processing of Goat Blood-Rumen Content Mixture: Goat blood-rumen content was collected from the main abattoir while slaughtering of the animal was in progress. The rumen was split open with the aid of sharp knife and the content was emptied into a 25 litres plastic bucket. The rumen content was mixed with blood collected from the abattoir at a ratio of 3:1. It was boiled for 30 minutes with constant stirring and was sun-dried on concrete floor to about 12% moisture.

Table 1: Proximate CompositionGoat Blood-Rumen Content Mixture and Rosemary used in the formulation of the experiment diets

Parameter%	GBRCM	Rosemary
Dry matter	93.10	78.03
Crude protein	35.00	1.06
Crude fibre	27.96	18.00
Ether Extract	4.32	0.05
Total Ash	13.50	3.40
Nitrogen free extract	48.92	40.01

Experimental Diet: Four experimental broiler diets were formulated such that diet I (T_1) contained 0% GBRCM without supplementation (control). Diet 2 (T_2) contained 10% GBRCM without supplementation. Diets T_3 contained 10% GBRCM supplemented with 5g rosemary 1kg of feed.

Table 2: Ingredients Composition of the Experimental Broiler Chicken diets

Ingredients %	T_1	T_2	T_3
Maize	48	48	48
Soyabean meal	22	12	12
Wheat oftal	15	15	15
GBRC	00	10	10
PKC	10	10	10
Fish meal	2.0	2.0	2.0
Bone meal	2.0	2.0	2.0
Lysine	0.25	0.25	0.25
Methonine	0.25	0.25	0.25
Premix	0.25	0.25	0.25
Salt	0.25	0.25	0.25
	100	100	100
Rosemary	-	-	-
Calculated Chemical Composition:			
Crude Protein	19.16	18.15	18.15
Ether Extract	3.83	3.78	3.78
Crude Fibre	4.71	6.86	6.86
Total Ash	3.12	2.86	2.86
Total ME/cal.(kg)	309579	298566	295866

Premix supplied (Univit 15 Roche) contained: 15001.U, Vit.A;15001.U, Vit.D;30001.U, Vit.E;3.0g, Vit.K;2.5g, Vit,B2;0.3g, Vit.B6; 8.0mg, Vit.B12;8.0g, Nictinic acid; 3.0, Ca-Panthothenate;5.0mg, Fe;10.0g, Al;0.2g, Cu;3.5mg, Zn;0.15mg, I;0.02g, Cu;0.01g,Sc. GBRCM =Goat blood rumen content mixture.PKC =Palm kernel cake. ME (cal/g) = Metabolizable Energy (calories per kilogramme).

Experimental Animal and Management of the Broiler Chicken

One hundred and twenty 5 weeks old chicks of Anak strain were used for this experiment. The birds were allotted to three (3) dietary treatments in a completely randomized design (CRD). The experiment lasted for five (5) weeks (35days).

Statistical analysis: All data obtained were statistically analyzed using the method of Snedecor and Cochran,(1980) and separation of means Duncan's New Multiple Range Test as outlined by Obi, (2002).

Collection of Blood Samples and Analysis: Two 2mls of blood was collected from three birds of each replicate via wing vein, using EDTA bottle as anticoagulant and vial bottle without anticoagulant.

RESULTS AND DISCUSSIONS

Table 3: The proximate composition of the experimental diets is as presented below.

Treatment (%) GBRCM & APs	DM	CP	CF	EE	ASH	ME(Cal/)
0%	92.73	19.18	8.57	8.19	9.10	2889.71
10% GBRCM	92.66	20.38	12.14	9.29	9.50	2910.95
10% GBRCM (rosemary)	92.19	20.88	12.30	9.23	9.38	2925.30

GBRCM & APs = Goat blood-rumen content mixture and Aromatic plants (%) = (percentage), DM = Dry matter, CP = crude protein, CF = Crude fibre, EE = Ether Extract, Ash = Total Ash, ME (CAL/kg) = Metabolizable Energy (calories per kilogram).

The range of ash values obtained in this study was adequate to provide the necessary mineral such as calcium and phosphorus needed for development of bones.

Table 4: Performance characteristics of Broiler chicken Fed Experimental Diets

Parameters (g)	T_1 (0%)	T_2 (10% GBRCM	T_3 10% GBRCM (0.5% rosemary)	SEM (+)	SIGN
Initial Body Weights (g)	1252.50^b	1250.00^b	1260.00^a	12.31	*
Final Body Weights (g)	3031.55^b	3083.33^b	3325.00^a	39.36	*
Total Body Weights (g)	1866.50^b	1880.83^b	2040.90^a	31.30	*
Daily Body Weights (g)	53.33^b	53.74^b	53.31^a	0.91	*
Total Feed Intake (g)	4025.00^b	4027.76^b	4061.33^b	17.75	*
Daily Feed Intake (g)	115.00^b	115.08^b	116.03^b	0.51	*
Feed Conversion Ratio	2.16^a	2.14^a	2.00^b	0.03	*
Daily Protein Intake	22.03^a	20.89^c	21.22^b	0.12	*
Protein Efficiency Ratio	2.42^b	2.57^b	2.75^a	0.04	*
Mortality	0.00	0.00	0.00		

a, b, c – Means with different superscripts along the row are significantly different ($p<0.05$). GBRCM =Goat Blood-Rumen Content Mixture, SEM=Standard Error of Mean

Diets T_3significantly ($P<0.05$) improved the weight gain of birds than the control diet. The improved body weight gain obtained in this work strengthened the reports of Ademola *et al*. (2009) who reported weight gain of birds fed aromatic plants.

There were significant ($P<0.05$) differences in the feed conversion of the birds among the treatments. Hassan *et al*. (2004) reported an improvement in feed conversion ratio by the addition of herbal feed additives in the diets.

Table 5: The effect of aromatic plants on the Haematology and Serum Biochemistry of Broiler chicken fed experimental diets

Parameter	T_1	T_2	T_3	SEM	SIGN
Haemoglobin conc. (g/100ml)	10.30^b	11.30^a	12.00^a	$\pm$0.50	*
Packed Cell volume (%)	34.00^b	35.00^a	36.00^a	$\pm$0.84	*
White Blood Cell ($x10^9/_L$)	9.60^a	11.10^a	10.90^a	$\pm$0.49	NS
Red Blood Cell ($x10^{12}/_L$)	1.80^b	1.90^b	2.05^a	$\pm$0.25	*
Mean Cell Volume (FL)	115.10^b	117.00^b	124.00^a	$\pm$1.22	*
Mean Cell Haemoglobin (Pg)	75.60^b	79.70^b	86.70^a	$\pm$1.09	*
Mean Cell Haem.Conc. (g/L)	626.00^c	667.00^b	692.00^a	$\pm$2.69	*
Protein (g/L)	37.40^b	39.80^a	39.50^a	$\pm$0.57	*

Albumin (g/L)	12.70^{b}	13.50^{a}	13.05^{a}	±0.34	*
Globulin (g/L)	24.70^{b}	26.30^{a}	26.45^{a}	±0.45	*
Urea (mg/dl)	3.00^{c}	4.40^{b}	5.00^{a}	±0.42	*
Creatinin (mg/dl)	0.74^{b}	0.90^{a}	0.64^{a}	±0.22	*
Total cholesterol (mmo/L)	2.90^{a}	1.30^{b}	1.28^{b}	±0.42	*

a,b, c, means with same superscripts along the same row are significantly (P>0.05) the same; But a, b, c, means with different superscripts along the same row are significantly (P<0.05) different, SEM = Standard Error of Means.

The dietary treatments had significant (P<0.05) influence on all the haematological indices evaluated except the white blood cell of the blood. The higher serum albumin and globulin values of birds fed supplemented and unsupplemented GBRCM diets means that the proteins of the treatments T_2– T_3, were readily available to the birds (Anon.,1980) who reported changes in protein reserve in animal as indicated by serum total protein to be associated with alteration in the albumin fraction. Birds fed control diet had significantly (P<0.05) higher cholesterol level than those fed diets GBRCM. This finding strengthened the reports of Onu and Aja (2011). The results are also in agreement with the report Fuhrman *et al.* (2000) who reported that phytogenic foods possess cholesterol-suppressive capacity.

SUMMARY/CONCLUSION

The studies herein reported mere efforts to find alternative feedstuffs to the highly priced conventional feedstuffs, and also enhance the utilization of GBRCM by poultry, by evaluating the effect of phytogenic supplemented goat blood rumen content mixture based-diets on the growth, haematological and biochemical component. Supplementation of GBRCM based-diets with phytogenic substance (rosemary) enhanced the performance, immune response, reduced blood cholesterol, improved health of chicken and reduced cost efficiency of broiler rearing.

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Effects of Dietary Levels of Enzyme Supplemented Rice Husk on Performance, Nutrient Retention and Microbial Gut Profile of Broilers

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Abstract: Rice husk was treated with *xylanase* enzyme and fed to broiler chickens to investigate its prebiotic potential on their performance, nutrient retention and microbial gut content. Feeding trial was conducted for 5 weeks and 192-day old Arbo acre birds were fed control diet (50% maize) and diets with Rice husk included at 10, 20, and 30% levels at the expense of maize in the control diet. Data were collected on bird performance and in third week of the feeding trial, nutrient retention was determined. On the last day, microbial gut profile was determined. All data were subjected to two-way analysis of variance using General Linear Model procedure SAS Institute (2000). Birds fed diet with 10% RH gained more weight than those on 20% or 30% RH ($p<0.05$). Protein retention of birds fed diet with 30% RH was significantly lower than those of birds fed diets with 10% or 20% RH ($p<0.05$). LBC for birds fed control diet was significantly lower than those of birds fed diets with 10% or 20% RH ($p<0.05$). Enzyme supplementation had significant decreased effects on feed intake, feed/gain ratio and on the FCC ($p<0.05$). It however had significant increased effect on the weight gain ($p<0.05$) and all nutrient retention. In conclusion, birds on 10% RH supplemented with *xylanase* enzyme out-performed birds fed other diets. Enzyme supplementation of RH improved nutrient retention. Dietary levels of RH (10, 20 or 30% inclusion) with supplementation of enzyme *xylanase* enhanced the growth of beneficial microbes.

Keywords: Enzyme, Rice husk, Performance, Nutrient Retention, broiler

INTRODUCTION

Food ingredients that are non-digestible or of low digestibility and selectively stimulate the growth of limited number of gut microbiota species are referred to as prebiotics and it confers health benefits to its host (Roberfroid *et al*., 2010). Rice Husk (RH) is a by-product in the rice-milling industry with a lignocellulosic biomass and accounts for about 40 million metric tonnes of wastes from more than 500 million metric tonnes of the world's annual paddy rice production. Its composition is made up of 15-20% oil, 12-16% protein, 6.5% oligosaccharides, 35-55% other carbohydrates and 7-10% silica and other micro elements (Wang and Qui, 2005). It has a high phytate content which makes it prone to rancidity, high in fibre and contains a trypsin inhibitor (Gallinger *et al*. 2004). Some of these characteristics are responsible for its limited use in poultry diets but this limitation could be reduced with enzyme supplementation. Exogenous microbial enzymes have long been used to improve the nutritional value of high fiber diets (Angelovicova *et al*. 2005; Raza *et al*. 2009). However, there is little or no information on the prebiotic's potentials of enzyme supplemented rice bran in Chickens. Thus, this study is designed to investigate the prebiotic potential in the gut content of broiler chickens fed Rice Husk (RH) treated with *Xylanase* enzyme.

MATERIALS AND METHODS

Birds were fed a control diet (50% maize) and diets in which Rice husk (RH) was added at 10, 20, and 30% levels at the expense of maize in the control diet. Each of these diets was given with or without enzyme supplementation in a 4 x 2 factorial combination. There were 8 experimental treatments each with 3 replicates. 192-day old broiler chicks of Arbor acre strain were used for this trial. Water and feed were administered to the birds ad libitum in a feeding trial that lasted 5weeks. The composition of experimental diet is as shown in Table 1.

Performance parameters measured were Feed Intake, Body Weight Gain and Feed conversion Ratio. For Nutrient retention trial weighed quantities of feed and excreta samples were oven dried at 70^0c, weighed and ground prior to analysis. Chemical constituents were determined using the procedures outlined by A.O.A.C (2005). Microbial gut profile was determined on the last day of the feeding trial. The luminal contents of the crop, duodenum, ileum and caecum were collected and pooled together. Approximately, 1.5ml of each sample were transferred into tightly closed tubes and frozen prior to subsequent analysis. This was done to determine population and profile of microorganisms present in the broiler gut. All data collected were subjected to two-way analysis of variance using General Linear Model procedure SAS Institute (2000). Significant differences between treatments means were separated using the Duncan multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

The results of the effects of dietary levels of Rice Husk (RH) with or without enzyme supplementation on the performance of broilers (Table 2) showed that feed intake in birds fed diet with 30% RH was significantly higher than those of birds fed diets with 10% or 20% RH ($p<0.05$). Birds fed diet with 10% RH gained more weight than those of birds fed diets with 20% or 30% RH ($p<0.05$). Enzyme supplementation had significant decreased effects on feed intake and feed/gain ratio but significant increased effect on the weight gain ($p<0.05$). Marquardt *et al*., (1994) reported that the ability of the birds to facilitate access of enzymes to intracellular starch granules, proteins and other nutrients by breaking down otherwise intact bonds between non-starch polysaccharides was the reason for better performance in birds fed enzyme supplemented diets. Table 3a shows the protein retention of birds fed diet with 30% RH was significantly lower than those of birds fed diets with 10% or 20% RH ($p<0.05$). Enzyme supplementation had significant increased effects on all nutrient retention. There was interaction (Table 3b.) between RH and enzyme supplementation as regards crude protein retention ($P<0.05$). The use of exogenous microbial enzymes improved nutrient digestibility, destroy anti-nutritional factors and manipulate gut flora population as well as supplementing endogenous enzymes (Bedford, 1996). LBC for birds fed control diet was significantly lower than those of birds fed diets with 10% or 20% RH ($p<0.05$), but comparable with birds fed diet with 30% RH ($p<0.05$) (Table 4). Enzyme supplementation had significant decreased effect on the FCC ($p<0.05$). According to Sukaryana (2007), high population of fungus can increase the crude protein content of the substrate as the mold is a source of single cell protein. This may be the reason behind 20% RH inclusion having similar protein retention as 10% RH inclusion level.

In conclusion it was observed that birds fed diet with 10% RH supplemented with *xylanase* enzyme out-performed birds fed diets with 20 or 30% RH supplemented with *xylanase* enzyme. Also enzyme supplementation of RH helped in increasing and improving nutrient retention. Dietary levels of RH (10, 20 or 30% inclusion) with supplementation of enzyme *xylanase* enhanced the growth of beneficial microbes which resulted in inhibition or elimination of the opportunistic/pathogenic microbes.

Table 1: COMPOSITION OF EXPERIMENTAL DIET (%)

Ingredients	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Maize	50	50	40	40	30	30	20	20
Rice Husk	0	0	10	10	20	20	30	30
Xylanase (ppm)	0	100	0	100	0	100	0	100
Basal ingredients	50	50	50	50	50	50	50	50
Total	100	100	100	100	100	100	100	100
Analyzed nutrient composition (%)								
Crude Protein	21.64	20.67	19.93	20.33	19.58	18.65	19.39	20.97
Crude Fibre	6.05	5.60	6.90	7.45	7.52	8.45	8.98	9.75
Crude Fat	9.29	9.15	7.54	7.49	6.50	7.76	8.27	8.67

Dry matter 93.22 93.30 95.10 95.32 96.40 95.21 95.78 96.69

Basal diets: Groundnut cake (GNC) – 26%, corn bran- 1%, soybean meal- 12%, fishmeal (72%)- 4%, palm oil- 2%, oyster shell- 2%, bone meal- 2%, salt- 0.25%, methionine- 0.25%, lysine- 0.25% and vitamin premix- 0.25% (provided per kg; Vit.A 4,000IU, Vit.D_3 8,000IU, Vit.E 4,000mg, Vit.K 900mg, Vit.B_1 500mg, Vit. B_2 2000mg. Vit.B_3 5,500mg, Choline chloride 15,000mg, Antioxidant (BHT) 0.05%, Iron 1.8%, copper 0.02%, manganese 2.4%, cobalt 0.045%, zinc 2.8%, iodine 0.04%, selenium 0.18%, calcium 12.8%).

Table 2: Effects of Dietary Levels of Rice Husk (RH) with or without Nutrase Xyla Supplementation on Performance of Broilers (0-5wks)

	Feed Consumed (g/bird/day)	Weight Gain (g/bird/day)	FCR
RICE BRAN (%)			
0	55.1^{c}	32.6^{a}	1.7^{d}
10	57.2^{b}	27.6^{b}	2.1^{c}
20	56.9^{b}	25.3^{c}	2.3^{b}
30	58.9^{a}	23.8^{d}	2.5^{a}
SE	0.21	0.32	0.03
ES (100ppm)			
0	57.4^{a}	26.2^{b}	2.2^{a}
100	56.7^{b}	28.5^{a}	2.0^{b}
SE	0.15	0.22	0.02
RB*ES	NS	NS	NS

Column means with different superscripts are significantly different NS: not significant, S: Significant

Table 3a: Effects of dietary levels of Rice Husk (RH) with or without enzyme supplementation on Nutrient Retention of Broilers

	Crude Protein (%)	Crude Fiber (%)	Crude Fat (%)
RB (%)			
0	83.1^{a}	73.8^{a}	74.3^{a}
10	69.2^{b}	63.6^{b}	57.4^{b}
20	59.0^{c}	61.6^{bc}	56.9^{b}
30	55.6^{d}	59.2^{c}	54.7^{b}
SE	0.89	0.95	1.52
ES (100ppm)			
0	62.7^{b}	60.7^{b}	58.1^{b}
100	70.8^{a}	68.5^{a}	63.5^{a}
SE	0.63	0.67	1.07
RB*ES	S	NS	NS

Column means with different superscripts are significantly different NS: not significant, S: Significant

Table 3b: The detail of Interaction on Crude Protein

ES (100ppm)	Dietary Rice Bran Supplementation (%)			
	0	**10**	**20**	**30**
0	80.1^{b}	60.2^{c}	55.2^{d}	55.2^{d}
100	86.0^{a}	78.1^{b}	62.8^{c}	56.1^{d}

Table 4: Effects of dietary levels of Rice Husk (RH) with or without enzyme supplementation on the microbial gut profile of broilers

	TVC (10^7cfu/ml)	TCC (10^7cfu/ml)	FCC (10^7cfu/ml)	LBC (10^7cfu/ml)	FC (10^5cfu/ml)	pH
RB (%)						
0	5.8^b	4.7^b	2.4	1.3^b	1.5^b	5.5^b
10	6.5^{ab}	5.3^{ab}	1.7	1.8^a	1.8^b	5.8^a
20	7.0^a	5.9^a	1.7	2.1^a	2.4^a	5.7^{ab}
30	6.5^{ab}	5.8^a	1.7	1.8^{ab}	1.5^b	5.7^a
SE	0.33	0.26	0.37	0.18	0.17	0.04
Enzyme (100ppm)	6.2	5.6	2.6^a	1.0	1.0	5.7
0	6.6	5.3	1.2^b	2.9	1.9	5.7
100	0.24	0.18	0.26	0.13	0.12	0.03
SE						
RB*ES	NS	NS	NS	NS	NS	NS

Total Viable Counts (TVC), Total Coliform Counts (TCC), Feacal Coliform Counts (FCC), Lactobacillus Counts (LBC) and Fungi Counts (FC).

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Effects of Dietary Protein and Energy Levels on Reproductive Performance of Guinea Hens

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Abstract: The effects of different protein and energy levels on the reproductive performance of guinea hens was studied using one (100) hundred hens that were randomly allocated to one of the treatment groups. The treatment groups consist of 5 levels of protein (16%, 18%, 20%, 22% and 24%) and 2 levels of energy (2750 and 2850kcal/kg) in a 5 x 2 factorial design. In the experiment that lasted 52 weeks, data were collected on age at first egg, body weight at first egg, egg number, egg weight, egg mass, hen day production and egg quality. Dietary protein levels had significant influence ($P<0.05$) on age at first egg, egg number, egg mass and hen day production. Feed intake averaged 88.8g and 89.1g for birds on 16 and 22% protein diets (respectively) and were significantly ($P<0.05$) lower than the feed intake of birds on 18% (102.0g) and 24% (104.7g). The group on 20% protein performed better ($P<0.05$) than other protein groups. Body weight at onset of lay and average egg weight did not differ ($P>0.05$) between the protein groups. The energy levels had no significant effect (($P>0.05$) on the different parameters measured. The result of the study suggests that 20% crude protein and 2750kcal/kg ME improve performance of guinea hens in the tropics.

Keywords: egg production, energy, guinea hens, protein, sexual maturity.

INTRODUCTION

Guinea fowls are reported to grow slowly and to utilize feed less efficiently than chickens (1), thus taking them a longer time and more feed to reach mature weight and age at lay. Ayorinde (2) reported that though exact dietary requirement of the helmet guinea fowl is not completely known, studies have indicated requirements of several nutrients. It has been observed that the assessment of calorie and protein requirements appear to be the most critical considering that the two components attract the highest cost in livestock feed and also form the largest bulk by weight of compounded rations (3). It is known that the poultry specie eats to satisfy their energy needs and this is affected by the calorie density of the feeds. Similarly, the ratio of calorie to protein has been scientifically verified to remarkably affect the biological productivity, physiological well being and carcass composition of animals, especially monogastrics (4, 5).

Most wild birds breed during a restricted period of the year irrespective of the latitude at which they are found (6, 7). This restriction is usually imposed by the seasonal availability of the appropriate food source required for feeding and fledging the young. The female would also require sufficient food to form her eggs. Guinea fowls in the wild are known to have access to insects and grasses especially in the wet season which coincides with the breeding season. This suggests that protein and energy rich components predominate in their diets and this appears necessary for maintenance of daily activities (7, 8, 9). Under domestication therefore, reproductive performance appears to be guaranteed with the availability of adequate nutrients. This study is aimed at investigating the effect of five protein and two energy levels on the reproductive performance of the domesticated guinea hen.

MATERIALS AND METHODS

The experiment was carried out at the pavilion of Department of Animal Production, University of Ilorin, Ilorin, Nigeria. A total of 100 guinea hens at 20 weeks of age were selected from an existing base population previously established from hatched eggs collected from peasant keepers in Northern Nigeria and randomly assigned to one of the treatment groups of five levels of dietary protein (16%, 18%, 20%, 22% and 24%) and two levels of energy

(2750 and 2850kcal/kg). The birds were kept in individual battery cages and feed (Table 1) and water supplied *ad libitum* for the 52 weeks duration of the experiment.

Data Collection

Feed intake: Total feed consumed was monitored and recorded fortnightly.

Body weight: The body weight of each hen was taken fortnightly using a top loading weighing scale.

Feed Efficiency: The weight gained over a period of time for each replicate was expressed as a percentage of feed intake over same period.

Age at first egg: The age at which each group started to lay was recorded.

Body weight at onset of lay: The weights of the birds were recorded at the age of first egg.

Egg weight: Eggs laid were weighed on a daily basis, and the average weight for each group taken.

Egg number: Total eggs laid for each group during the experimental period was recorded.

Hen Day Production: This was calculated using the formula:

(No of eggs laid/No of days) x 100

Egg mass (EM): This was calculated using the following formula:

Total number of eggs laid x Average egg weight

Statistical Design and Analysis:

Datacollected were analyzed using Genstat Release 10.3DE as appropriate for a 5x2 Factorial design and means for each combination of protein and energy levels separated using DMRT of the same package.

RESULTS AND DISCUSSION

Table 1: Proximate composition of experimental diets fed to guinea hens.

Energy (kcal/kg)	2750					2850				
Protein level	16	18	20	22	24	16	18	20	22	24
Ingredient (%)										
Maize	59.03	59.03	55.83	38.00	36.00	63.13	59.75	58.42	40.00	36.00
Wheat offal	5.00	3.00	3.00	5.00	0.00	1.50	3.48	1.00	0.00	0.00
BDG	0.00	0.00	0.00	20.00	32.4	0.00	0.00	0.00	34.00	32.40
Fish meal	2.00	3.80	5.00	2.50	3.00	2.00	3.50	5.20	2.50	3.50
GNC	20.00	20.80	22.80	7.00	6.00	20 .00	19.90	22.01	6.20	7.70
SBM	3.40	3.40	3.40	9.20	11.20	3.40	3.40	3.40	10.50	13.60
Oyster shell	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
Bone meal	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40
Lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 2: Effect of dietary protein and energy levels on performance of guinea hens.

	Average Feed Intake (g/b/day)	Body Weight at first Egg (g)	Age at first Egg (days)	Egg No	Average Egg Wt (g)	Egg Mass (g)	Hen Day Production (%)
Protein							
16%	89.1[b]	1158	211.90[a]	30.7[c]	34.56	1065[c]	8.43[c]
18%	102.0[a]	1152	204.40[b]	54.9[b]	33.49	1832[b]	15.08[b]

20%	89.1[b]	1106	196.90[c]	62.9[a]	33.61	2108[a]	17.28[a]
22%	88.8[b]	1149	205.30[b]	50.5[b]	35.02	1769[b]	13.88[b]
24%	104.7[a]	1124	204.60[b]	53.9[b]	35.20	1894[ab]	14.81[b]
SED	5.55	54.0	3.04	0.49	1.19	118.6	0.88
Energy							
2750kcal/kg	94.1	1139	205.24	50.9	34.12	1734	13.99
2850kcal/kg	95.4	1137	204.00	50.2	34.14	1733	13.80
SED	3.51	34.2	1.93	2.03	0.75	75	0.56
Protein x Energy	NS	NS	*	*	NS	*	*

Means within each group followed by different superscripts differ significantly (P<0.05) NS: Not Significant *: Significantly different

Table 3: Interaction between Protein and Energy levels for different parameters.

Energy (kcal/kg)	Protein (%)	Age at first egg (days)	Egg Number	Egg Mass (g)	Hen Day production (%
2750	16	209.40[ab]	29.4[c]	1002[c]	8.07[c]
	18	209.60[a]	50.6[b]	1655[b]	13.90[b]
	20	199.20[b]	63.4[a]	2129[a]	17.42[a]
	22	200.80[b]	56.4[ab]	1988[ab]	15.50[ab]
	24	207.20[ab]	54.8[a]	1896[ab]	15.05[ab]
2850	16	214.40[a]	32.0[c]	1127[c]	8.79[c]
	18	199.20[b]	59.2[ab]	2009[a]	16.26[ab]
	20	194.60[b]	62.4[a]	2086[a]	17.14[a]
	22	209.89[a]	44.6[b]	1550[b]	12.25[b]
	24	202.00[b]	53.0[b]	1891[a]	14.56[b]

Means along each column followed by different superscripts differ significantly (P<0.05)

Average daily feed intake (Table 2) was significantly (P<0.05) influenced by protein level, but not by the energy level and there was no significant interaction (P>0.05) between protein and energy. Feed intake was highest for birds fed 24% protein and similar to birds fed 18%. Birds on other levels had significantly (P<0.05) lower feed intake. Feed intakes based on energy levels were similar; which suggests that the levels were comparable in meeting the needs of the birds as poultry are generally known to eat to satisfy their energy requirement. There were no significant differences (P>0.05) in the values obtained for body weight at first egg based on the protein and energy levels. Birds fed 16% protein and 2850kcal/kg ME had the highest body weight at onset of lay (1181g) while 20% protein and those on 2750kcal/kg ME had the lowest weight (1080g). The results agree with the reports of (10) that dietary protein intake had no influence on body weight in broiler breeders. Body weights obtained at onset of lay for all groups are slightly higher than was reported by (12) but similar to (11) who reported higher body weight at onset of lay for birds fed 16% protein and 2750kcal/kg ME. Age at first egg was significantly influenced (P<0.05) by protein levels but not energy level. Birds on 20% protein came into lay at 196.9days while those on 16% protein did not come into lay till 15 days later. This is an indication that birds fed lower protein diets could not attain the body weight threshold required for initiation of egg production early enough. This is contrary to the reports of(10) who obtained no significant effect of dietary protein on age at sexual maturity. There was significant (P<0.05) interaction between protein and energy levels (Table 2).

Egg number was significantly increased (P<0.05) by dietary protein. The lowest level of protein, 16% had the lowest egg number (29.4). Highest egg number (63.4) was recorded for 20% protein. The other protein levels had similar egg number (50.6 – 56.4). Result obtained is similar to the report of previous authors who obtained

an increase in egg production in hens fed additional protein (13, 14). Egg weight was not different (P>0.05) among the different protein and energy levels. The results agree with the findings of(8) that there is no difference in egg weight of guinea hens fed different dietary protein and energy levels and in broiler breeders by(10). There was interaction (P<0.05) between energy and protein levels for egg number. Except for the 16% protein diets, all the protein levels had better egg number at 2750kcal/kg energy. Egg mass was significantly (P<0.05) influenced by the protein levels. Birds fed the 20% protein had highest egg mass (2108g) while those on 16% protein diet had the least (1069g). There was significant (P<0.05) interaction between protein and energy level. Hen day production was highest (P<0.05) at the 20% protein level (17.28%) and lowest at 16% (8.43%) protein level. There was significant interaction (P<0.05) between protein and energy levels on hen day production, with 2750kcal/Kg energy having better hen day production for the protein levels except for 16 and 18%.

CONCLUSION

The diet containing 20% protein was associated with the best responses for several of the parameters(body weight at first egg, age at first egg, egg number, egg mass, hen day production)that were measuredin this study. For all parameters measured, there were no differences as a result of the energy level. It is concluded that a protein level of 20% and 2750kcal/kg ME is ideal for optimum egg production for guinea fowl in the tropics.

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Effect of Feeding Frequency on Growth Performance of Pigs

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Abstract: The study examined the performance and cost implications of pigs on varying feeding frequencies. Thirty (30) weaner pigs were allotted to three (3) treatments replicated 10 times of a pig per replicate in a completely randomized design in a feeding trial that lasted for 112 days. The treatments imposed were based on frequency of one or two or three meals a day. A measured quantity of feed at 5% body weight were made into either one or two or three portions and fed once at 8.00 am or twice at 8.00 am and 12.00 pm or thrice at 8.00 am and 12.00 pm and 4.00 pm, throughout the experimental period. Data collected were analyzed by one way analysis of variance using SAS and differences in means where observed were separated using Duncan option of the same statistical software. Results of performance of pigs were not significant (P>0.05) by the frequency of feeding. However, numerical improvement by 11.71% in the weight gain and 9.17 – 15.96% in feed intake of pigs fed three times daily were observed over those fed once or twice daily. Cost of pigs production showed that the cost of feed expended to gain a kilogram weight of pigs was lesser in pigs fed twice (N390.11) or thrice (N404.25) a day when compared with those fed once daily (N421.57). The study showed that feeding pigs thrice daily improved weight gain with better economic advantage.

Keywords: Cost, **f**eeding frequency, performance, pigs.

INTRODUCTION

The increased growth rate of animals fed *ad libitum* has been challenged by a number of metabolic disorders of skeletal problems, increased body fat deposition, high mortality and sudden death syndrome (1). Livestock farmers are trying to evolve a nutritional strategy that will ensure optimum growth, lean carcass quality, low cost of production without adversely affecting the growth and health status of the animal. The objective of livestock farmers was to produce animals with lean body mass, highest feed conversion efficiency, maximum growth and minimum cost of production. Thus, there is need to adopt a feeding program that will achieve this objective.

In Nigeria, most farmers feed their pigs once daily while others allow their animals free access to agro-by-products throughout the day. In conventional pig feeding management, more variable feeding management systems are applied. The question of how often pigs should be fed for efficient feed utilization still remains unanswered. The present study was therefore designed to assess the effect of feeding frequency on the performance and cost implications of weaned pigs.

MATERIALS AND METHODS

Area of the Study: The experiment was carried out at the piggery unit of Aladenika livestock farms, located at km 7, Awoyaya Ondo-Ore Road, Ondo state.

Gross Composition of the Basal Diet and Animal Protocol: A basal diet was formulated to meet the nutrient requirements for the pigs (2) (Table 1). The basal diet was fed to the animals at 5% live body weight at different frequencies of once 8.00 am), twice (8.00 and 12.00 noon) and thrice (8.00 am, 12.00 noon and 4.00 pm) meals per day for treatments 1, 2 and 3 respectively. For those fed twice or thrice, quantity of feed at 5% of the live weight of the pig were divided into two or three equal portions and fed to the animals two or three meals per day respectively.

Prior to the start of the experiment, the pigs were given ivermectin at the rate of 0.2ml/pig by subcutaneous injection. Iron III and vitaflash were also injected at the rate of 2ml/pig.

A total of thirty (30) pigs of mixed sexes (Large white × Landrace) were arranged in a completely randomized design (CRD) of 3 treatments of 10 replications of a pig per replicate. The pigs were fed at 5% live body weight of one or two or three meals per day to 3 groups 1 or 2 or 3, respectively. Animals were fed for a period of 112 days during which daily feed consumption and weekly weight changes were recorded. The feed conversion ratio was calculated as the ratio of average feed intake to average weight gain (in grams).

Table 1. Gross composition of experimental diet (g/100g)

Feed Ingredients	**Quantity**
Maize	53.00
Groundnut cake	8.00
Soybean meal	10.00
Palm kernel cake	17.20
Wheat offal	10.00
Limestone	0.50
Premix	0.50
Lysine	0.15
Methionine	0.15
Salt	0.50
Total	100

Data Collection and Analysis: Data collected on daily feed intake and weekly weight gain were analyzed by one-way analysis of variance using SAS and where the differences were significant, the means were separated using Duncan option of the same statistical software

RESULTS AND DISCUSSION

Although no significant (P>0.05) difference was observed in the performance of pigs irrespective of the frequency of feeding but there was numerical improvement in the weight gain by 11.71% in pigs and in feed intake by 9.17-15.96% in pigs fed thrice a day over those fed once or twice a day.

Result on Table 3 shows that cost of pig production were not significantly (p>0.05) affected irrespective of the varying feeding frequency. However, the cost of feed expended to gain a kilogram weight of pigs was lesser in pigs fed twice (N390.11) or thrice (N404.25) when compared with those fed once (N421.57), thus leaving a saving cost of N31.46 and N17.32, respectively as shown in the cost differential with respective relative cost benefit of 7.46 and 4.12%.

Table 2. Performance and cost implications of pigs on varying feeding frequency

	Frequency of feeding (in days)				
	Once	**Twice**	**Thrice**	**SEM**	**Sig**
Parameters					
Initial body weight, kg/pig	6.67	6.63	6.63	0.77	0.83
Final live weight, kg/pig	55.33	55.33	62.67	4.06	0.74
Total weight gain, kg/pig	48.67	48.70	56.03	3.52	0.62
Average weight gain, kg/pig	0.44	0.44	0.50	0.32	0.62
Total feed consumed, kg/pig	146.61	135.65	161.42	12.00	0.65
Average feed consumed, kg/pig	1.32	1.22	1.45	0.11	0.65
Feed conversion ratio	3.01	2.78	2.88	0.08	0.26

Cost items					
Average cost of feed consumed, N	185.15	171.32	203.85	15.15	0.65
Cost of feed N/kg weight gain	421.15	390.11	404.25	11.16	0.26
Cost differential, N	-	31.46	17.32	-	-
Relative cost benefit (%)	-	7.46	4.12	-	-

The similar weight gain and feed consumption of pigs in the present study is in agreement with the previous findings by Urdaneta-Rincon and Leeson (3) and in apposition with broilers (4) and Tilapia (*Oreochromis niloticus*) (5). The similar weight gain and feed intake of pigs in this study could be due to the capacity of the stomach of large animal to adequately handle large quantity of feeds. The decreased in cost of pig production in pigs fed more than once daily could have resulted from the increased weight gain of those pigs.

CONCLUSION AND APPLICATION

Although similar weight gain was obtained in pigs fed either once or twice or thrice a day but there was numerical improvement with lower feed cost per kilogram weight gain in pigs fed thrice daily over those fed once or twice daily. Thus, for improved weight gain with less cost to gain a kilogram meat, pig farmers are advised to feed their pigs either twice or thrice daily.

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Effect of Fermented Cassava Root-Leaf Meal - Blend as a Replacement for Maize on Growth Performance of Ducks

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Abstract: A study was concluded to investigate the effect of replacing maize with fermented cassava root – leaf meal (FCRLM) and its subsequent effect on growth performance, carcass yield and gut micro flora of Mallard ducks. A total of one hundred and fifty, one-day old unsexed Mallard ducklings with average initial weight of 60g were randomly assigned to 5 dietary treatments in a completely randomized design over a 42- days feeding trial. Each treatment was replicated thrice with 10 ducks each. Dietary treatment consisted of 0%, 25%, 50%, 75% and 100% replacement level of maize with FCRLM. Highest ($P<0.05$) final live weight, weight gain and feed intake were recorded with ducks fed diet containing 25% FCRLM. The least ($P<0.05$) final live weight and weight gain was recorded with 75 and 100% replacement of maize. Ducks fed control diet, 25 and 50% replacement of maize recorded the best ($P<0.05$) feed conversion ratio. It can be concluded that cassava root when fermented with cassava leaves (at 300g/kg leaf- root) can successfully replace maize up to 50% with improved growth in ducks

Keywords: Cassava Root-Leaf Meal, Ducks, Growth Performance, Maize

DESCRIPTION OF PROBLEM

Cassava root is rich in digestible starch (El-sharkawy, 2012) supplying approximately thirteen times energy/ha yield than maize or guinea corn (Ojewola *et al.,* 2000). Cassava root has been used to a limited extent as energy feed-stuff in poultry nutrition (Idowu *et al*., 2005; Oso *et al.*, 2014). The use of cassava meal, for non-ruminant animals is limited by its high fibre content and hydro-cyanic acid which is deleterious to their growth and development (Tewe and Iyayi, 1989; Panigrahi,1996; Yeoh and Yruong, 1993).

The inclusion of leaf meal in poultry nutrition serves as sources of proteins, vitamins, minerals and carotenoids at a relatively reduced cost (D'Mello *et al*., 1987; Opara, 1996). However, the major constraints to the utilization of leaf meal in monogastric nutrition is the fibrous nature of the meal and bulkiness of the resultant feed. Fermentation has been employed to break down fibrous feedstuffs and reduce toxicity of hydrocyanide in cassava leading to nutritionally enriched product due to the increase in growth and proliferation of fungi or bacterial complex in the form of single cell proteins (Antai and Mbongo, 1994; Oboh, 2002).

Ducks are considered to be the most important asset and source of income for ultra-poor rural women. Small scale duck farming has not only been proved to be a beneficial occupation for small, marginal and landless farmers, but also a potential source for self-employment youths and distressed women (Jabber, 2004). It is evident that in spite of the innate potentials as an alternative source of animal protein and congenial environment for its rearing in all agro-ecological zones, its exploitation suffered neglect/set back majorly due to the adverse synergistic effects of taboos, myths, superstitions and stigmas made to protect and conserve ducks due to their perceived weak nature (Ogunjimi, 2014). Based on these, there is a compelling need to integrate duck production into Nigerian agricultural system, for they are not only important as source of nutritious meat, but as a veritable source of eggs for human consumption. Ducks have higher percentage of meat than chickens weighing 2.48 to 2.93 kg at 8 to 9 weeks of age, their eggs are very big and delicious, suffer less from local diseases which are common in chickens and do not necessarily need sophisticated compounded feeds (World Bank, 1996; FAO, 1996; Nworgu *et al*., 1997). The current study seeks to investigate the growth response of ducks fed diet containing cassava root-leaf meal blend

MATERIALS AND METHODS

Experimental site: The project was carried out at the Teaching and Research farm of Yaba College of Technology Epe Lagos State. It is situated at latitude 6.58ºN, Longitude 3.98ºE. It is 42m above the sea level along the Epe- Ijebu Ode road. Epe lies in the low land rain forest, vegetation zone within the savannah agro ecological zones of south Nigeria (Google earth, 2015).

Cassava root- leaf meal processing: Fresh cassava root tubers (TMS30572) were harvested, washed and grated. The cassava leaves were harvested and chopped into smaller pieces using kitchen knife. A maize-soybean diet was formulated as control. Fresh grated cassava root and leaves was mixed at a ratio of 1kg cassava root meal with 300g cassava leaves, fermented for 5 days under an air-tight environment, air dried (for 2-3 days) and used to replace maize at varying proportions in the basal diet. Products obtained at the expiration of the fermentation were analysed for proximate composition using the standard methods of AOAC, (2002) and gross energy (Adiabatic Bomb Calorimeter).

Experimental Birds, Management and Design: One hundred and fifty, one-day old unsexed Mallard ducklings was distributed randomly into 5 groups of 30 ducklings per treatment. Each treatment was further subdivided into 3 replicates with 10 ducklings per replicate in a completely randomized design (CRD). The study is made up dietary treatments consisting of control (Treatment 1), fermented cassava root-leaf blend used to replace maize at 25% (Treatment 2), 50% (Treatment 3), 75% (Treatment 4) and 100% (Treatment 5) levels, respectively. Diets were formulated to meet the NRC (1994) requirements. The ducklings were raised on deep litter in an open sided deep litter house. Feed were offered *ad libtum.* The study lasted for a period of 6 weeks.

DATA COLLECTION

Performance: The performance of the experimental ducklings in term of feed intake, live weight gain and feed conversion ratio were recorded on weekly basis.

Statistical analysis: Data obtained was analyzed using SAS statistical software (SAS, 2002). Differences between significant means were separated using Turkey's Test. Statements of significance was based on a probability of $P<0.05$.

RESULTS AND DISCUSSION

Table 1: percentage composition of the experimental diet (duck starter 0-42days)

Ingredients	T1	T2	T3	T4	T5	FCRLM
Maize	54.00	40.50	27.00	13.50	0.00	
Palm oil	1.00	1.00	1.00	1.00	1.00	
Soybean meal	30.00	30.00	30.00	30.00	30.00	
FCRLM	0.00	13.50	27.00	40.50	54.00	
Wheat offal	6.00	6.00	6.00	6.00	6.00	
Fish meal	3.00	3.00	3.00	3.00	3.00	
Bone meal	3.00	3.00	3.00	3.00	3.00	
Lime stone	2.00	2.00	2.00	2.00	2.00	
Lysine	0.25	0.25	0.25	0.25	0.25	
Methionine	0.20	0.20	0.20	0.20	0.20	
Salt	0.25	0.25	0.25	0.25	0.25	
Premix	0.30	0.30	0.30	0.30	0.30	
Total	100.00	100.00	100.00	100.00	100.00	
Calculated Analysis						
Crude protein (%)	21.30	21.34	21.38	21.41	21.46	9.76

Crude fibre (%)	4.25	3.98	3.71	3.44	3.71	3.84
Calcium (%)	1.19	1.19	1.19	1.19	1.19	-
Phosphorus (%)	0.65	0.65	0.62	0.61	0.60	-
Energy (kcal/kg)	2864	2827	2870	2913	2956	3560

Starter premix: - Vit. A 8, 500,000 (iu), Vit D3 1,500,000 (iu), Vit. E 10,000(mg), Vit K3 1,500 (mg), Vit B1 1,600 (mg), Vit. B2 4,000 (mg),Niacin 20,000 mg, Pantothenic acid 5,000mg, Vit. D6 1,500mg, Vit.B12 10mg, Folic acid 500mg, Biotin H2 750mg, Chlorine chloride 175,000mg,Cobalt 200mg, Copper 3,000mg, Iodine 1,000mg, Iron 20,000mg, Manganese 40,000(mg), Selenium 200mg, Zinc 30,000mg, Anti-oxidant 1,250mg.

T1 (0% replacement level), T2 (25% replacement level), T3 (50%replacement level), T4 (75% replacement level), T5 (100% replacement level) and FCRLM- Fermented cassava root leaf meal.

Table 2. Performance of ducks fed fermented cassava root –leaf meal.

Parameters	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
Initial weight (g)	60.00	60.00	60.00	60.00	60.00	0.00
Final weight (g)	1200.00^{b}	1300.00^{a}	1200.00^{b}	1000.00^{c}	1000.00^{c}	32.07
Weight gain(g)	1140.00^{b}	1240.00^{a}	1140.00^{b}	940.00^{c}	940.00^{c}	32.07
Daily feed intake(g)	87.32^{b}	94.71^{a}	86.98^{b}	83.34^{d}	85.84^{c}	1,02
Total feed intake(g)	3667.44^{b}	3977.82^{a}	3653.16^{c}	3500.14^{e}	3653.16^{d}	42.69
FCR	3.22^{c}	3.20^{c}	3.20^{c}	3.73^{b}	3.88^{a}	0.07

abcd Means in the same column with different superscripts were significantly ($p<0.05$) different.
T1(0% replacement level), T2 (25% replacement level), T3 (50%replacement level), T4 (75% replacement level), T5 (100% replacement level).

The proximate composition of fermented cassava root-leaf meal is as shown in Table 1. The result of the growth performance (Table 2) revealed the highest ($P<0.05$) final live weight, weight gain and feed intake with ducks fed diet containing 25% FCRLM. The least ($P<0.05$) final live weight and weight gain was recorded with 75 and 100% replacement of maize. Ducks fed control diet, 25 and 50% replacement of maize recorded the best ($P<0.05$) feed conversion ratio. Ducks fed 100% replacement of maize had the worst feed conversion ratio. The fermentation process increased the nutrient composition most especially protein content due to the increase in growth and proliferation of the fungi or bacterial complex in the form of single cell proteins (Antai and Mbongo, 1994; Oboh, 2002). This may possibly be attributed to the soluble nutrients released following fermentation of fermented cassava root-leaf meal. The observed increase in crude protein value (2.5% to 9.76%) of fermented cassava root meal was in line with the studies of Igbabul *et al.*, (2014) who found an increase in protein percentage of fermented cocoyam from 15.61- 18.75%. Michodjehoun *et al*., (2005) also observed an increase in protein content of millet from 7.9% to 10% during fermentation.

Replacing maize with fermented cassava root leaf meal appears to have a positive impact on ducks' performance up to 50% replacement level in the present study. Ducks fed control diet, 25 and 50% replacement of maize recorded the best ($P<0.05$) feed conversion ratio while those fed 100% replacement of maize had the worst feed conversion ratio. The least final live weight and weight gain was recorded with 75 and 100% replacement of maize. Previous study already showed improved weight gain, average feed intake, feed conversion ratio in cherry valley ducks fed with cassava diet when compared with those fed with maize (Saree *et al*., 2012). Feed intake increased from group fed control to 25% replacement levels. Beyond this level, intake reduced appreciably. Birds are known to eat more to satisfy their energy requirement (Tewe and Egbunike ,1992). Also. the significant increase in mean daily feed intake may be due to the relative decrease in energy level of the diet. This observation agreed with those of (Osei,1992) and (Oruwari, *et al* 1996), who respectively indicated that feed intake decreased with increase in energy level. It also corroborates the scientific evidence that birds eat to satisfy their energy

requirement (Akinfala, *et al*., 2002; Aderemi, *et al*.2006). The trend of the feed conversion ratio showed that replacing maize with fermented cassava root leaf meal appears to have a positive impact on ducks' performance up to 50% replacement level.

CONCLUSION

It can be concluded based on findings of this study that cassava root when fermented with cassava leaves (at 300g/kg leaf- root) can successfully replace maize up to 50% replacement value with improved growth performance.

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Assessment of Two Phytogenic Leaf Meals on Nutrient Digestibility and Egg Sensory Properties of Nera Black Layer Chickens

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Abstract: The need to explore natural alternatives to synthetic additives using phytogenic leaf meals (PLM) in varying inclusion levels cannot be overemphasized. Ninety (90) Nera black layers (30 weeks old) were randomly divided into five (5) dietary treatments and three replicates of six birds each. The control dietary (Treatment A) had no PLM, while Tridax leaf meal (TLM) was included in Treatments B and C at 0.25% and 0.50% respectively. Treatments D and E contained 0.25% and 0.50% Turmeric leaf meals respectively using a completely randomized design. The feeding trial lasted for 8 weeks. Data were analysed using SAS (2000).The results indicated that Tridax and Turmeric at 0.25% and 0.50% had no significant ($p>0.05$) influence on egg sensory properties such as albumen and yolk colour, odour/smell, taste/flavour, texture and overall acceptability but significantly ($p<0.05$) improve nutrient digestibility coefficients which include dry matter (DM), crude protein (CP), crude fibre (CF), ash content, ether extract (EE) and nitrogen-free extract (NFE) In conclusion, both Tridax (0.25-0.50%) and Turmeric (0.25%) leaf meals enhanced nutrient digestibility with no detrimental effect on sensory properties of the eggs.

Keywords: Digestibility, Layers, Leaf Meal, Microbiology, Phytogenic, Sensory.

INTRODUCTION

Herbs and plant extracts utilized in animal feed are referred to as phytogenic or herbal feed additives, which are derivative compounds of plant foundation. The inclusion of these phytogenic additives in animal feed can enhance productivity through the enhancement of digestibility, nutrient assimilation and elimination of pathogens resident within the animal gut (Athanasiadou *et al*., 2007). Sequel to this, Karásková *et al*. (2015) indicated that phytogenic additives present a reasonable alternative to synthetic feed additives. Examples of such include Turmeric, Tridax, Moringa among others.

Turmeric *(Curcuma longa)* is an herbaceous perennial plant of the ginger family, *Zingiberaceae* (Chan *et al.*, 2009), rhizomatous in nature with antimicrobial and antioxidant attributes (Surai, 2002). *Tridax procumbens* Linn belongs to family Asteraceae. It was reported to have high flavonoids, alkaloids, hydroxycinnamates, tannins and phytosterols, moderate benzoic acid derivatives including lignans and low carotenoid contents (Ikewuchi, 2015).

Phytogenic feed additives can affect consumers' senses (sight-colour, smell, taste and touch-texture) of perception and acceptability of the egg produced (Choi, 2013). Therefore, this study aimed at assessing various inclusions of phytogenic leaf meals (Turmeric and Tridax) on egg sensory indices and nutrient digestibility of laying chickens.

MATERIALS AND METHODS

The study was carried out at the Poultry Research Unit of Ladoke Akintola University of Technology Teaching and Research Farm, Ogbomoso, Oyo State, Nigeria. Tridax and Turmeric leaves were harvested at flowering stage from Teaching and Research farm of Ladoke Akintola University of Technology, Ogbomoso and other locations within Ogbomoso Agricultural zone of Oyo State and authenticated by Botanist in the Department of Pure and Applied Biology as well as Pasture Scientist in the Department of Animal Production and Health of Ladoke Akintola University of Technology, Ogbomoso. The matured leaves were detached from stalks, rinsed with distilled water, air-dried to a stable weight and then pulverized to powder form using electric grinding

machine (Master mixer grinder with 3 S.S. jars, excella model), sieved with 0.5mm mesh and stored in an air-tight container for feed trial.

Experimental diets: Five dietary treatments were compounded such that control diet (Treatment A) contained none of the phytogenic leaf meals. Tridax leaf meals were included in Treatments B and C at 0.25% and 0.50%, respectively while Treatments D and E contained 0.25% and 0.50% Turmeric leaf meals, respectively. Ninety (90) Nera black layers (30 weeks old) sourced from a reputable commercial farm were used for the study. The birds were housed in a two tier-cage compartment in an open-sided pen. The birds were randomly divided into the five (5) dietary treatments with six (6) replicates per treatment such that each replicate have three (3) birds, which were subjected to normal management practices.

Data collection: Nutrient Digestibility was done at week eight (8), nine (9) birds were selected at random from each treatment and transferred to the metabolic cage for faecal collection after four days adjustment period for three days and digestibility coefficients were evaluated (Baker *et al.*, 2001).

Egg sensory was done using eggs laid, eight (8) weeks after the commencement of the trial. Three (3) eggs per treatment randomly selected were boiled by placing them inside water bath at room temperature, then the water was raised to the boiling point and the eggs were kept in the boiling water for seven (7) minutes. Eggs were then cooled to an external temperature of about 40^0C before peeling and thereafter divided into four parts for sensory evaluation with the aid of 9-point hedonic scale.

The scale ranges from score 1 (dark) to 9 (extremely light) for albumen colour, score 1 (yellow) to 9 (extremely golden)for yolk colour, score 1 (not perceptible) to 9 (extremely intense) for smell/odour, score 1 (dislike extremely) to 9 (like extremely) for taste/flavour, score 1 (extremely coarse) to 9 (extremely fine) for texture and score 1 (dislike extremely) to 9 (like extremely) for overall acceptability according to the modified method of Lim (2011). Ten (10) panelists were used for the sensory evaluation.

Data collected were analysed as appropriate for a Completely Randomized Design using the General Linear Model procedure of SAS (2000) to determine treatment effects. Significant mean differences were determined using Duncan Multiple Range Test of the same package at 5% level of significance.

RESULTS AND DISCUSSION

The effect of treatments for the assessment of varying levels of Tridax and Turmeric on digestibility parameters of laying chickens as shown in Table 1 revealed that the parameters evaluated were significantly ($p < 0.05$) similar (C and D) except for ash on comparison with other treatments (A, B and E) across the treatments such that Tridax digestibility coefficient in B and C improve with increase in inclusion level and otherwise for Turmeric in D and E but both phytogenic leaf meals have better nutrient digestibility coefficients on comparative basis with A (Control) which could be attributed to the presence of derivative compounds of plant origin which inclusion in animal feed can enhance digestibility as also observed by Athanasiadou *et al*. (2007) but negated Radwan *et al.* (2008) postulation that there were no significant differences in nutrient digestibility of laying hens fed either 0.5% or 1.0% thyme powder**.** Ige *et al.* (2006) recorded no significant difference when layers were fed 0%, 5%, 10%, and 15% gliricidia leaf meal.

Table 1: Effect of varying levels of two phytogenic leaf meals on nutrient digestibility of layers

Parameters	A Control	B 0.25% Tridax	C 0.50% Tridax	D 0.25% Turmeric	E 0.50% Turmeric	SEM	P-value
Dry Matter (%)	58.63^{c}	67.92^{abc}	72.39^{a}	71.84^{ab}	61.18^{bc}	3.27	0.04
Crude Protein (%)	64.52^{c}	74.09^{ab}	75.24^{a}	77.68^{a}	66.17^{bc}	2.71	0.02
Crude Fibre (%)	50.31^{b}	68.21^{a}	70.83^{a}	71.19^{a}	63.66^{a}	3.60	0.01

Ether Extract (%)	73.09 [b]	79.18[ab]	82.68 [a]	85.79 [a]	80.14 [a]	2.04	0.01
Ash (%)	46.85 [b]	41.03 [b]	48.61 [b]	66.13 [a]	55.84[ab]	4.84	0.04
Nitrogen-free Extract (%)	58.16 [b]	68.82 [a]	74.04 [a]	69.32 [a]	57.76 [b]	3.31	0.02

SEM: Means with different superscripts along the same row were significantly ($P < 0.05$) different.

Egg sensory properties of laying chickens fed varying inclusion levels of two phytogenic leaf meals as shown in Table 2 revealed that all the parameters were not significantly different ($p > 0.05$) across the treatments as indicated by Saki *et al.* (2014) using 4, 8 and 12 gkg^{-1} of phytogenic additives mixtures (Garlic, Marigold, Fennel and Thyme). Though, it was observed from the mean values of the properties evaluated that Treatment E (0.50% Turmeric) had the highest mean values of 7.30, 4.40, 7.2 (same as Treatment A), 5.90 and 7.60 for albumen colour, yolk colour, smell or odour, texture and overall acceptability, respectively which could be attributed to organoleptic properties of Turmeric.

This result indicated that varying levels of 0.25 and 0.50% for Tridax and Turmeric have no direct bearing on egg sensory properties which negated Rizza *et al.* (2008) and Windisch *et al.* (2008) reports on the influence of phytochemicals due to phyto-additives inclusion in the diets on the organoleptic qualities of poultry products which was expected to influence the taste significantly because some of the plants, as well as their extracts, contain compounds of bioactive origin that can improve the quality of poultry products when consumed. The result corroborates Olugbemi *et al.* (2010) assertion that consumers preferred eggs obtained from laying chickens on Moringa Leaf Meal (MOLM) in term of general acceptability on comparison with treatments without MOLM (Treatments A and E).

Table 2: Effect of varying levels of two phytogenic leaf meals on egg sensory properties of layers

Parameters	**A Control**	**B 0.25% Tridax**	**C 0.50% Tridax**	**D 0.25% Turmeric**	**E 0.50% Turmeric**	**SEM**	**P-value**
Albumen Colour	7.10	6.90	7.00	7.30	7.30	0.42	0.95
Yolk Colour	4.00	3.80	3.60	4.00	4.40	0.45	0.79
Smell / Odour	3.90	3.70	4.30	4.00	4.90	0.66	0.74
Taste / Flavour	7.20	6.60	6.40	6.50	7.20	0.44	0.55
Texture	5.50	4.40	5.50	5.60	5.90	0.65	0.54
Overall Acceptability	6.90	7.00	6.80	6.90	7.60	0.41	0.65

CONCLUSION

The study showed that both Tridax (0.25 - 0.50%) and Turmeric (0.25%) leaf meals could be included in the diets of laying chickens for nutrient digestibility enhancement without compromising
the sensory properties of the eggs.

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Comparative Effects of Ascorbic and Baobab Fruit Pulp Meal on Perforamnce and Haematological Status of Broiler Chicks in Hot-Dry Season

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Abstract: The study was carried out to investigate the effects of two sources of ascorbic acid (AA) on performance and Haematological parameters of broilers chicks. 180 Oba Marshal (day old) broilers were divided into 3 treatment groups. Each treatments group of 60 birds were replicated 3 times. Group 1 serves as control while 2 and 3 had AA and Baobab Fruit Pulp Meal (BFPM) added to their diets at the rate of 150mg/kg and 5.25% respectively. The study lased for 4 weeks period. Results showed significant differences in the 2nd and 3rd groups compared with the control, with regards to final weight, weight gain, feed intake, feed conversion ratio and mortality. Significance increase in group 2 (AA) in Packed Cell Volume, Haemoglobin content and total blood protein as compared to control and group 3 (BFPM) were also observed. It was concluded that BFPM significantly increase the growth performance of broiler chicks during the hot dry season than AA and control though AA were better than BFPM in PCV, and TP values.

Keywords: Ascorbic Acid, Broiler, Haemoglobin, Hot-Season, Performance

INTRODUCTION

It has been established that high ambient temperature induces stress in poultry. (Bottje and Harrison 1985; Ogbogu 1988, Njoku, 1990; Balogun *et al*., 1996). Ayo *et ali., (1996)* further indicated that high ambient temperatures and relative humidity result in heat stress in poultry and that they have significant effects on egg and broiler production. This is because of the relationship that exist between ambient temperatures and metabolic rate in the body of these animals. During low ambient temperatures, metabolic rate is increased while in high ambient temperatures it decreases. In order to replace energy spent on heat production, the animal consume more feed (Playschenkov and Sidorov, 1987), whereas at high temperatures, animals want to lose heat, therefore consume less feed. Heat stress is evident at 32^{o}C through depressed feed intake. Therefore, hot season does not favour egg and broiler production because of the heat stress experienced during this period. In attempt to counteract the detrimental effects of heat on poultry production researchers have supplemented animal dies with ascorbic acid. Baobab plant, known as Africa tree has fruit whose pulp serves as a natural source of valuable Ascorbic acid. The Obizoba and Amaechi (1983) stated that baobab fruit pulp is used as a beverage and in food preparation. In Africa, baobab fruit pulp is used as famine food to prepare decoctions, sauces and natural refreshing drink due to its nutritional properties (Lunven and Andrian,1960, Obizoba and Anyika, 1994; Lockett *et a*l, 2000). This study therefore seeks to compare the effects of synthetic AA as compared with the natural source of AA from baobab fruit pulp meal, with it intended antioxidant capacity.

MATERIALS AND METHODS

Experimental Site: The experiment was carried out at the Livestock Teaching and Research Farm, Department of Animal Science, Ahmadu Bello University, Zaria. Zaria is situated within the Northern Guinea Savanna at latitude 11^{o}9′45″N, longitude 7^{o}38′8″E and an altitude of 610m above sea level. The area is characterized by hot environment with a predominantly sub-humid tropical climate by distinct wet and dry seasons. The mean annual rainfall of about 1093 and temperature range of 13.8 – 35.8^{o}C.

Experimental Design, Diets and Birds Management: The experiment was conducted during the hot-dry season of the year. One hundred and eighty day Old Oba Marshal chicks were used in this study. The birds were divided into three dietary treatment groups with each group consisting of 60 birds replicated three times. Treatment 1 serves as control diet, and had neither synthetic ascorbic acid nor Baobab Fruit Pulp Meal (BFPM). Treatments groups 2 and 3 had Synthetic Ascorbic Acid (AA) and Baobab Fruit Pulp meal added to them at the rate of 150mg/kg and 5.25% respectively (Table 1).

The study which lasted for four weeks period was laid out in completely randomized design. Feed and water were supplied *ad libitum*. The indices measured included initial weight, final weight, body weight gain, feed intake, feed conversion ratio, feed cost per kilogram body weight and mortality rate. At the end of the trial, fourth week, blood samples were collected via the wing vein from 3 birds in each replicate, the blood samples were used for haematological status for Packed Cell Volume (PCV), Haemoglobin Content (Hb) and Total Blood Protein (TP) according to Cheerbrough (2006) methods.

Data Analysis: The data obtained from the study were summarized and subjected to analysis of variance using the general linear model (GLM) procedure of SAS and means were separated by Duncan Multiple Range Test (SAS Institute 1995).

RESULTS

Table 1: Composition of Experimental Diets Supplements of Ascorbic Acid and Baobab Fruits Pulp Meal for Broiler in Hot-dry Season

Ingredient	Control	AA	BFPM
Maize	47.18	47.17	46.28
Groundnut cake	33.00	33.00	29.47
Soya bean cake	10.00	10.00	10.00
Fishmeal	3.00	3.00	3.00
Palm oil	2.00	2.00	1.18
Limestone	0.50	0.50	0.50
Bone Meal	3.28	3.28	3.28
Salt	0.35	0.35	0.35
Vit. Premix	0.25	0.25	0.25
Lysine	0.26	0.26	0.26
Methionine	0.18	0.18	0.18
Ascorbic acid	-	0.02	-
BFPM	-	-	5.25
Total	**100.00**	**100.00**	**100.00**
Calculated Analysis			
Metabolizable energy (Kcal/kg)	2943.00	2943.00	2941.00
Crude protein (%)	32.90	23.90	23.90
Ether extract (%)	6.57	6.57	6.57
Calcium (%)	3.89	3.89	4.29
Aval Phosphorus (%)	0.64	0.64	1.90
Lysine (%)	1.30	1.30	1.30
Methionine (%)	0.9	6.90	0.90

Table 2: Comparison of the Control, Ascorbic Acid and Baobab Fruit Pulp Meal Diets on the Performance of Broiler Starters (0-4 Weeks0 During Hot – Dry Season

Parameter	Treatment Sources of Ascorbic Acid in Diet			
	Control diets	AA Diets	BFPM Diets	SEM
Initial weight g(bird)	55.83	55.83	55.28	0.59
Final weight (g/bird)	570.37^{c}	646.05^{b}	711.69^{a}	21.46

Weight gain (g/bird)	514.54[c]	591.21[b]	656.29[a]	21.26
Feed intake(g/bird)	1406.31c	1551.23b	11675.03[a]	42.96
Feed coversion ratio	2.74[c]	2.62[b]	2.55[a]	0.06
Feed cost/kg body weight (N)	130.84	130.02	131.84	2.41
Mortality (%)	10.00[c]	9.17[b]	0.83[a]	2.2

a,b,c: Mean with different superscript in the same row are significantly ($p<0.05$) different
SEM: Standard Error of Mean; AA: Ascorbic Acid Diets and BFPM: Baobab Fruit Pulp Meal Diets

Table 3: Comparison of the Control, Ascorbic Acid and Baobab Fruit Pulp Meal diets on the haematological status of the Broiler Starters (0-4 weeks) during hot-dry season

Parameter	**Treatment Sources of Ascorbic Acid in Diet**			
	Control diets	**AA Diets**	**BFPM Diets**	**SEM**
Packed Cell Volume (%)	28.33[b]	29.78[a]	28.00[b]	0.39
Haemoglobin content (%)	10.41[b]	11.16[a]	10.93[a]	0.38
Total Protein (g/dl)	6.07[b]	7.07[a]	6.37[b]	0.17

a,b: Mean with different superscript in the same row are significantly ($p<0.05$) different
SEM: Standard Error of Means; AA: Ascorbic Acid Diets and BFPM: Baobab Fruit Pulp Meal Diet

Table 2 and 3 show the comparative effects of Ascorbic acid (AA) and Baobab Fruit Pulp Meal (BFPM) diets as compared to the control diet on the growth performance and Haematological status of broiler starters during hot-dry season.

From table 2, it was observed that there were significant ($P<0.05$) differences among treatment means for final weight, weight gain, feed intake, feed conversion ratio and on mortality rates. The diets however had no significant ($P>0.05$) effect on feed cost/bird. In terms of final weight gain, BFPM showed significantly better performance than control and AA. In a similar trend, feed intake improved significantly with BFPM than with AA and control diet. Following the same pattern, BFPM had better feed conversion ratio than AA and the control diet. Ironically, no significant differences were observed in feed cos/kg (N) body weight for control, AA and BFPM. However, mortality rate was highest with control and lowest with BFPM. In all, broiler fed BFPM diets performed better than those fed the AA supplemented and control diets (Table 2). Table 3 shows heamatological status of broiler starter. However, in terms of Haemoglobin content (Hb) both AA and BFPM were comparable but higher than the control. Conversely, the control diet and BFPM were significantly lower than the AA in Hb. The total protein (TP) with AA diet was better than both for control and BFPM.

DISCUSSION

Baobab Fruit Pulp Meal (BFPM) significantly increased the growth performance of broiler chicks during the hot dry season than the ascorbic acid and control diets even though AA supplemented diets were better than BFPM diets for PCV and TP values. Therefore, when considering which of the two sources of vitamin C to use as supplements in broiler starter diet during the hot dry season, BFPM should be preferred as it gives overall better performance than the synthetic ascorbic acid at the rate of 5.25% level inclusion in the diet which is equivalent to 150mg of synthetic AA.

CONCLUSION

From the findings in this experiment, it was concluded that BFPM significantly increase the growth performance of broiler chicks during the hot dry season than AA and control, though AA were better than BFPM in PCV and TP values.

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Abstract: History has it that for well over 10,000 years, livestock production practices and indeed goat production have been carried out without the use of synthetic chemicals and other non-natural inputs (Paul, 2010). The introduction of synthetic compounds into goat production processes has boosted goat production to satisfy the growing animal protein needs of the world's teeming population. However, these new technologies have their disadvantages. They include chemical residues on goat products which constitute threat to human life and the entire ecosystem. Hence, consumers today seek goat products free of such chemicals and that are produced in a way that is environmentally friendly. Organic goat production offers an approach that has been suggested as the solution to this quest for goat products without synthetic residues and that does not negatively affect the environment. The aim of this paper was to explore literature for evidence of existence and possibility for introduction of organic goat farming to Rivers State. Findings could be useful baseline information for use by stakeholders to empower smallholders and produce goat products that are free of chemical residues and whose environmental footprint will be negligible.
Keywords: Chemical residues, environment, food security, sustainability, synthetic Drugs.

INTRODUCTION

Organic agriculture implies the method of food production that sustains promotes and enhances agro- system health. It is a system that is said to be holistic due to the emphasis on sustainability of agricultural processes and improves the health of ecosystems and organisms for the production of quality food (Codex Alimentarius Commision, 2007, Coffey and Baier, 2012, NOSB, 2016, Galgano *et.al*, 2016). Smallholder farmers are the drivers of many economies (Chander *et al*., 2011, Escribano, 2015). This is true as the bulk of livestock produced in Nigeria and indeed Rivers State can be attributed to smallholder farmers. However, these farmers are poor resourced, hence, cannot afford the cost of huge external inputs needed for increased food production under conventional systems. They rely on the traditional methods of livestock production which is unable to support large-scale livestock production (Aid Environment, 2013).

As the demand for animal source foods is on the increase due to the rising world population (Chander *et al*., 2011), the role of conventional methods in satisfying this rising demand for food of animal origin becomes indispensable. Though conventional livestock production supports high yield from livestock it does not guarantee products safety and sustainability of productivity.

The alarming concern of consumers on the effect of chemical residues in livestock produce on human health due to the use of synthetic drugs, chemical fertilizers, pesticides and other agro-chemicals in conventional livestock production systems is a threat (Baroilhett, 2012). The environment is not spared either as these chemicals pollute the environment resulting in the death of some soil microbes. This distorts the ecological balance. Due to all these effects, the trend is consumers of livestock products today are increasingly seeking to know how the food they consume is produced. This is presently a huge trend in developed countries of the Western hemisphere where such unfolding tendency has been exploited by producers and marketers of livestock products as a market opportunity. They certify their produce as organic and then sell at premium prices to earn huge profits compared to conventionally produced products. This trend, according to many reports is eminent in sub-Saharan Africa, such as Nigeria as the literacy level, population of middle class and income levels rise. Therefore, Nigeria and indeed Rivers State, being one of the biggest cities in Nigeria whose residents have high buying power, need to be proactive and key into this market opportunity before it manifests. However, there is lack of published information on the existence of or possibility of introducing organic livestock production into Rivers State. This information deficiency is even more acute on organic goat production even as Nigeria is said to be the largest producer and consumer of goat meat in the world.

Consequently, there is need to first evaluate from literature the existence of and possibility of introducing organic goat production into Rivers State to enhance the environmentally friendly, chemical residue free and

sustainability of meat industry in Rivers State. This paper therefore aims at reviewing literature to seek whether organic goat farming exists in the area and the possibility of its introduction as a better alternative farming method suitable for smallholder goat farmers in Rivers State and Nigeria.

MATERIALS AND METHODS

This work was a desk review of existing literature on the status of organic agriculture, livestock and indeed goat production in Nigeria and Rivers State. Review material include peer reviewed journal articles, reports, blogs, newspapers, websites, and books both online and offline. Results were collated and analyzed using thematic analysis.

RESULTS AND DISCUSSION

History: From the literature reviews made, the practice of organic farming in general is about 10 years old in Nigeria (Gain Report, 2014). This is quite young compared to developed countries where it has been in existence for more than 50 years. The International Federation of Organic Agriculture Movement (IFOAM) in a 2003 report on the evolution of agro-ecology movements in some parts of Africa particularly Senegal and Ghana resolved to create network centers in Africa to strengthen the organic movement. Consequently, there was the emergence of some network bodies in different parts of Africa. In Nigeria, Olusegun Obasanjo Centre for Organic Agricultural Research and Development (OOCORD) was established in 2007. This initiated the formation of Association of Organic Practitioners in Nigeria formally called Nigerian Organic Agriculture Network (NOAN) in 2008. This body serves as a link between organic agriculture stakeholders in Nigeria and international bodies interested in organic agriculture. Also, there is a network of professionals interested in organic agriculture called Organic Agriculture Project in Tertiary Institutions in Nigeria (OAPTIN), established in 2004 which focuses on capacity building and networking of academics in organic agriculture.

Organic land in Africa and Nigeria: The world statistics of organic agriculture (Willer and Kiltcher, 2011) indicates that there are more than one million hectares of certified organic agricultural land in Africa with countries like Uganda having the highest (226, 954 hectares), followed by Tunisia and Ethiopia with 167,302 and 122, 727 hectares, respectively. Nigeria has about 3,154 hectares of documented cultivated organic land as at 2007 and 11,979 hectares in 2010. As at 2017, Nigeria had 5,023 hectares of cultivated organic land (Olaito, 2014).

Principles of organic farming: The four basic principles put in place by IFOAM are health, care, ecology and fairness.

Health: This principle denounces the use of synthetic drugs and emphasizes sustenance and health of ecosystems and organisms.

Fairness: It emphasizes the need for all parties in organic production process to be fair to each other. Such parties include farmers, distributors, workers and others.

Ecology: This principle encourages recycling, sustaining the natural ecosystem and cycles.

Care: This principle deals with being precautious and responsible so as to retain the organic essence.

Certification in organic agriculture Certification is a pre-requisite in organic farming. Before a product can be labeled "organic", it must have been produced in compliance to some standards called organic principles. These principles are set by IFOAM and certification bodies are put in place to monitor farmers' compliance. Different countries have set up their certification bodies which must be accredited. For instance, in America, the United States Department of Agriculture (USDA) is responsible for certification. In Nigeria however, full certification is still in the process even though some kind of accreditation as recommended by IFOAM is being carried out. This is the Participatory Guarantee System (PGS). In PGS, farmers write down the standards they have complied based on IFOAM's standards.

Practice of organic agriculture in Nigeria: Presently, Nigerians are into organic herbs and crop production. Medicinal herbs and crops produced by a pioneer organic farm in Nigeria–Dara/Euro Bridge farm include lemon

grass, turmeric, plantain and ginger. Others crops produced in Nigeria and the location they are grown are listed in Table 1.

Table 1: Organic food production in Nigeria and location

Name of farm	Location	Produce
Ajibode Organic Group	Akinyele L.G.A., Ibadan	Vegetable
Elekuru Organic Group	Elekuru, Ibadan	Vegetables, yam, cassava, maize, sweet potatoes
Ago-Owu Organic Group	Osun State	Plantain, banana, golden melon, pepper, cocoa, maize, oil palm

Evidence from literature does not indicate that organic livestock farming, let alone organic goat farming is taking place in Nigeria and indeed Rivers State. The commonest goat production system referenced in literature is traditional goat farming. Though close to organic farming, such practices cannot be said to be organic because of lack of certification. However, traditional goat farming can be a big stepping stone to organic goat production.

Need organic goat farming by smallholder farmers: As earlier stated, there is need for smallholders to embrace organic goat production because:

Smallholder farmers are poor resourced and cannot afford huge capital for incurring large external input in conventional farming.

Organic Livestock production emphasizes use of low input, locally sourced material and recycling of used materials.

Organic goat farming will enhance food sustainability, security and safety.

Organic goat farming will result in good food quality, giving the farmer an advantage of selling his product in produce market or exporting his product thereby increasing income.

It involves the use of non-competitive food materials such as forage grasses for feeding.

Steps in adopting organic goat farming method: For smallholder goat farmers that intend to embrace organic goat farming, they should be aware that organic farming begins from the soil where the crops are planted to the animals that consume the crops and to man that consumes the animals. In adopting or converting to organic goat system, vegetation of browse shrubs, trees and grasses should be planted or existing ones can be converted and allowed a period of 1year before use as feed material. Collaboration can also be made with organic crop farmers for feed ingredients. The steps to take include:

Seek access to good and relevant information on organic farming

Apply for certification

Get breeding stock from a good farm that is managed organically.

Put up a well aerated housing with enough space for exercise by the animals

Avoid overcrowding of the goats

CONCLUSION AND APPLICATION

Based on evidence from literature, organic goat farming ensures quality, safety of products, sustainability and food security if the four basic principles of organic production are applied. The presence of natural rich vegetation on which browse herbs and grasses grow without fertilizer and pesticide application as is done in traditional goat farming offers a good potential for organic goat farming in Rivers State.

It is concluded that smallholder goat farmers in Rivers State are yet to embrace organic goat farming Traditional goat farming currently practiced is a good stepping stone to organic production if certification can be done by the appropriate accrediting bodies.

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Effect of Stages of Growth on Dry Matter Yield and Nutrients Composition of Centro (*Centrosema molle* Mart. ex Benth) in the year of Establishment in Jos, Nigeria

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Abstract: An experiment was conducted in Jos to evaluate effect of stages of growth on dry matter yield and nutrients composition of Centro (*Centrosema molle*) in the year of establishment. Five stages of growth (5, 9, 13, 17 and 21 weeks after sowing) were the treatmenmts arranged in a Randomized Complete Block Design replicated four times. The land was divided into twenty plots of 5 m X 3m each. The spacing between each block was 1m and 0.5m along the rows and columns, respectively. Growth components and DM yield were measured at the various stages of growth. There was no significant difference in plant height at 17 and 21WAS as both stages had 148 cm. However, the two satges were sugnificantly (P>0.01) higher than the other stages of growth in plant height. Leaf to stem was however, significantly higher at 5WAS (1.90) compared to the other stages of growth, while 21WAS had the least value of 0.34. Forage DM yield was significantly (P<0.01) higher at 17 WAS (3.43 t ha^{-1}) compared with the other stages of growth. Crude protein content at 9WAS (19.51%) was significantly (P<0.01) higher than the other stages of growth, while 21 WAS had the lowest value of 16.93%. Crude protein decreased from 9 to 21 WAS, while the fibre fractions increased from 9 to 21WAS. The legume grown in early June on Jos Plateau should be harvested at 17 WAS when the DM yield is maximum and crude protein content could also meet the requirements for ruminant animals.

Keywords: Growth stage, nutrients composition, *C. molle*, Dry matter, yield

INTRODUCTION

Centrosema molle Mart. ex Benth is widespread in the humid-tropics from the Tropic of Cancer in the Northern hemisphere to Tropic of Capricorn in the Southern hemisphere, and up to an altitude of 1600 m and is one of the most palatable legumes (Teitzel and Chen, 1992). It is considered to be a valuable feedstuff since it provides fresh green matter during the dry season (Heuzé and Tran, 2014). Different locations have been found to influence the yield and quality of forage crops. Stage of growth for which a forage crop is harvested for livestock feeding is also very important as this could have great influence on the overall forage yield and quality. As forage crop matures, the dry matter content increases, but digestibility of NDF, starch, sugar and crude protein contents, are all reduced (Kilcer *at al*., 2003). Therefore, there should be a growth/maturity stage to harvest in order to obtain optimum dry matter yield and forage quality in different environment. It has become important to evaluate forage yield and quality of Centro (*Centrosema molle*) at different stages of growth so as to determine the optimum stage of growth for which the forage crop could be harvested for livestock feeding either as pasture, hay or silage. The study was therefore designed to examine the effect of stages of growth on dry matter yield and nutrients composition of Centro (*centrosema molle*) in the year of establishment on Jos Plateau, Nigeria.

MATERIALS AND METHODS

Location of the Study: The experiment was carried out at the Nigerian Institute for Trypanosomiasis Research (NITR), Vom, (Lat 9° 43' 60N, Long 8° 46' 60E and 1,223m above sea level), (Ovimaps, 2014), Jos, Nigeria. The area is characterised by two major seasons (rainy and dry seasons). The rainy season starts from late-May and ends in early-October each year, while the dry season starts from late-October and ends in early- May. Peak of the rain is normally observed in the month of August each year. The soil is classified as sandy-clay loam. It is low in total nitrogen (0.33%), phosphorus (7.53 mg/litre), but fair in potassium (247.2 mg/litre)

Land Preparation and Experimental Design: The land was ploughed and harrowed twice using tractor mounted implements. The field was levelled and all debris were removed to provide a clean seedbed. Five stages of growth (5, 9, 13, 17 and 21 weeks after sowing) were the treatmenmts arranged in a Randomized Complete Block Design replicated four times. The land was divided into twenty plots of 5 m X 3m each. The spacing between each block was 1m and 0.5m along the rows and columns, respectively. Growth components and dry matter (DM) were measured at the various stages of growth.

Pasture Establishment and Yield Measurement: The trial was conducted when the rains were well established in the first week of June, 2016 rainy season. Seedrate was calculated using the method and formular provided by Karki (2013) as follows:

PLS Index = (% Germination x % Purity) ÷ 10,000

Kg of Seed per hectare = Recommended Seeding Rate ÷ PLS Index

Where; Kg= kilogram and PLS= Pure live seeds

Recommended planting spacing and depth were used. The seeds were drilled along the rows. Prior to planting, Single Superphosphate (SSP) fertiliser (18% P_2O_5) was applied at a rate of 30 kg ha^{-1} in both cropping seasons. The plots were manually weeded three times throughout the duration of the experiment using hoes. Five (5) plants in the middle of a row in each plot were tagged and used to determine the growth components which were plant height, number of leaves per plant and number of branches per plant at each stage of growth. The height of the tagged plants was measured from the ground level to the top of the plant with the aid of graduated meter rule. The number of leaves per plant and branches of the tagged plants were counted. Other five plants within a row in each plot were harvested to determine leaf to stem ratio by separating the leaves of the harvested plants from the stem. The leaves and the stem were wighed immediately in the field after separation, and were thereafter oven-dried at a temperature of 65^{o}C for 48 hours and weighed again until a constant weight was attained. Thereafter, the leaf dry weight was divided by stem dry weight to determine leaf to stem ratio (Tucak *et al*., 2013). Plants within 0.5 m^2 quadrat placed in the middle rows of the plots at pre - determined points were cut at 5cm above the ground level to determine the forage yield at 9, 13, 17 and 21 WAS using 0.5 m^2 quadrat.

The cut forages samples were immediately weighed to determine fresh weight after which sub-samples were oven dried at a temperature of 65^{o}C for 48 hrs to determine the dry matter yields. Forage dry matter yields were calculated as shown below;

$$\frac{Sub-sample\ dry\ weight}{Sub-sample\ fresh\ weight} \times 100 \times Total\ Harvest = \boldsymbol{Z}$$

Z X *40,000 = Dry matter yield per hectare. *There are 40,000 quardrat ($0.5m^{-2}$) per hectare

Analyses of Samples and Data: Proximate analysis (CP, ash, CF, ether EE and NFE) and mineral composition (Ca, P, Mg, K and Na) of the samples were determined using the method of (AOAC, 1990). All data generated were subjected to analysis of variance (ANOVA). The General Linear Model of SAS (2002) Statistical Software was used for the analyses and means were separated (Tukey, 1949).

RESULTS AND DISCUSSION

Growth components and dry matter yield of the legume at different stages of growth is presented in Table 1. Plant height was significantly higher at the later stages of growth compared to the early stages. Both 17 and 21 WAS had the height of 148cm, while 5 WAS had the lowest value of 19.30 cm. Similarly, there was no significant difference between 17 and 21 WAS in number of leaves per plant, but the two stages of growth were significantly higher and significant than the other stages of growth. There was no record of number of branches at 5 WAS because, the legume was at the establishment stage. The number of branches was significantly higher at 21WAS (19.25), while 9WAS had the lowest value (4.25). The number of branches for *C. molle* obtained in

this study at 13 WAS was higher than 3.3 reported by Omokanye (2001) in the year of establishment at Shika, Zaria, Nigeria. Leaf to stem ratio was significantly higher at 5WAS, and the lowest value of 0.34 was recorded at 21WAS. The decrease in leaf to stem ratio (5 - 21 WAS) observed in this study agrees with Ramírez *et al.* (2008) that leaf to stem ratio decrease as plant matures. The DM yield of the legume relatively increased from 9 WAS, reached a peak at 17 WAS, and then decreased at 21 WAS. Forage DM yield was significantly higher at 17 WAS (3.43t ha^{-1}) decreasing to 2.90 t ha^{-1} at 21 WAS. Forage DM yields were higher than 2.9 t ha^{-1} in the first year obtained by Geleti *at al*. (2013) in Ethiopia, while Omokanye (2001) reported similar DM yield to what was obtained in this study at 17 WAS. During the growth stage and as the plant undergo morphological changes, leaf growth becomes slower, the stem increases in length and proportion of dry matter increases.

Table 1: Growth components and forage dry matter yield of *C. molle* at different stages of growth

Parameter	Weeks after sowing					
	5	**9**	**13**	**17**	**21**	**SEM**
Plant height (cm)	19.30^{d}	70.25^{c}	99.00^{b}	148.50^{a}	148.40^{a}	1.23
Number of leaves per plant	5.00^{c}	8.75^{c}	26.75^{b}	93.25^{a}	91.75^{a}	3.46
Number of branches per plant	-	4.25^{d}	8.25^{c}	17.25^{b}	19.25^{a}	0.75
Leaf to stem ratio	1.90^{a}	1.49^{b}	1.15^{c}	0.60^{d}	0.34^{c}	0.07
Forage DM yield (t/ha)	-	0.64^{d}	1.42^{c}	3.43^{a}	2.90^{b}	0.51

Table 2 shows the nutrients compositions at different stages of growth. Crude protein, ether extract and ash were significantly higher at 5 WAS with 19.51, 3.56 and 10.83 % compared to 16.93, 2.04 and 8.47 % at 21 WAS respectively. However, crude fibre fraction was significantly higher at 21 WAS. Similarly, NDF and ADF were significantly higher at 21 WAS (47.15 and 35.73 %) compared to 36.11 and 27.54% recorded at 5WAS respectively. The CP, ADF obtained for the legume in this study were similar, but NDF was lower than 55.2% reported by Adjorlolo *et al.* (2014) in Ghana. The CP content of the legume could meet the requirements for ruminant animals in the tropics. The NDF and ADF contents were similar to the result reported by Geleti *at al*. (2013) in Ethiopia. All the mineral elements analysed were significantly (0.01) higher at 9 WAS compared to 21 WAS, which had lowest values except for sodium. The forage legume can meet the Ca (0.3 - 0.8%) and Mg (0.18 - 0.4%) required for growth and all productive/physiological functions of small ruminants (Rashid, 2008). The legume could also meet requirements of 0.53 - 0.67% Ca, 0.22 - 0.44% P, 0.18 - 0.21 % Mg and 11% K for lactating cows (NRC, 2001).

Table 2: Effect of different stages of growth on nutrients composition of *C. molle*.

Parameter	Weeks after sowing				
	9	**13**	**17**	**21**	**SEM**
	%				
Crude protein	19.51^{a}	18.85^{b}	17.19^{b}	16.93^{c}	0.12
Crude fibre	26.56^{d}	28.59^{c}	32.15^{b}	33.61^{a}	0.19
Ether extract	3.56^{a}	2.90^{b}	2.43^{c}	2.04^{d}	0.02
ash	10.83^{a}	9.70^{b}	9.10^{c}	8.47^{d}	0.09
Nitrogen free extract	34.04^{d}	34.53^{c}	36.20^{b}	37.95^{a}	0.33
Neutral detergent fibre	36.11^{c}	38.71^{c}	43.23^{b}	47.15^{a}	1.42
Acid detergent fibre	27.54^{d}	30.12^{c}	33.24^{b}	35.73^{a}	0.32
	g kg^{-1}				
Calcium	14.83^{a}	14.53^{b}	14.15^{c}	13.73^{d}	0.02
Phosphorus	2.79^{a}	2.35^{b}	1.51^{c}	1.22^{d}	0.03
Magnesium	3.13^{a}	2.71^{b}	2.07^{c}	1.09^{d}	0.02
Potassium	15.24^{a}	14.73^{b}	14.46^{c}	13.26^{d}	0.13
Sodium	0.34	0.28	0.46	0.37	0.18

CONCLUSION AND RECOMENDATION

It is therefore concluded that stage of growth has influence on *C. molle* DM yield and nutrient composition. *Centrosema molle* grown in early June on Jos Plateau should be harvested at 17 WAS when the DM yield is at maximum and crude protein content could also meet the requirements for ruminant animals.

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In Vitro Gas Volume Production of Compounded Diet Containing Graded Levels of *Aspergillus Niger* Biodegraded Corn Cob

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Abstract: Corn cob being a waste product could be utilized as an energy source in feed formulation if properly processed and harnessed through fungal degradation. Gas volume production content of graded levels of *Aspergillus niger* biodegraded corncob based diet was estimated using *in vitro* gas production technique. The *Aspergillus niger* was isolated and sub-cultured to obtain a pure culture on Potatoes Dextrose Agar (PDA) using the samples obtained from the decaying corncob. Degraded corn cob meals (DCCM) of four dietary treatments were prepared to include: T_1 (0% DCCM which served as the control), T_2 (15% DCCM), T_3 (30% DCCM) and T_4 (45% DCCM). Each diet sample (200mg) was incubated in buffered rumen liquor for 24h and gas volume were estimated using established *in vitro* gas production models. Each treatment was replicated three times. The proximate composition of the dietary treatments was carried out and the crude protein content varied from 11.67–12.67%, crude fiber 10.94–21.56%, ether extract 2.12–4.88%, ash 6.48–9.44% and nitrogen free extract 58.17–62.99%. Amount of gas volume produced was determined every 3 hours for 24 hours of incubation in buffered rumen fluid. Results obtained shows that volume of gas produced in time "t" denoted by (b) were significantly different ($P<0.05$) across the dietary treatments. However, rate of gas production (h^{-1}) and time between incubation and gas production were not significantly different ($P> 0.05$) across the dietary treatments. Gas volume production at 24h were significantly ($P<0.05$) influenced by different inclusion levels of biodegraded corncob with values obtained ranging from diet containing 45% DCCM (15.33 ml/gDM) to 30% DCCM (35.33 ml/gDM). It can be concluded that 30% DCCM based diet had the potential of meeting the nutritional needs as small ruminant livestock feeds, if properly biodegraded and incorporated into feeds.

Keywords: Biodegradation, Corn Cob, *In vitro, Aspergillus niger*

INTRODUCTION

Poor nutrition is one of the main constraints of small ruminant livestock production in the tropics. Even where forage resources abound, seasonal fluctuation in their nutritive value makes sustainable gains in production from good management and disease controlled programme unrealistic [1]. These challenges result in reduction of production of certain livestock and the effect of these challenges have reflected on the quality and amount of animal protein available for human consumption. However, this has necessitated the search for non–conventional feedstuffs that are cheap and not in high demand by humans [2]. Corn cob used as feedstuff for large-scale energy production is a modern concept. However, a major limiting factor in the utilization of this agricultural waste is its low digestibility and relatively poor nutrient composition [3]. Thus, the use of fungi in biodegradation of agro industrial by-products (AIBs) and crop residues has the potential of increasing productivity, efficiency and quality output in agro industrial processing operations in many developing countries. Therefore, this study was conducted to evaluate the *in vitro* gas volume production of compounded diet containing graded levels of *Aspergillus niger* biodegraded corn cob.

MATERIALS AND METHODS

Experimental site: The process of biodegradation was carried out at the Microbiology Laboratory of Institute of Agricultural Research and Training, Moor plantation, Apata, Ibadan.

Preparation of Experimental diets

***Isolation of microorganism*:** The isolation of *Aspergillus niger* was carried out on Potatoes Dextrose Agar (PDA) using the samples obtained from the decaying corncob. Samples of the fungus were suspended in 10ml of sterile distilled water and shaken vigorously for 10 minutes. This was diluted with sterile water until a spore count of approximately 3×10^6 per ml was obtained; spore count was monitored by using the Hawksley Haemocytometer. 1.0ml of the resulting liquid was spread on the surface of the PDA and incubated at 37^0C for 7 days. The fungal isolates formed were sub-cultured until a pure culture of *Aspergillus niger* was obtained, this was done according to a similar research carried out by (4).

***Solid State Fermentation*:** The corn cob used in this experiment was obtained from Gege market in Ibadan. The process of biodegradation which lasted for seven (7) days was carried out according to the method of (4) using the fungus *Aspergillus niger*. The corn cob was grinded and sterilized in an autoclave machine at 121^0 C for 15 minutes. This was allowed to cool down and then inoculated with the pure fungus culture and moistened with distilled water at the rate of 300 ml per kg of corncob. After a period of seven days the action of the fungus was stopped by oven drying the substrate at 80^0C for 24 hours. The dried materials (degraded corncob) obtained from the solid state fermentation was then incorporated at varying levels of 0%, 15%, 30% and 45% with other ingredients to formulate four dietary treatments T_1, T_2, T_3 and T_4 respectively where T_1 served as the control.

***In vitro* Gas Production Procedure**

In vitro study was carried out at the Department of Animal science, University of Ibadan. This study was carried out as described by [5]. A sensitive scale was used to measure out 200 mg of the milled samples in triplicates (substrate) and was then placed into 100 ml graduated glass syringes with fitted silicon tube. Rumen liquor was collected from five (5) WAD goats using suction tube as described by [6]. Strained liquor collected was mixed with buffer in the ratio 1:2. 30 ml of the inoculum was then added to each of the pre-warmed glass syringe containing substrate at 39 ± 1ºC. A blank containing 30 ml of the buffered inoculums only was included as control. Then gas production was recorded at 0, 3, 6, 12, 24, 36 and 48 hours of incubation. Data obtained from *in vitro* gas production was fitted to the non-linear equation [7]: V (m/l0.2 g DM) =GV (I-e^{-ct}). Where V is the potential gas production, GV is the volume of gas and ct is the fractional rate of gas production. Incubation temperature was maintained at 39 ± 1^0C and volume of gas production was measured at 3h intervals for 24h. After 24h and 48h of post incubation period, 4ml of 10M NaOH solution was introduced at the end of the incubation to estimate methane produced as reported by [8]. The average volume of gas produced from the blanks was deducted from the volume of gas produced per sample.

Table 1: Proximate Composition (%) of the Experimental diet containing *Aspergillus niger* biodegraded corncob

	Inclusion levels of DCCM			
Parameters	**T_1 (0%)**	**T_2 (15%)**	**T_3 (30%)**	**T_4 (45%)**
Dry matter	86.82	86.72	84.89	83.39
Crude protein	11.75	12.23	12.67	11.67
Crude fibre	10.94	12.40	15.81	21.56
Ether extract	4.88	3.90	3.76	2.12
Ash	9.44	8.74	9.27	6.48
NFE	62.99	62.73	58.59	58.17

NFE: Nitrogen free Extract, DCCM: Degraded corn cob meal

RESULTS AND DISCUSSION

Table 2 presents the gas production at various incubation hours of compounded ration containing graded levels of *Aspergillus niger* biodegraded corn cob. The results indicated that there were significant differences (P <0.05) across the dietary treatments for the incubation hours of gas volume production except at 3 and 6 hours of incubation. It was recorded that T_4 had the lowest values obtained while T_3 had the highest values throughout the incubation hours. However, the cumulative gas volume produced at 24hours of incubation ranged from 15.33-35.33 ml/gDM. It was observed in this study that as the time increased, volume of gas produced also increased alongside. This agreed with results of [9].

Table 2: Gas production (ml/gDM) at various incubation hours of compounded ration containing graded levels of *Aspergillus niger* biodegraded corncob

	Inclusion levels of DCCM				
Time (hr)	**T_1(0%)**	**T_2(15%)**	**T_3(30%)**	**T_4(45%)**	**SEM±**
3	2.83	3.50	2.67	2.00	0.29
6	5.33	6.00	5.33	4.00	0.52
9	8.67^{ab}	11.00^{ab}	14.00^{a}	5.33^{b}	1.26
12	12.00^{b}	20.00^{a}	20.00^{a}	8.67^{b}	1.64
15	16.00^{b}	24.00^{a}	25.33^{a}	9.33^{c}	2.05
18	18.00^{b}	28.00^{a}	30.67^{a}	12.00^{b}	2.46
21	19.33^{b}	32.00^{a}	34.00^{a}	12.67^{c}	2.80
24	20.67^{b}	31.00^{a}	35.33^{a}	15.33^{b}	2.56

^{a,b,c} means along the same row with different superscripts are significantly different (P<0.05)

Table 3 shows the *in vitro* gas production characteristics of compounded ration containing graded levels of *Aspergillus niger* biodegraded corncob. There was no significant difference (P>0.05) in all the parameters observed in this study except the volume of gas produced in time (b) and gas volumes (GV). Volume of gas produced in time (b) ranged significantly (P< 0.05) from 0% DCCM (35.960 ml/200mgDM) to 30% DCCM (72.770 ml/200mgDM). Gas volume (GV) production varied significantly across the dietary treatments in which diet containing 30% DCCM (35.333 ml/gDM) and 15% DCCM (31.000 ml/gDM) recorded similar value but significantly higher than those containing 0% DCCM (20.667 ml/gDM) and 45% DCCM (15.333 ml/gDM). Gas volume (GV) generally reflects the contents of fermentable carbohydrate or carbohydrate degradation, nitrogen and lipids (10). This was further explained by [11] that gas production from protein fermentation is relatively small as compared to carbohydrate fermentation while contribution of fat to gas production is negligible. In most cases, feedstuffs that show high capacity for gas production are also observed to be synonymous for high methane production.

Table 3: *In vitro* gas production characteristics of compounded ration containing graded levels of *Aspergillus niger* biodegraded corncob

Parameters	**Inclusion levels of DCCM**				
	T_1 (0%)	**T_2 (15%)**	**T_3 (30%)**	**T_4 (45%)**	**SEM±**
b(ml/200mgDM)	35.960^{c}	55.330^{b}	72.770^{a}	38.230^{c}	0.002
c(ml/hr)	0.041	0.043	0.038	0.030	0.003
Lag(hr)	2.452	2.305	2.683	2.083	0.158
GV24hrs(ml/gDM)	20.667^{b}	31.000^{a}	35.333^{a}	15.333^{c}	0.056

^{a,b,c} means along the same row with different superscripts are significantly different (P<0.05)

b: Volume of gas produced in time 't' c: Rate of gas production (h^{-1})

Lag: Time between incubation and gas production GV: Gas volume

CONCLUSION

It can be concluded that biodegraded corncob meal can be incorporated into small ruminant's diet at 30% inclusion level especially during long period of dry season in the tropics.

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Botanical composition of native forage species in an established Gamba (*Andropogon gayanus* Kunth) pasture in the semi-arid zone of Nigeria

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Abstract: The objective of the study was to assess the botanical composition of native forage species in an established Gamba pasture. Two (2) hectares of land were cleared, ploughed and harrowed to provide a fine seed bed for better seedling establishment. Subsequently, plots measuring 3m x 3m were laid and seed of Gamba grass was planted at 37.5cm interval for grazing experiment. Data were collected on the botanical composition of native forage species in the established Gamba pasture prior to commencement of grazing. The results showed that there were many species of grasses, legumes, forbs and browses in the experimental site in addition to the established Gamba but their composition varied. Frequency of occurrence of the species evaluated revealed that grasses accounted for 31.43%, legumes 17.14%, forbs 42.86%.and browses 8.57%, suggesting that there were high proportions of grasses and forbs compared to legumes. It was concluded that the site had many forage species that would support livestock production. However, there is the need to determine the chemical composition of the species evaluated.

Keywords: Botanical composition, forage species, Gamba grass.

INTRODUCTION

The northern region of Nigeria is concentrated with most of the nation's ruminant livestock. However, this region is characterized by a long dry season (6-9 months) which often causes serious shortage of feed for ruminant animals. Obviously, most of the beef that reaches the market comes from the traditional cattle owners' herds whose input into production is very minimal and depends mostly on natural range to feed their stock with little or no supplementation (1). Despite the fact that forage provides the cheapest and most important feed for ruminant animals, its availability is one of the major constraints to livestock production in the tropics (2). Sub Saharan livestock production is increasingly constrained by feed shortage both quantitatively and qualitatively. (3) reported that non-availability of adequate feeds for most parts of the year in Nigeria is a major constraint to livestock production. Generally, Nigerian livestock population depends mostly on the available natural pastures for their feed. The potential yield of native grass species, such as Gamba, has been reported by several authors (4; 5; 6; 7; 8). It is one of the most important native forage grass species relished by livestock in Nigeria and is valued for its ease of establishment, high yielding ability, drought resistance and excellent palatability, particularly at vegetative stage (7). As part of the new technology in animal husbandry, improved pastures produce more dry matter of high nutritive value and lead to greater animal productivity than do native pastures (9). (10) also reported that sown pastures, where properly managed, have the potential to improve forage quality and increase herbage yield several folds over that of natural grasslands, and thus leads to marked increase in animal production.

Botanical composition of species refers to the contribution of each plant species to the vegetation. It is generally expressed as a percent, so that all species components add up to 100% (11). It can be expressed on either an individual specie basis, or by specie groups that are defined according to objectives of the inventory or monitoring program. It is a commonly determined attribute in rangeland inventory and monitoring. It is regarded as an important indicator of ecological and management processes at a site. The objective of this study was therefore to assess the botanical composition of the native forage species in an established Gamba pasture in the semi-arid zone of Nigeria.

MATERIALS AND METHODS

Description of the Study Location: The experiment was conducted at the Kano University of Science and Technology Teaching and Research Farm, Gaya ($11^0 51^1$ N; $9^0 20^1$E; alt. 430m above sea level) in the semi-arid zone of Nigeria (12). The mean annual rainfall is about 800mm, while the mean annual temperature is about 26^0C (13). The study area is characterized by a defined wet season which normally begins in May and ends in October. The dry season therefore lasts from October to May. The soil of the study area is loamy sand with little organic matter (14). The natural vegetation is the savanna type which consists of moderately tall grasses such as *Andropogon gayanus*, *Panicum maximum, Pennisetum pedicellatum* etc and scattered browses such as *Acacia, Balanites, Faidherbia, Piliostigma and Zizipus spp* (15). The area supports good agricultural activities with sorghum, millet, cowpea and groundnut being the major crops cultivated (12). The most common livestock found are the Bunaji, Yankasa and the Red Sokoto breeds of cattle, sheep and goats, respectively.

Experimental Design and Establishment: Two (2) hectares of land was cleared, ploughed and harrowed to provide a fine seed bed for better seedling establishment. Subsequently, plots measuring 3m x 3m were laid in a randomized complete block design (RCBD). Seed of Gamba grass was planted at 37.5cm interval (7) for grazing experiment.

Data Collection: The botanical composition of native forage species in the established Gamba pasture was evaluated prior to commencement of grazing. The annual forage species that emerged in the experimental site, after the last weeding, were identified and categorized into grasses, legumes, forbs and browses as described by (11). Subsequently, frequency of occurrence of the species evaluated was also determined.

Data Analysis: The data collected were subjected to analysis of variance (ANOVA) using simple descriptive statistical tools such as frequency and percentages.

RESULTS AND DISCUSSION

The botanical composition of native forage species in the established Gamba pasture prior to grazing is presented in Table 1. The annual forage species that emerged in the experimental site were identified and categorized into grasses, legumes, forbs and browses (11). A total of thirty-five (35) species were evaluated and the results showed that the grazing site had many forage species in addition to the established Gamba pasture, although their composition varies. This is in line with earlier report by (10) that weeds emergence is inevitable in newly established pastures. Weeds compete with pasture species for nutrients, water and light, which consequently affects the vigour of the emerging seedlings and thus, reduces the forage cover (15). Pastures established on newly cleared lands are usually invaded by regrowth from stumps and roots of plant species that occur in the area and their emergence could be as high as 45 to 50% in the year of establishment of pasture species such as *Andropogon gayanus*.

The frequency of occurrence of the species evaluated (Table 2) indicated that grasses accounted for 31.43%, legumes 17.14%and browses 8.57%, and could serve as increasers. However, forbs were also encountered as invaders (42.86%), out of which seven (*Senna obtusifola, Senna occidentalis, Tribulus terrestri, Zonia glochidiata, Hibiscus asper, Ampelocissus africanus* and *Amaranthus viridis*) were found to be noxious and unpalatable and thus, would not add to the feed resources of the experimental site. The results indicated that there were high proportions of grasses and forbs compared to legumes. Earlier reports showed that growth of newly established pasture may be impaired if weeds are not properly controlled, especially when the forage consists mainly of grasses (15; 10).

Table 1: Botanical composition of native forage species in the established Gamba pasture prior to grazing

Hausa/English name	Scientific name	Classification			
		Grass	Legume	Forb	Browse
*Tafasa	*Sennaobtusifola*			x	
Coffee senna	*Sennaoccidentalis*			x	

**Kyasuwa grass	*Penniestumpedicellatum*	x				
*Alkamartururuwa	*Monechmacilliatum*				x	
*Harkiya	*Digitariavelutina*	x				
*Komayya	*Eragrostisciliaris*	x				
Carpet grass	*Axonopuscompressus*	x				
*Garafuni	*Momordicabalsamina*		x			
*Farar kaya	*Acacia Senegal*					x
*Kargo	*Piliostigmathonningii*					x
*Tsidau	*Tribulusterrestris*				x	
*Dankadifi	*Zoniaglochidiata*				x	
Love grass	*Eragrostistremula*	x				
*Yakuwarkare	*Hibiscus asper*				x	
*Aya-aya	*Cyperusrotundus*	x				
*Gemunkwado	*Kyllingaspp*	x				
*Yawo	*Ampelocissusafricanus*				x	
*KanBarawo	*Leucasmartinicensis*				x	
*Balasaya	*Commelinaspp*	x				
*Kayarrakumi	*Hygrophilaauriculata*					x
*Karangiya	*Cenchrusbiflorus*	x				
*Yadiya	*Leptadeniahastata*		x			
*Nononkurciya	*Euphorbia hirta*				x	
*Gogamasu	*Mitracarpusvillosus*				x	
*Hanjinkuda	*Commelinaforskalaei*				x	
Witch weed	*Strigaspp*		x			
Bahama grass	*Cynodondactylon*	x				
*Gude-gude	*Dactylocteniumaegyptium*	x				
*Zakibanza	*Amaranthusviridis*				x	
*Gyadarawaki	*Crotalaria spp*		x			
*Hankufa	*Waltheriaindica*				x	
*Miyartsanya	*Indigoferaechinata*				x	
*Gabaruwarkasa	*Tephrosialinearis*				x	
*Gadagi	*Alysicarpusvaginalis*		x			
*Yaryadi	*Ipomeaeriocarpa*		x			

*Hausa name **Recognized both in Hausa and English

Table 2: Occurrence of native forage species in the established Gamba pasture prior to grazing

Specie	Frequency	Percentage
Grass	11	31.43
Legume	06	17.14
Forb	15	42.86
Browse	03	08.57
Total	35	100.00

CONCLUSION

Based on the results of the present study, it was concluded that the experimental site had many forage species that would support livestock production. Future research should focus on the chemical composition of the species evaluated.

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RUMINANT ANIMAL NUTRITION AND PRODUCTION

Effects of Strains and Energy Levels on Carcass and Primal Cuts of Some Broiler Birds in Hot Season of Sokoto Semi-Arid, Nigeria

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Abstract: Three commercial broiler strains namely: *Arbor-acre*, *Marshall* and *Hubbard* were placed under three different dietary energy and crude protein levels of 2900Kcal/kg (ME) 22% CP, 3100Kcal/kg (ME) 23% CP, and 3300 Kcal/kg (ME) 24% CP for low, medium and high energy levels at starter phase, respectively. While at the finisher phase, they were fed 2800 Kcal/kg (ME) 19% CP, 3000 Kcal/kg(ME) 20% CP and 3200Kcal/kg(ME) 21% CP in order to determine their effect on carcass and primal cuts in hot season of semi-arid environment of Sokoto State, Nigeria. A total of 675birds were used in a completely randomized design (CRD) comprising 225birds each of *Arbor-acre*, *Hubbard* and *Marshall*s trains serving as treatments with each group replicated five times so that each replicate had 15birds. Each strain group was fed three different dietary energy at both starter and finisher phases. The trial was for 56days. At the end of finisher phase carcass analysis was carried out. Data recorded were subjected to Analysis of variance (ANOVA) and least significant difference was used to compare the means. Results obtained indicated the effect of strain on the weights of back muscle, drum stick, wings, neck and dressing percentage ($P<0.05$), while the energy level appeared to have no influence on the primal cuts. It could therefore be concluded that *Arbor-acre* strain should be raised in hot season of semi-arid Sokoto and it should be fed low energy diet owing to its higher dressing percentage compared to other strains.

INTRODUCTION

Broiler birds among other species of poultry have the potential of providing quality protein to the populace owing to its short generation interval. However, seasonal challenges, nutrient content of the diet particularly energy and the strain of the birds have been some of the problems faced by broiler farmers in different parts of the world, particularly sub-African semi-arid environments, where environmentally controlled houses are not available for efficient broiler rearing particularly in hot season when the environmental temperature is usually high throughout the period which is known to significantly affect the performance of broiler birds in the region.

Researches have shown that; different strains of broilers require different energy/protein levels in different environment for efficient carcass production (Zahid and Hussain 2002; Javid iqval et al., 2012; Huwaida et al., 2012). Therefore, identifying energy required by a particular strain of broiler for better carcass production in semi-arid Sokoto will significantly improve broiler production in the area and hence reduce the problem of malnutrition faced by developing countries.

MATERIALS AND METHODS

The study area: The experiment was conducted at the Poultry Production and Research Unit of the Department of Animal Science, Usmanu Danfodiyo University, Sokoto, located at the Sokoto State Veterinary Centre, along Aliyu Jodi road, Sokoto. Sokoto state is located between latitudes 12o and 130 05'N and between longitudes 408 and 604 E in the northern part of Nigeria and at an altitude of 350m above sea level (Mammanet al., 2000). The State falls within the Sudan savannah vegetation zone, with alternating wet and dry seasons. The hot dry spell extends from March to May and some time to June in the extreme northern part.

Experimental design: A total of 675 broiler birds were used in each of the trials, two hundred and twenty-five (225) birds each of *Hubbard,* Arbor acre, and *Marshall* Strains in a completely randomized design. Each of the strains was divided into three different energy groups of five replicates and each replicate contained fifteen birds. The three different energy groups for starter phase were 2900Kcal/kg (ME) 22% CP, 3100Kcal/kg (ME) 23%

CP, and 3300 Kcal/kg (ME) 24% CP, respectively. For the finisher group energy and protein levels were 2800 Kcal/kg(ME) 19% CP, 3000 Kcal/kg(ME) 20% CP and 3200Kcal/kg(ME) 21% CP, respectively. As shown in Tables 1 and 2, respectively.

Table 1: Gross and calculated chemical composition of diets to be fed at the starterphase

Ingredients (%)	Diet1	Diet2	Diet3
Maize	50.00	54.50	50.00
Groundnut cake	14.50	32.00	30.00
Soya bean meal	20.00	4.50	7.50
Wheat Offal	4.00	2.00	-
Maize Bran	5.00	-	-
Blood Meal	1.50	2.00	3.50
Lime Stone	2.00	2.00	2.00
Bone Meal	1.80	1.80	1.80
Premix	0.25	0.25	0.25
Methionine	0.30	0.30	0.30
Lysine	0.30	0.30	0.30
Salt	0.30	0.30	0.30
Oil	-	-	4.00
Total	**100**	**100**	**100**
Calculated Analysis			
M. E. K (cal/kg)	2,911	3,070	3,282
C. P. (%)	22.00	23.00	24.00
P(av) (%)	0.45	0.39	0.40
Ca (%)	1.27	1.27	1.28
EE	3.73	4.63	4.12
C.F	3.98	3.17	3.02
Methionine	0.60	0.60	0.60
Lysine	1.36	1.22	1.35

*Vitamin A 30000000 i.u, Vitamin D3 6000000 i.u, Vitamin E 30000 i.u, Vitamin K 2000 mg, Vitamin B2 30000mg, Vitamin C 30 g, Niacin 40000 mg, Panthothenic acid 12000 mg, Vitamin B6 1500 mg, Vitamin B12 10000 mg, Folic acid 1000 mg, Bioton 400 mg, Choline chloride 300000 mg, Cobalt 200 mg, Copper 1200 mg, Iodine 20000 mg, Iron 40000 mg, Manganese 100000 mg, Selenium 150 mg, Zinc 30 mg, Antioxidant 1250 mg
**M. E = Metabolisable energy, C. P. = Crude protein, P(av) = Available phosphorous, Ca = calcium, C. F = crude fiber, and EE = Ether extract

Table 2: Gross and calculated chemical composition of diets to be fed at the finisher phase

Ingredients (%)	Diet1	Diet2	Diet3
Maize	45.50	57.10	52.00
Groundnut cake	16.00	22.00	28.00
Soya bean meal	11.50	7.00	7.00
Wheat Offal	10.00	8.00	5.00
Maize Bran	12.00	-	-
Blood Meal	-	1.00	-
Lime Stone	2.00	2.00	2.00
Bone Meal	2.00	1.90	1.90
Premix	0.25	0.25	0.25
Methionine	0.21	0.20	0.25
Lysine	0.21	0.20	0.25
Salt	0.30	0.30	0.30
Oil	-	-	3.00
Total	**100**	**100**	**100**
Calculated Analysis			

M.E.Kcal/kg	2,827	2,977	3,178
C.P.(%)	19.00	20.00	21.00
P(av)(%)	0.44	0.41	0.41
Ca(%)	1.31	1.29	1.29
EE	3.53	4.15	4.18
C.F	4.75	3.39	3.32
Methionine	0.48	0.47	0.53
Lysine	1.02	1.03	1.06

*Vitamin A 30000000 i.u, Vitamin D3 6000000 i.u, Vitamin E 30000 i.u, Vitamin K 2000 mg, Vitamin B2 30000mg, Vitamin C 30 g, Niacin 40000 mg, Panthothenic acid 12000 mg, Vitamin B6 1500 mg, Vitamin B12 10000 mg, Folic acid 1000 mg, Bioton 400 mg, Choline chloride 300000 mg, Cobalt 200 mg, Copper 1200 mg, Iodine 20000 mg, Iron 40000 mg, Manganese 100000 mg, Selenium 150 mg, Zinc 30 mg, Antioxidant 1250 mg
**M.E= Metabolisable energy, C.P=Crude protein, P(av) = Available phosphorous, Ca = Calcium, C.F = Crude Fiber and EE = Ether extract

Sources of experimental birds: The birds used for this experiment were sourced from three commercial hatcheries all of which are from Oyo State in Nigeria. The strains used were *Hubbard*, *Marshall* and Arbo acre broiler strains. The birds were purchased from these hatcheries at the same time so that each strain was obtained in the same day.

Birds and their management: Experimental birds were kept for three days after transport to take care of stress due to transportation. During the three days, they were administered anti stress drugs, later weighed and allotted to their replicate groups. Each strain group (treatment) were replicated five times. Routine vaccinations were administered; antibiotics and coccidiostats were also administered according to the recommendations of Oluyemi and Roberts (2000). The birds were housed on a deep litter with open sided walls. The house and pens were cleaned, washed Fumigated and disinfected prior to the arrival of the birds. Wood shavings were used as litter material.

Period and duration of the experiments: The experiment was carried out in the months of March and April because they are characterized by high ambient temperature and low humidity for the period of 56days (8weeks) for both starter and finisher phases from 9th March to 8th May, 2015.At the end of starter phase the replicates were combined together and then re allocated for finisher phase depending on the number of birds that survived to the finisher phase after which the experiment was terminated.

Data collection: At the end of the finisher phase i.e. eight weeks, three birds were slaughtered from each replicate group for carcass evaluation. Weight of primal cuts and dressed weight were recorded. Dressing percentage was determined from live weight and dressed weight.

Data analysis: Data obtained from carcass evaluation was subjected to Analysis of Variance (ANOVA) using Stat View Analytical computer package version 5 (SAS, 1998). Least significant difference (LSD) was used to compare means.

RESULT

Table 3 shows the main effects of strain, energy and their interaction on the carcass and other primal cuts of different broiler strains in hot season of semi-arid Sokoto. There was no significant difference ($P>0.05$) in terms of Live weight, breast muscle and carcass weight across all the three strains, irrespective of the energy level, but significant difference ($P<0.05$) was observed in the main effect of strains on weights of back, drum stick, thigh muscle, wings, neck and dressing percentage. *Marshall* and *Arbor-acre* strains were observed to have significantly ($P<0.0$) higher values for weight of back (160.88 and 136.63g), respectively, than the *Hubbard*

strain which had 119.69g. However, with regards to drumstick *Arbor-acre* and *Hubbard* strains were observed to have higher values of 140.07 and 133.30g respectively, than *Marshall* the strain which had 72.30g. Similarly, *Arbor-acre* and *Hubbard* strains were observed to have significantly (P<0.05) higher values of 166.11 and 157.27g respectively, as weight of thigh muscle weight than *Marshall* strain which had 116.59g. Conversely *Marshall* Strain was observed to have significantly (P<0.05) higher values of weight of wings (136.04g) than both *Arbor-acre* and *Hubbard* strains which had 113.26 and 110.30g, respectively. *Marshall* strain was observed to have significantly (P<0.05) higher value of 129.90g for weight of neck than both *Arbor-acre* and *Hubbard* strains which had 72.07 and 71.60g respectively, significant difference (P<0.05) was also observed in dressing percentage where Arbor- acre strain was observed to have dressing percentage of 74.36% compared to *Marshall* strain which had 66.17%. However, there was no significant difference (P>0.05) between *Arbor-acre* and *Hubbard* strains and between *Hubbard* and *Marshall* Strains in terms of dressing percentage.

With regards to main effect of energy irrespective of the strain on the carcass and primal cuts of different broiler strains in hot season of semi-arid Sokoto, there was significant difference (P<0.05) in terms of live weight and dressing percentage only but no significant difference (P>0.05) was observed in terms of weight of other primal cuts (Brest, Back, Drumstick, Thigh, Wings, Neck and Carcass). It was observed that birds that consumed low and medium energy diets were seen to have significantly (P<0.05) higher value of 1446.67and 1406.67g live weight, respectively, than those that consumed high energy diets which had 1163.33g. Conversely those that consumed high energy diets were observed to have significantly (P<0.05) higher dressing percentage of 75.28% than those that consumed medium and low energy diets which had a dressing percentage of 68.34 and 67.16% respectively. Significant interactions (P<0.05) was also observed between strains and energy levels with respect to live weight, weights of breast muscle, back, thigh muscle, wings, carcass and dressing percentage in hot season of semi-arid Sokoto.

Table 3 Main effects of strain, dietary energy and their interactions on prime cuts and carcass yield of different broiler strains in hot season of semi-arid Sokoto

Factor	Parameters								
	Live weight(g)	Breast muscle weight (g)	Back (g)	Drumstick weight (g)	Thigh muscle weight (g)	Wings weight (g)	Neck weight (g)	Carcass weight (g)	Dressing percentage (%)
Strain									
Arbor-acre	1340.00	307.65	136.63^{ab}	143.07^{a}	166.11^{a}	113.26^{b}	72.07^{b}	972.07	74.36^{a}
Hubbard	1271.67	282.61	119.69^{b}	133.30^{a}	157.27^{a}	110.30^{b}	71.60^{b}	896.44	70.25^{ab}
Marshall	1405.00	274.68	160.88^{a}	72.30^{b}	116.59^{b}	136.04^{a}	129.90^{a}	923.16	66.17^{b}
SEM	86.93	20.48	11.15	8.75	9.58	6.81	6.48	58.99	1.75
Energy									
Low energy	1446.67^{a}	293.00	138.52	133.20	158.35	123.59	92.65	965.78	67.16^{b}
Medium energy	1406.67^{a}	308.08	153.14	110.43	148.22	123.88	94.66	966.33	68.34^{b}
High energy	1163.33^{b}	263.87	125.54	105.00	133.39	112.13	86.25	859.56	75.28^{a}
SEM	82.15	20.12	11.62	11.66	10.92	7.32	9.92	57.95	1.88
Strain X Energy	**	**	*	NS	*	*	NS	**	*

Means with different superscript across the column are statistically significant at (P<0.05)

DISCUSSION

Carcass and primal cuts of different broiler strains in hot season of semi-arid Sokoto

The non-significant difference (P>0.05) in terms of live weight, breast muscle and carcass weight that was observed across all the three strains irrespective of the energy level is in conformity with the findings of Garcia et al. (1992); Missouhou et al. (1996) which reported no significant difference (p>0.05) in terms of carcass weight of different broiler strains in their separate studies. But significant difference (p<0.05) that was observed in the main effect of strains in terms of back, drum stick, thigh muscle, wings, neck and dressing percentage, is also in line with the findings of Zahid and Hussain (2002) that reported significant difference (P<0.05) in the dressing percentage of five broiler strains.

With regards to main effect of energy irrespective of the strain, the significant difference (P<0.05) that was seen in terms of live weight and dressing percentage and non- significant difference (P>0.05) in terms of other primal cuts(breast, back, drumstick, thigh, wings, neck and carcass), where the birds that consumed low and medium energy diets were seen to have significantly (P<0.05) higher value of live weight, than those that consumed high energy diet Conversely those that consumed high energy diets were observed to have significantly (P<0.05) higher dressing percentage than those that consumed medium and low energy diets, is in line with the finding of Skrivan and Tomora (1992); and Anjum (2001) that reported significant differences (P<0.05) in the dressing percentages of broiler birds fed different dietary nutrients in their separate researches. It is equally in agreement with the results obtained by Javid-iqbal et al. (2012) that reported significant differences in the dressing percentage and live weight of four different broiler strains under local conditions of Pakistan.

Furthermore, the values they reported for *Arbor-acre* and *Hubbard* strains were 70.0 and 71.4%, respectively which are closely similar to 74.30 and 70.25 observed for the same strains in the present studies. Significant interactions (P<0.05) that was also observed between strains and energy levels with respect to live weight, breast muscle, back, thigh muscle, wings, carcass and dressing percentage in hot season of semi-arid Sokoto, is in agreement with the findings of Huwaida et al. (2012). From this we can therefore deduce that; the consistent lower value for thigh muscle observed in *Marshall* strain could be genetic because it does not change across different energy levels.

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Olfaction: Stress Management Strategy to Improve Performance in Ruminants – A Review

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Abstract: Stress is a multi-factorial and growing concern in ruminant production. However, in most cases the real impact is often overlooked which affects both short and long – term productivity of animals. Ruminants are exposed to varied stress conditions ranging from grazing pressure movement (trekking), handling/transportation to management and environment issues with extremes of weather conditions. Various complementary solutions to control stress levels in ruminants are known, but among these solutions is the re-discovery of an age long experience known as Olfaction. The impact of olfaction lies in the fact that specific aromatic compounds, molecules, complexes or essential oils from natural plant sources are able to stimulate sensory activities in the brain, which reduce stress response in ruminants, regulate feed intake with a positive impact on the overall animal well-being and productivity. This article therefore reviews the role of olfaction as a stress management strategy in ruminant animals.

Key words: Stress, Ruminant, Olfaction, Aromatic Complexes, Essential Oils.

DESCRIPTION OF PROBLEM

Stress in ruminant production is a growing concern that influences both short and long-term production. This renewed interest in stress and its effects on ruminant productivity derives from climate change, which is expected to increase temperatures and the frequency of extreme weather events. Stress condition accounts for the inability of an animal to maintain a normal state or homeostasis. Stress is simply a reflex reaction that occurs ineluctably when an animal is exposed to adverse conditions, the result of which is severe enough to cause behavioural or physiological responses (1).

Stress in ruminants is multi-factorial with multiple consequences which finally impacts on the farmer's revenue or profit. Many may think of stress as a tropical issue, but even in temperate climatic conditions this problem is even more pervasive with more severe financial consequences (2). Many unfavourable consequences ranging from discomfort, reduction in feed intake to death usually occurs when animals are exposed to prolonged stress. An estimated 80% of stress related loses are associated with loss of productivity and 20% related to health issues, including reproduction and immunity problems which translate to increased mortality and frequency of mastitis in ruminant animals. One very important impact of stress on ruminant animals is the change in metabolic priorities. Stress mobilizes body reserves to the detriment of meat and milk production. Adrenaline stimulates gluconeogenesis and lipolysis, resulting in increased level of circulating glucocorticoids which leads to protein catabolism. Stress inhibits the production of prolactin and oxytocin – the hormones of milk ejection (3).

Several workers have reported on the need for animals to be stress free, including conducive environment, feed and water provisions etc. Proven impacts of stress include, induce changes in the secretion of pituitary hormones, resulting in reduction in milk and meat production, failure or alteration in reproduction/reproductive cycles, poor immune defences and generally production losses (3, 4). Major stress factors include restraining, handling or novelty, hunger, thirst, fatigue, injury, disease conditions and thermal extremes which directly impinge on the welfare of ruminants (5, 1). Other stress conditions in ruminants include transportation, slaughter conditions, early weaning, overcrowding, dietary changes, veterinary operations and confinement (5, 6, 3). Under acute, prolonged or extreme stressful conditions, the health of the animal is compromised resulting in irreversible loss in productivity and death.

Stress can also affect animal production "beyond the farm", with consequences for the consumer on product quality (taste, tenderness, preservation) and safety (7, 3). Harsh environmental conditions are probably the stressors with the longest lasting effect since they may prevail for months. However, a farmer's attitude and

behaviour have a significant effect on animal fear, welfare and productivity (8). Negative attitude/handling significantly increases the cortisol response and flight distance of ruminants (9, 10). Thus, ruminant animal farmers must strive to keep their animals within the animal's comfort zone with the help of adequate and proper management techniques/practices.

Olfaction

Among the various complementary solutions reported to control stress levels in ruminants is an approach known as "olfaction" (11, 12, 13). This involves the use of aromatic complexes to create a positive olfactory experience to alleviate stress or reduce stress response in animals and regulate feed intake with a positive impact on short and long-term performance. Olfaction is based on the re-discovery of a primary sense that we seem to have lost in the evolution race (3). [11] reviewed attempts by researchers to use flavours through essential oils (EOs) to manipulate the senses of dairy cows to affect feed preference and perhaps increase feed consumption. The reason is simply that the olfactory experience is intimately linked to feed intake (palatability, loyalty to feed) and overall well-being of the animals. However, the hypothalamus has been identified as the portion of the Central Nervous System (CNS) that controls feed intake, initiating feeding and evidence suggest that lesions on the lateral hypothalamic area (LHA) will result in aphagia and eventually starvation/death (14, 15).

Behavioural studies have shown that certain olfactory compounds can have a positive effect on stress and mood of animals (3). D-limonene or essential oil (EO) that contains it, Linalool from lavender, Cinnamaldehyde from Cinnamon tree and citrus EO has shown anxiolytic, antimicrobial and anti-oxidative properties in animals. EOs are natural steam-volatile or organic solvent extracts of plants. Essential oils appear to be natural alternative to antibiotics and function similarly to ionosphores (16). To elucidates the effect of these aromatic compounds/complexes on stress, several modes of action are possible. Olfactive perception can be associated with cerebral pleasure created by the compound (complexes), imprinting a positive and unique sensory experience in the animals memory. This action reduces anxiety/aggression and induces feed loyalty. These active compounds can also have effect on the nervous transmission of stress at the brain level, probably by the modulation of neurotransmitters via endo-cannabinoid system (3). Also anti-inflammatory properties of some compounds can limit the impact of stress on animals. Substantial evidences suggest that immune system suppression is mediated by glucocorticoids (steroids that reduce inflammation) following hypothalamic pituitary adreno-cortical axis activation by stress (17). Complexes of some specific aromatic molecules of natural origin commonly called Ve'O's are now being developed with the expertise of olfaction. This group of aromatic molecules or complexes have been shown to improve or restore the well-being, improve feed intake and better performance of ruminants under any form of stress. For reproductive efficiency, anti – stress properties of complexes and essential oils are now known to cause the reduction or complete inhibition of the release of stress hormones; which allows the overall unhindered cyclicity and effective action at specific target sites of the reproductive hormones. This appears as a natural solution to optimise reproduction in dairy cows and possibly in other ruminant species.

CONCLUSION

The exposure of ruminant animals to various stress conditions has a variety of effects. Ruminant animals can be very excitable responding to these conditions. The principle behind olfaction involves taking advantage of the important role of sensory stimulation and sensory feed additives – EOs (compounds, molecules, complexes) mostly aromatic in nature that stimulate the brain into inducing calm on the animal thereby improving performance in ruminants. The combined effects of pleasure, appetite stimulation and stress reduction are able to enhance the animal's feed intake, feed loyalty and general well-being naturally. Convincing evidences have shown that positive olfactive experience appears a natural and effective solution to optimise productivity in ruminants.

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Effect of Turmeric and Black Pepper Based Diet on Haematological and Biochemical Paramters of West African Dwarf Does

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Abstract: The purpose of this study was to evaluate the effect of turmeric and black pepper-based diet on the haematological and serum biochemical parameters of West African dwarf does. Twelve apparently healthy, pregnant West African Dwarf pregnant goats aged between 13 and 15 months old were used. The does were randomly assigned into three treatment groups; Each of the treatment groups were allotted with four animals, with each animal constituting a replicate. Animals in Treatment 1 (Control), 2 and 3 were fed not turmeric based diet, 0.5% of turmeric powder and black pepper powder-based diet and 1% of turmeric powder and black pepper based diet, respectively. The does were given fresh water *ad libitum*. There were no significant ($P>0.05$) difference in the haematological parameters considered at both 0.5% and 1% inclusion level of turmeric and black pepper powder. However, the albumin contents of the serum significantly decreased ($P<0.05$) with 1% inclusion of turmeric and black pepper powder in the diet.

Keywords: Black pepper, Haematological parameters, Serum biochemical indices, Turmeric and West African Dwarf Does

INTRODUCTION

Haematological and biochemical indices of livestock animals can give little insight into the production performance and potentials of West African Dwarf does (Taiwo and Ogunsanmi, 2003). Nutrition, breed, sex, age, reproductive status, environmental factors, stress and transportation are known to affect haematological and biochemical parameters (Balikci *et al.,* 2007), it is thought to play major roles in the differences of haematological and biochemical parameters observed between tropical and temperate animals (Opara and Fagbemi, 2009). However, (Belewu and Ogunsola 2010), stated that the haematological and biochemical parameters of livestock animals may give some insight as to the production and performance potentials of West African Dwarf goats. There is a great difference in the haematological and biochemical parameters as observed between breeds of goats (Tambuwal *et al.* 2002). It may be difficult to formulate a universal metabolic profile test for goats. These differences have further underlined the need to establish appropriate physiological baseline values for various breeds of livestock in Nigeria, which could help in realistic evaluation of the management practice, nutrition and diagnosis of health condition. This study was designed to evaluate the effect of turmeric and black pepper-based diets on the haematological parameters and biochemical indices of West African Dwarf does.

MATERIALS AND METHODS

Site of the Experiment: The experiment was done at the University of Ilorin Teaching and Research farm, Ilorin, Kwara state, Nigeria.

Experimental Animals: A total of 12 West African Dwarf Goat apparently healthy, pregnant West African Dwarf goats between the age 13 and 15 months old were used. The experiment followed a completely randomized design (CRD). The goats were randomly assigned into three groups; the first group was Treatment 1 (Control) comprising 4 does fed non-turmeric based diet, while the second group was Treatment 2 (Experimental) also comprising of 4 does fed 0.5kg of turmeric powder and black pepper powder-based diet and the third group (Treatment 3) comprising 4 does fed 1kg of turmeric powder and black pepper based diet.

Preparation of Turmeric and Black Pepper Powder: *Curcuma longa* rhizomes and *Piper nigrun* were obtained from Ipata market, in Ilorin, cleaned and air dried. They were milled into powdery form and kept in a labelled container for feed composition.

Animal and Management: Apparently healthy animals were purchased from Ogbomoso, Oyo state. The animals were free from externals and internal parasites. The study was conducted during the dry season. Animals were housed in separate pens and were given the experimental diets prior to blood sampling. The pens, feeders and drinkers were cleaned every morning. The animals were given fresh water *ad libitum.*

Table 1: Composition of the basal diets and the experimental diets formulated in 100kg for West African Dwarf goats fed turmeric and black pepper

Feed (Kg)	Treatment 1	Treatment 2	Treatment 3
Cassava wastes	55.00	55.00	55.00
Rice husk	10.00	10.00	10.00
Palm kernel Cake	33.00	33.00	33.00
Salt	1.00	1.00	1.00
Premix	1.00	1.00	1.00
Total	100	100	100
Experimental diets	100	99.5	99
Turmeric and black pepper powder	-	0.5	1.0
Calculated Value			
Crude Protein (%)	9.90	9.94	9.99
Crude Fiber (%)	20.20	20.22	20.25

Haematology Parameters and Biochemical Indices: Blood samples were obtained from West Africa Dwarf goats belong to the three treatments. The 3ml of blood samples were obtained from the jugular vein of each animal using 5ml syringe into sample bottles containing Ethylene Diamine Tetra Acetic Acid (EDTA) for haematological determinations. Another 2ml was collected into plain bottles for biochemical indices.

The blood sample were allowed to mix with EDTA to prevent clotting. Blood samples for biochemistry determinations were collected into clean sample bottles without anticoagulant. Serum was obtained by allowing the blood sample to clot at room temperature for 30 minutes, after which it was centrifuged for ten minutes at 3,000 revolutions per minute using a table centrifuge to enable a complete separation of the serum from the clotted blood. The clear serum supernatant was then carefully aspirated and freeze stored.

Each of the samples was thoroughly mixed and slotted into the sample plot of the haematology auto analyzer (sysmex KX – 21N) machine; the haematology parameters that were determined were White Blood Cell, Red Blood Cell, Haemoglobin, Packed Cell Volume (Haemotocript), Mean Cell Volume, Mean Corpuscular Haemoglobin, Mean Corpuscular Haemoglobin Concentration, Lymphocytes, Red Blood Cell Distribution Width Concentrated Volume, Platelet Distribution Width, Mean Platelet Volume, Platelet Large Cell Ratio. The serum biochemical indices determined were Alanine Aminotransferase (ALT), Aspartate Aminotransferase (AST), Alkaline Phosphatase (ALP), Albumin, Total Protein and Glucose.

Statistical Analysis: The data obtained were analyzed using one-way analysis of variance (ANOVA) model suitable for the design with the aid of SAS computer package (SAS, 2000). Means were separated using Duncan's multiple range test of the same package. Means differences were considered at significant of ($P<0.05$).

RESULTS AND DISCUSSION

The result of the serum biochemical indices of West African Dwarf goats fed control (T_1), turmeric and black pepper (T_2 and T_3) is presented in Table 2.

The inclusion of turmeric and black pepper powder did not significantly ($P>0.05$) affect ALT, AST, ALP, glucose and total protein in goat. However, albumin significantly ($P<0.05$) decreased with the inclusion of turmeric and black pepper powder at 1%.

The result that West African Dwarf goats fed turmeric and black pepper powder at 0.5% and 1% diets did not differ significantly ($P>0.05$) in enzymatic serum biochemical compared with the control (Ogunleke *et al.* 2014) reported significant ($P<0.05$) decrease in the total protein, albumin and globulin with varying levels of concentrate in diet.

The haematological parameters obtained from West African Dwarf goats fed control (T_1), turmeric and black pepper (T_2 and T_3) is shown in Table 3.

Table 2: Serum biochemical indices of West African Dwarf Goats fed turmeric and black pepper.

	T_1	T_2	T_3	± SEM	Remarks
ALT (U/l)	33.75	33.93	32.80	3.54	NS
AST (U/l)	77.55	98.27	97.63	13.83	NS
ALP (U/l)	120.72	161.00	88.33	44.33	NS
Glucose (mg/dl)	139.80	121.97	48.35	34.09	NS
Albumin (mb/dl)	0.70^a	0.69^a	0.52^b	0.03	*
Total Protein (g/L)	54.75	49.67	50.75	3.54	NS

^{a,b,c} means within the same row with different superscripts are significantly different (P<0.05). ALT: Alanine Aminotransferase, AST: Aspartate Aminotransferase, ALP: Alkaline Phosphatase. SEM: Standard Error of Mean, Not Significant *: Significant.

Table 3: Haematological Parameters of West African Dwarf goats fed turmeric and black pepper

	WBC ($\times10^3$/µL)	RBC ($\times10^6$/µL)	Hb (g/dL)	HCT (%)	MCV (fL)	MCH (pg)	MCHC (g/dL)	LYM (%)	NEUT (%)	LYM# ($\times10^3$/µL)	PDW (fL)	MPV (fL)	P_LCR (%)
T_1	17.00	1.33	5.78	15.30	117.78	45.00	38.38	9.88	46.00	8.73	13.93	11.48	30.75
T_2	14.83	1.51	6.33	16.30	109.40	42.20	38.80	12.70	21.33	16.87	10.53	13.07	48.07
T_3	12.33	1.86	6.97	19.00	103.90	37.63	37.80	10.37	31.33	19.43	11.00	13.90	58.10
SEM ±	3.97	0.18	0.54	1.81	9.49	1.66	3.21	2.16	6.57	1.89	0.91	0.38	5.08
Remarks	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

SEM: Standard Error of Mean, NS: Not Significant *: Significant. WBC: White Blood Cell, RBC: Red Blood Cell, Hb: Haemoglobin, PCV: Packed Cell Volume (Haemotocript), MCV: Mean Cell Volume, MCH: Mean Corpuscular Haemoglobin, MCHC: Mean Corpuscular Haemoglobin Concentration, LYM: Lymphocytes, PDW: Platelet Distribution Width, MPV: Mean Platelet Volume, P_LCR: Platelet Large Cell Ratio.

Haematological values could serve as baseline information for comparison in conditions of nutrient deficiency, physiology and health status of farm animals (Daramola *et al.* 2014). According to Research Animal Resources [RAR] (2009) the reasons accounted for variation are age, sex, breed or strain, sampling techniques, and testing methodology.

The haematological parameters of West African Dwarf goats fed turmeric and black pepper powder at 0.5% and 1% diets showed that there was no significant (P>0.05) differences in all the parameters measured with the present results agrees with (Ogunleke *et al.* 2014) who reported no significant (P>0.05) difference in West African Dwarf goat fed varying levels of concentrate. The PCV values obtained in this study were within the range reported by (Opara, 2010) for clinically healthy West African Dwarf goats and sheep. The Hb range in this study fell within the range reported for clinically healthy West African Dwarf goats by (Daramola *et al.* 2014) the dietary treatments seemed to capable of supporting high oxygen carrying capacity blood in the goats. The RBC counts obtained in this study were within the range reported for West African dwarf goats by (Tambuwal *et al.* (2002; Taiwo and Ogunsanmi, 2003). The WBC count obtained in this study fell within the range documented for clinically healthy West African Dwarf goat (Daramola *et al.* 2014). There was no breakdown in the immunity of the goats fed the experimental diets. The lymphocytes values obtained in this study falls within the range reported by (Daramola *et al.* 2014 and Tambuwal *et al.* 2002) for West African Dwarf goats.

CONCLUSION AND RECOMMENDATION

There was no significant (P>0.05) effect on the haematological parameters and the biochemical indices, except that the albumin content decreased significantly (P<0.05) with turmeric + black pepper inclusion.

I was recommended that more studies be carried out in order to determine the best inclusion level of turmeric + black pepper in the diets of goat does More studies should be carried out to ascertain the full effect of turmeric and black pepper on rumen activates.

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Optimization of Chloroform Quantity for Methane Inhibition in *In Vitro* Gas Production Experiments

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Abstract: Chloroform is one of the several chemical compounds known as inhibitors which are commonly used in enteric methane mitigation experiments. Chloroform is a very potent inhibitor such that its use even in little quantities completely shuts down methane production in in vitro experiments. This usually presents a challenge in such experiments especially when chloroform is to be combined with another compound to investigate their synergistic effect on methane production. This study was therefore carried out to determine the quantity of chloroform needed to decrease methane to a reasonable level (for example 50%) without shutting it down completely. The experiment was arranged in a randomized block design. It employed in vitro gas production technique to measure the effect of various levels of chloroform on methane production. The experiment also measured the effect of chloroform on VFA production and hydrogen recovery. The result revealed that the various levels of chloroform – 0.1, 0.05, 0.025 and 0.01µL/30mL incubation – decreased methane production by 99, 89, 55 and 27% respectively. It also revealed that increasing levels of chloroform led to significant reduction of acetate production, acetate-propionate ratio and total VFA production. Hydrogen recovery was also significantly reduced by increasing levels of chloroform. The study concluded that any quantity above 0.1µL of chloroform per 30mL incubation will completely shut down methane production.

Keywords: chloroform, methane inhibition, *in vitro*, VFA, hydrogen recovery.

DESCRIPTION OF PROBLEM

Climate change continues to remain an important issue globally especially with increased green house gas (GHG) emissions. Livestock production particularly ruminant production is said to contribute significantly to global methane emission through enteric fermentation (1). One of the various dietary strategies for mitigating enteric methane emission is the use of chemicals generally known as inhibitors. Chloroform is one of the potent inhibitors of enteric methane as reported by several studies (2; 3; 4; 5; 6; 7and 8). It is suggested to inhibit methane production by interfering with the conversion of methyl-coenzyme M to methane in the last step of methanogenesis (8). Reduction of methane production by chloroform is mostly associated by concomitant accumulation of hydrogen gas, increase in propionate production and decrease in production of acetate (7; 4 and 15).

Although very potent, chloroform is reported to have a transient effect on methane inhibition (8) and this makes it a less attractive strategy for reducing methane production in ruminants (11). Moreover, it is reported to have carcinogenic (9) and hepatotoxic (10) effect when administered to animals for a long time. Nevertheless, chloroform remains an important laboratory chemical which can be used in *in vitro* or short-term *in vivo* methane reduction trials (8). A report by (11) suggested that the transient effect of chloroform could possibly be overcome by combining it with an electron acceptor (eg nitrate). However, a common problem encountered in *in vitro* experiments when using chloroform is its complete inhibition of methane production even when used in minute quantities; thus, preventing the observation of its interaction with other compounds when combined together to reduce methane production. Therefore, this experiment was designed to determine the quantity of chloroform needed to suppress methane production by approximately 50% in *in vitro* experiments.

MATERIALS AND METHODS

The experiment used the batch culture *in vitro* fermentation technique of (12) to determine methane production and some rumen fermentation properties using hay as substrate. The experimental design was arranged in a randomized block design with eight levels of chloroform (0.0000, 0.0010, 0.0025, 0.0050, 0.010, 0.025, 0.05,

0.1µL per 30mL incubation) and rumen fluids from four different cows (blocks); all replicated twice making a total of 64 incubation bottles. Due to the very minute quantities of chloroform needed for the experiment and for ease of pipetting and administration, all the chloroform concentrations required were diluted with ethanol such that 100µL of each of the dilutions contained the appropriate quantity of chloroform needed as planned for the experiment. This was achieved by diluting various quantities of chloroform with ethanol as indicated in Table 1.

Table 1 Dilution of Chloroform Quantities Needed for Experiment

Actual quantity of chloroform required for experiment (µL)	Quantity of chloroform to be diluted (µL)	Quantity of ethanol required for dilution (mL)	Molar concentration of diluted chloroform (mM)
0.0000	0.00	0	0
0.0010	0.50	50	4.16×10^{-7}
0.0025	1.25	50	1.04×10^{-6}
0.0050	2.50	50	2.08×10^{-6}
0.0100	0.50	5	4.16×10^{-6}
0.0250	1.25	5	1.04×10^{-5}
0.0500	2.50	5	2.08×10^{-5}
0.1000	5.00	5	4.16×10^{-5}

Hence, 100µL of each of the various diluted chloroform was then used as an equivalent of the originally required quantities while the control had 100µL ethanol added with no chloroform. Inoculation media was prepared by mixing strained rumen fluids collected from four canulated cows together with Coleman-Simplex buffer in a ratio of 1:2. While bubbling with CO_2, 30mL of the inoculation media prepared from the rumen fluid of each cow was dispensed into Wheaton bottles (WHEATON®, Millville, NJ, USA) each containing 300mg of previously weighed hay according to the experimental design. The bottles were sealed with rubber stopper and incubated at 39°C for 24hrs. After 24h incubation, gas pressure of bottles was measured using a gas transducer (Type T443A, Bailey and Mackey, Birmingham, England) and this was used to calculate volume of total gas produced using Boyle's Gas Law equation as described by (13). Methane production was determined using (Unicam 610 Gas Chomatograph, Cambridge, UK) as described by (14). VFA production was determined using gas chromatograph (Varian CP3380 Gas chromatograph GC; Palo Alto, California, US) with settings as described by (14). Hydrogen recovery was calculated using the formulae below as described by (14).

$$Hydrogen\ Recovery\ (\%) = \frac{2H\ accepted}{2H\ released}$$

$$2H\ released = (2 \times Acetate) + Propionate + (4 \times Butyrate)$$

$$2H\ accepted = (4 \times Methane) + (2 \times Propionate) + (2 \times Butyrate)$$

Data obtained from the experiment were analysed using one-way ANOVA (IBM SPSS version 22) with Tukey's HSD as the post hoc test.

RESULTS AND DISCUSSION

Table 2 Effect of Chloroform Levels on Total Gas Production and Methane Production

Chloroform (µL)	0	0.001	0.0025	0.005	0.01	0.025	0.05	0.1	SEM	*P*-values
Total Gas Prod (mL)	33.50	33.97	34.80	35.37	34.05	33.12	32.87	33.15	0.774	>0.05
CH_4 Conc (%)	5.95^{cd}	6.73^{d}	6.76^{d}	6.41^{d}	4.39^{bc}	2.75^{b}	0.69^{a}	0.09^{a}	0.349	<0.001
CH_4 Prod (ml/g)	23.85^{de}	25.71^{e}	26.29^{e}	25.92^{e}	17.47^{cd}	10.74^{bc}	$2.65a^{b}$	0.34^{a}	1.409	<0.001
CH_4 (µmol/mmol VFA)	6.39^{cd}	7.38^{d}	7.54^{d}	7.22^{d}	5.13^{cd}	3.51^{bc}	0.93^{ab}	0.10^{a}	0.413	<0.001

^{abcde} along rows indicates significant difference using Tukey's HSD

Table 2 shows the effect of various levels of chloroform on total gas production and methane production. Chloroform levels had no significant effect on total gas production as there was no difference between the control

and the other levels. This was in congruence with reports of (6) and (5) who both reported no significant difference in gas production with chloroform administration in *in vivo* and *in vitro* studies respectively. The result was contrary to the findings of (7) who reported a significant reduction of gas production when chloroform was administered in an *in vivo* study. It is generally known that chloroform strongly inhibits methane production; the result also revealed that methane production was significantly decreased by chloroform levels. The various levels of chloroform – 0.1, 0.05, 0.025 and 0.01µL – reduced methane production by 99, 89, 55 and 27% respectively.

Table 3 Effect of Chloroform Levels on Volatile Fatty Acids (VFA) Production

Chloroform (µL)	0	0.001	0.0025	0.005	0.01	0.025	0.05	0.1	SEM	*P*-values
Acetate (mM)	32.52^{d}	31.13^{bcd}	31.34^{cd}	31.90^{cd}	29.01^{abcd}	24.68^{abc}	21.92^{a}	23.54^{ab}	0.767	<0.001
Propionate (mM)	8.55	8.42	8.51	8.64	8.79	9.15	9.37	9.98	0.196	>0.05
Butyrate (mM)	6.42	6.00	6.13	6.32	6.66	6.71	6.59	6.68	0.118	>0.05
Valerate (mM)	0.73	0.73	0.75	0.75	0.76	0.79	0.75	0.75	0.011	>0.05
Caproate (mM)	0.12	0.12	0.12	0.12	0.12	0.12	0.10	0.10	0.005	>0.05
BCVFAs (mM)	1.39	1.31	1.43	1.44	1.48	1.34	1.09	1.13	0.038	>0.05
A:P Ratio	3.87^{c}	3.73^{c}	3.72^{c}	3.72^{c}	3.33^{bc}	2.75^{ab}	2.37^{a}	2.38^{a}	0.097	<0.001
Total VFA (mM)	49.73	47.71	48.28	49.17	46.81	42.79	39.82	42.18	0.927	<0.05

^{abcd} along rows indicates significant difference using Tukey's HSD

The effect of chloroform levels on VFA production is shown in Table 3. The administration of chloroform is almost always associated with a decrease in acetate production and a concomitant increase in propionate production as reported by (7; 6; 4; 8 and 15). In this study, acetate production was significantly decreased while propionate production increased, though not significantly. Acetate to propionate ratio (A:P ratio) was significantly reduced by chloroform levels. Agreeing with (7 and 6), the total volatile fatty acids (VFA) production in this study was significantly reduced by increasing levels of chloroform. This however differs from the report of (8) who reported no difference in total VFA production. The production of butyrate, valerate, caproate and branched chain volatile fatty acids (BCVFAs) was not significantly affected by chloroform levels.

Table 4 Effect of Chloroform Levels on Hydrogen Recovery

Chloroform (µL)	0	0.001	0.0025	0.005	0.01	0.025	0.05	0.1	SEM	*P*-values
2HReleased (µmol)	2978	2840	2871	2932	2803	2561	2388	2514	56.014	>0.05
2HAccepted (µmol)	2176^{d}	2243^{d}	2287^{d}	2288^{d}	1863^{cd}	1527^{bc}	1100^{ab}	1018^{a}	71.499	<0.001
2HRecovery (%)	73.03^{cd}	80.19^{d}	81.46^{d}	79.20^{d}	67.38^{cd}	60.53^{bc}	46.25^{ab}	40.52^{a}	2.300	<0.001

^{abcd} along rows indicates significant difference using Tukey's HSD

Table 4 shows the effect of chloroform levels on 2H recovery. The inhibition of methane by chloroform always leads to an accumulation of H_2 (7; 4 and 15). Although H_2 was not measured in this study, the significantly lower 2H recovery associated with chloroform administration compared to control possibly suggests that H_2 accumulated.

CONCLUSION

The study discovered that very minute quantities of chloroform reduce methane production. It was concluded that any quantity above 0.1µL of chloroform per 30mL of incubation will certainly shut down methane production.

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Intake of Fibre by Yankasa rams fed sugarcane waste (SCW) silage

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Abstract: A feeding trial was conducted for twelve weeks (eighty-four days) to assess the fibre intake of Yankasa rams fed ensiled sugarcane waste (ESCW) enhanced with non – protein nitrogen sources (urea and poultry litter) and soybean meal. Sixteen (16) Yankasa rams (mean body weight 25kg±0.46; aged 8 to 15 months) were randomly allotted to the treatment groups viz; T1 (100% SCW plus urea, unensiled) as control, T2 (100% SCW plus urea, ensiled), T3 (75%SCW plus 25% SBM, ensiled) and T4 (75% SCW plus 25% PL, ensiled) in a completely randomised design (CRD). The experimental rams were offered basal diet along with clean drinking water and mineral salt lick *ad-libitum*, while a concentrate diet was formulated containing 16.26%CP and offered at 1.5% body weight to each of the experimental animals. The results obtained indicated non-significant (P>0.05) differences in the treatment means of all the fibre intakes evaluated however, all the values obtained for T3 and T4 were numerically higher. The results of the study showed that ensilage of SCW with urea, PL, SBM enhanced fibre intake. Therefore, SCW silage fortified with these materials could be used to feed small ruminants when feed resources are limited or low.

Keywords: sugarcane waste, non-protein nitrogen, fibre intake

INTRODUCTION

The problem associated with feeding ruminant livestock adequately in quantity and quality during the dry season calls for an alternative means of feeding bulky materials after ensiling. Sugarcane (*Saccharum officinarum*) is one of the tropical crops which have the highest biomass production (1; 2). Sugarcane waste is one of such unconventional feedstuffs which are produced in large quantities in the country and could be used to feed livestock after ensiling with urea, poultry litter and soybean meal. The treatment will increase the nitrogen content of the diet and also improves digestibility and utilization of fibre by ruminants. However, information on the nutritional value of sugarcane waste treated with urea or poultry litter is limited in this ecological zone. In Nigeria, sugarcane is harvested mainly in the dry season which is a period of the year when there is lack of roughage for ruminants. Sugarcane waste is obtained when the cane is being processed for chewing and comprises of the tops, peels and baggase (3). Small scale farmers cannot afford the investments required to establish improved pastures and feed concentrate supplements to alleviate dry season growth checks (4). Therefore, it has become imperative for ruminant nutritionist to investigate ways of utilizing feedstuffs that are of no nutritional needs to man for feeding various classes of livestock. This study therefore aimed at determining the effects of feeding ensiled sugarcane waste (ESCW) on performance of sheep as dry season feed. The objective of this study was to find the nutrients intake by Yankasa sheep fed ESCW enhanced with urea, soybean meal and poultry litter.

MATERIALS AND METHODS

Location and climate: The study was conducted at the Small Ruminant Unit of the Livestock Teaching and Research Farm, Department of Animal Science, Kano University of Science and Technology, Wudil, Kano State, located in the Sudan Savannah Region of Nigeria. The site is situated between longitude $8^0$25'E and latitude $12^0$58'N. The area has an average annual rainfall of 890mm with a peak in August with an average annual temperature of 38 to 43^0C and relative humidity of 40 to 51% (5).

Ensiling procedures and experimental materials: Sugarcane waste (SCW) was collected within and around the University campus, cleaned for extraneous materials like stones, iron and polyethene. Soybean grains were obtained from the market, soaked in water overnight and dried by spreading on a concrete floor under sun light. After drying it was milled to produce soybean meal (SBM). Inorganic granulated urea was obtained from market while poultry litter (PL) was obtained from the deep litter poultry production system. The collected SCW, PL and SBM were sun dried for the period of 3 days during dry season by thinly spreading on a concrete floor. The dried sugarcane wastes used for the silage were chopped into about 2-3cm length using forage chopper for better compaction (6). SCW was ensiled with urea, PL and SBM. The procedure of (7) was followed in which 1kg urea was dissolved in 15 litres of water and sprinkled on 25kg sugarcane waste. Diet T1 (control diet) was air dried for 7 – 9 hours every day for about 7 days until it became crispy and bagged while diets T2, T3 and T4 were ensiled for 21 days in a 300-liter capacity water reservoir as silo. Silos filled with weighed materials was covered with polyethene and compressed by human trampling. Four hundred kilograms (400kg) of each experimental diet were produced and bagged for the experiment. All basal diets were fed *ad-libitum* to all the experimental animals according to treatments while a concentrate diet with 16.26% CP was formulated (Table 1) and offered as supplement at 1.5% body weight to all the experimental animals.

Experimental animals and management: Sixteen (16) male Yankasa rams (mean body weight 25kg±0.46; aged 8 to 15 months) were purchased and treated for internal and external parasites with Ivomec® – super at 200µg/kg body weight subcutaneously before the start of the experiment. Rams were divided into 4 groups of 4 animals each in a completely randomized design (CRD). Rams were housed in individual pens measuring 2m x 1m. The pens were cleaned and disinfected using Omo® detergent and Moriguard®. Water and salt lick were provided *ad libitum*.

Data collection: The experimental animals were weighed individually prior to the commencement of the experiment and subsequently at weekly intervals between 8:00am and 10:00am before being offered feed. Daily records of feed intake were taken throughout the period of the experiment by weighing feed offered and left over the following day. Fibre intakes were calculated as the amount of fibre in feed after chemical analysis multiplied by feed intake. The feeding trial lasted for twelve weeks.

Chemical analysis: Fibre fractions viz., neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were analyzed by the procedures of (9). Hemicellulose and cellulose were derived mathematically according to (10).

Statistical analysis: Data generated were analyzed using SAS Statistical package (11) and significant differences between the means were tested by LSD (8). Differences between the means were considered significant at 5% probability level ($P<0.05$).

RESULTS AND DISCUSSION

The results of fibre intakes were presented on Table 2. Fiber intakes values did not differ significantly ($P>0.05$) between the treatment groups, however values recorded for T_3 and T_4 in all the variables were higher numerically except for intake of lignin from roughage which were higher in T_1 and T_2. Fibre is an important part of the metabolism of ruminants; it is the determining factor for the hydrolysis of all the nutritional ingredients in the feed (12). The mean values obtained in this study for ADFI and NDFI were lower than the values reported by (13). The values of ADFI and NDFI were higher for the soybean meal and poultry litter treatments suggesting better utilization of nutrient in those treatments. In the entire treatments the concentrate diets promote the activities of rumen microbes that eventually increase CF intake. (14) reported high intake of ADF and NDF in lactating cows fed urea treated corncobs and attributed higher nutrients intake to improved digestibility of fibre fractions. The values obtained in the present study were also higher than what (15) obtained for West African Dwarf goats fed cassava peels substituted with *Cajanus cajan* hay. Neutral detergent fibre represents the total fibre component of the feedstuff while ADF is a good indicator of digestibility and thus energy intake. Intake of lignin was low across the treatments, a reflection of low lignin in the diet. The differences observed in the fibre intakes in the present study between the treatments could be as a result of palatability of the materials used to

treat and ensiled the sugarcane waste. Furthermore, an improvement in intake could be attributed to positive influence of the materials used in the concentrate diet.

Table 1: Ingredients composition (%) of concentrate diet for Yankasa rams

Ingredients	Inclusion level (%)
Maize	19
Wheat offal	33
Soybean meal	14
Cowpea husk	33
Salt	1
TOTAL	100
Calculated CP (%)	16.26
Cost/kg diet (₦)	68.98

Table 2: Chemical composition of the experimental diets and untreated SCW

	Treatments				
Constituents (%)	**T_1**	**T_2**	**T_3**	**T_4**	**Concentrate diet**
DM	94.66	92.78	93.53	92.12	92.83
CP	14.96	14.06	15.30	15.28	16.74
CF	19.39	20.07	21.18	20.43	11.42
EE	3.03	2.99	3.08	3.57	4.05
Ash	8.78	9.04	8.66	8.17	9.81
NFE	52.98	53.75	56.87	53.41	58.56

T_1(100%SCW+urea unensiled), **T_2** (100%SCW+urea ensiled), **T_3** (75%SCW+SBM ensiled), **T_4** (75%SCW+PL ensiled)

Table 3: Fibre intake by Yankasa rams ensiled fed sugarcane waste (ESCW) treated with urea, soybean meal (SBM) and poultry litter (PL)

Parameters (g/day)	**Treatments**				
	T_1	**T_2**	**T_3**	**T_4**	**LSD**
Roughage NDF	293.55	294.48	312.09	344.06	127.450
Concentrate NDF	143.24	144.12	153.65	155.45	40.406
Total NDF	436.79	438.60	465.74	499.50	155.050
Roughage ADF	155.41	151.59	158.37	162.05	64.979
Concentrate ADF	60.31	60.68	64.70	65.45	17.013
Total ADF	215.72	212.26	223.07	227.50	76.520
Roughage Lignin	42.65	42.10	41.55	41.89	17.027
Concentrate Lignin	22.92	23.06	24.59	24.87	6.464
Total Lignin	65.57	65.16	66.14	66.76	21.634
Roughage Cellulose	112.76	109.48	116.82	122.66	46.995
Concentrate Cellulose	37.39	37.62	40.11	40.58	10.549
Total Cellulose	150.15	147.10	156.93	163.24	54.082
Roughage Hemicellulose	138.14	142.91	153.72	179.51	63.573
Concentrate Hemicellulose	82.93	83.44	88.96	90.00	23.393
Total Hemicellulose	221.07	226.35	242.67	269.50	79.515

T_1(100%SCW+urea unensiled), **T_2** (100%SCW+urea ensiled), **T_3** (75%SCW+SBM ensiled), **T_4** (75%SCW+PL ensiled)

CONCLUSION AND RECOMMENDATION

The results of the study clearly showed that ensilage of SCW with urea, PL, SBM enhanced fibre intake. It is therefore, recommended to use SCW silage fortified with these materials for small ruminants when feed resources are limited or low.

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Nutrient Intake and Apparent Digestibility of Pigeon Pea (*Cajanus cajan* L) Husk Fed to Red Sokoto Bucks

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Abstract: A study was conducted to evaluate the apparent nutrient intake and digestibility of pigeon pea (*Cajanus cajan*) husk fed red Sokoto goats bucks. Four Red Sokoto bucks aged between 11-12 months with an average live weight of 13.50 kg were randomly assigned to four iso-nitrogenous dietary treatments, containing 20, 40, 60 and 80% inclusion level of pigeon pea husk, respectively in a Latin square arrangement. The animals were fed 3% of their body weight of the experimental diets and water provided *ad lib*. The experimental animals were housed in metabolic crates for the digestibility trial. Total feed intake was recorded and feed conversion ratio and average daily weight gain were calculated. Results obtained from the study indicated that there was significance difference in all the parameters measured with a general increase between 20% to 40% and declining between 60 and 80% level of inclusion respectively. Fourty percent inclusion level was significantly ($p<0.05$) higher in final weight (23.13kg), weight gain (9.63kg) and average daily gain (68.79g). This could be attributed to the high fibre content of the pigeon pea which increased with level of inclusion. This could be as a result of the increasing contribution of roughage in a ration that could lead to a decline in cellulose digestion. It can be concluded that pigeon pea husk could be included in the diet of red Sokoto bucks up to 40% for maximum results.

Keywords: Red Sokoto bucks, Pigeon pea husk, digestibility, nutrient intake.

INTRODUCTION

Animal protein is one of the most important components of human diet and its consumption varies from country to country (Okai *et al*., 2005). Rapid human population coupled with low protein intake constitutes a major problem facing developing countries. Perhaps as a result of the increasing population and dismal productivity of livestock in developing countries like Nigeria, the demand for protein of animal origin has far exceeded the supplies. Ani and Adiegwu (2005) suggested that a solution to the problem of inadequate consumption of animal products by an average Nigerian is to increase the level of animal production by intensifying the production of highly reproductive animals. Fanimo *et al*. (2004) reported that feed cost accounts for 65-70% of the total cost of production in the intensive system of animal production. The situation is the result of competition between man and livestock for some feed and food ingredients. This competition is rigorous in developing countries, hence the urgent need to source for cheaply available feedstuff that meet requirements for growth and reproduction. The utilization of the cheapest and most available feedstuff is a major challenge facing livestock farmers in Nigeria amidst feed crisis (Bogoro, 1997)

The constraints on the feed supply both in roughages and concentrates has increased remarkably, especially during the last decade due to the intensive animal production in many parts of the world. Attempts were made to investigate the potential use of non-conventional feed to avoid the competition with human food and/or to improve the nutritive value of low quality feed.

Pigeon pea (*Cajanus cajan* (L.) Huth) is one of the most common tropical and subtropical legumes cultivated for its edible seeds. Pigeon pea is fast growing, hardy, widely adaptable, and drought resistant (Bekele-Tessema, 2007). Due to its drought resistance it can be considered of utmost importance for food security in areas where rainfall is not reliable and droughts are likely to occur (Crop Trust, 2014). At the end of the dry season, pigeon pea provides green forage of outstanding value when other forages are not available (Sloan *et al*., 2009). Therefore, the objective of the experiment was to determine the nutrient intake and digestibility of pigeon pea (*Cajanus cajan L*) husk fed to red Sokoto bucks.

MATERIALS AND METHODS

The experiment was conducted at the teaching and research Farm of the Department of Animal Science, Ahmadu Bello University Zaria, Kaduna State. The *Cajanus cajan* husk was locally sourced and milled with a crushing machine to enable homogenous mixing with other ingredients which were packaged and stored in jute bags until it was used. Four Red Sokoto bucks of about 11-12 months of age with average live weights of 13.50 kg were used for the study in a 4x4 latin square arrangement, which lasted for 12 weeks. The composition of the experimental diets consisted of the following ingredients: maize offal, cotton seed cake, bone meal and salt. Four iso-nitrogenous diets were formulated to contain 15%CP to contain pigeon pea at inclusion levels of 20, 40, 60 and 80% (Table 1). The animals were kept individually in a 127cm x 71cm metabolic crate with a height of 135cm which has a provision for feeder, drinker and also pans for urine and faecal collection. The animals were allowed to adjust to the experiment diets and the metabolic crates for a period of 14 days before the commencement of the experiment. The pens and crates were properly disinfected using Morigald® before the commencement of the study. The animals were vaccinated against PPR and prophylactically treated with against internal and external parasites. Fresh and clean drinking water was provided to the animals daily *ad libitum* while the experimental diets were fed at 3% body weight. Total feed consumed and left over (orts) were recorded daily and weight changes were taken fortnightly at the end of each stage of the experiment. At the end of the feeding trial feed intake, feed refusal, faeces and urine were collected daily to measure digestibility. Nitrogen loss from urine was prevented by collecting the urine into a well-labeled collection bottle containing 5ml of 0.1N [sulphuric acid (H_2SO_4) to trap the ammonia and stored in a refrigerator at -4^oC for laboratory analysis. Apparent nutrient digestibility of the diets was then calculated. The proximate composition of the experimental feed and faecal samples was done in the Biochemistry laboratory, Department of Animal Science, Faculty of Agriculture Ahmadu Bello University zaria, using the procedure described by AOAC (1990). Data collected from this study were subjected to statistical analysis using one way ANOVA procedure of statistical analysis system (SAS 2002) and significance means were separated using Duncan Multiple range test of SAS.

RESULTS AND DISCUSSION

Table 2 shows the results of performance characteristics of red Sokoto bucks fed concentrate containing varying levels of pigeon pea husk. The result showed significant difference in all the parameters measured with an increase in weight from 21.23kg in 20% to 23.13kg in 40% then declined between 60 and 80% level of inclusion respectively. This could be attributed to the fact that pigeon pea husk has high crude fibre content and its inclusion affected the crude fibre contents of the diet. High fibre contents of diets affects voluntary intake, consequently affecting the weight gain (Eniolorunda *et al.* 2008). The results for final weight, weight gain and feed intake followed a similar pattern of an increase from 20 to 40% inclusion level, then declined from 60 to 80% inclusion level. From the present study it can be deduced that the growing red Sokoto bucks can accommodate up to 40% level of inclusion of pigeon pea husk.

The results for nutrient digestibility of Red Sokoto bucks fed diet containing pigeon pea husk is as presented in table 3. From the present study, all the parameters measured showed significant differences and increased digestibility was observed between 20 and 40 % level of inclusion then declined for 60 and 80 % level of inclusion of pigeon pea husk. The high digestibility values obtained for most nutrients suggest that the diets were highly degraded in the rumen. This was in line with results obtained by Eniolorunda *et al.,* (2008) who suggested that high digestibility of cell wall fractions demonstrate the ability of ruminants to process structural carbohydrates and obtain nutritional benefit from them.

Lower digestibility values of 60 and 80 % may be due to increasing levels of pigeon pea husk leading to higher fibre content of the treatment diets and this could have inhibited digestibility (Baiden *et al.,* 2007). This is because the rate of microbial colonization of a feed with high fibre content is lower compared to another with lower fibre content. Increasing contribution of roughage in a ration could lead to a decline in cellulose digestion (Puppo *et al*., 2002)

Table 1. Ingredient Composition of Experimental Diet

	Inclusion level of pigeon pea husk(%)			
Ingredients	80	60	40	20
Maize offal	12.99	25.98	38.97	51.96

Cotton seed cake	6.41	12.82	19.23	25.64
Bone meal	3.00	3.00	3.00	3.00
Salt	0.30	0.30	0.30	0.30
Pigeon pea husk	80	60	40	20
Total	100	100	100	100

Table 2: Performance Characteristics of Red Sokoto Bucks Fed Concentrate Containing Pigeon Pea Husk

Parameters	Inclusion Level of Pigeon Pea husk (%)				SEM
	20	40	60	80	
Initial weight (kg)	14.00	13.50	13.50	13.50	0.00
Final weight (kg)	21.23^{b}	23.13^{a}	19.13^{b}	17.59^{c}	1.75
Weight gain(kg)	7.35^{ab}	9.63^{a}	5.63^{b}	4.59^{b}	0.69
Feed intake (g)	285.85^{b}	403.89^{a}	291.29^{b}	216.64^{c}	25.68
FCR	38.85^{b}	41.94^{ab}	51.74^{a}	47.20^{ab}	0.95
ADg (g)	52.50^{b}	68.79^{a}	40.21^{c}	32.79^{c}	8.20

^{a,b,c} means on the same row with different superscript are significantly ($p<0.05$) different FCR= feed conversion ratio, ADG= average daily gain.

Table 3 Nutrient Digestibility of Red Sokoto Bucks Fed Diet Containing Pigeon Pea Husk

Parameters	Level of inclusion of pigeon pea husk (%)				
	20	40	60	80	SEM
Dry matter	89.56^{a}	86.70^{b}	88.13^{a}	87.62^{b}	1.58
CP	9.62^{a}	8.87^{c}	9.13^{b}	8.77^{c}	0.21
CF	4.13^{b}	4.56^{a}	4.88^{a}	4.80^{a}	0.25
EE	1.82^{a}	1.63^{b}	1.09^{c}	1.81^{a}	0.11
ASH	5.39^{a}	4.79^{c}	5.36^{a}	5.10^{b}	0.24
NFE	79.04^{c}	79.05^{c}	80.10^{a}	80.00^{b}	0.27

^{a,b,c} means on the same row with different superscript are significantly ($p<0.05$) different. CP=crude protein, CF=crude fibre, EE=ether extract, NFE=nitrogen free extract.

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Effect of Turmeric and Black Pepper Based Diet on Milk Yield and Milk Quality of West African Dwarf Does

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Abstract: The purpose of this study was to evaluate the effect of turmeric and black pepper-based diet on milk yield and milk quality of West African dwarf does. A total of 12 apparently healthy, pregnant West African Dwarf goats between the age 13 and 15 months old were used. They were randomly assigned into three treatment groups. Each of the treatment were allotted with four animals, with each animal constituting a replicate. Animals in Treatment 1 (Control), 2 and 3 were fed comprised non-turmeric based diet, 0.5% of turmeric powder and black pepper powder-based diet and 1% of turmeric powder and black pepper-based diet, respectively. The does were given fresh water *ad libitum*. The milk yield of Treatment 3 was significantly ($P<0.05$) higher (177.18g/day) than the milk yield of animals in Treatment 1 (173.42g/day) and Treatment 2 (161.35g/day). Milk yield increased on the addition of turmeric and black pepper in feed; but there was no significant ($P<0.05$) difference between the milk yield obtained from morning across the treatments and evening in the same treatments. Turmeric and black pepper in the diet at 0.5% and 1% significantly ($P<0.05$) influenced protein, fat, FCM, lactose, solid not fat, phosphorus and zinc content of West African dwarf does' milk when compared to the control. There were no significant ($P>0.05$) difference in ash, and calcium content of the milk at both 0.5% and 1% inclusion level of turmeric and black pepper powder.

Keywords: Black pepper, Milk yield, Milk qualities, Turmeric and West African Dwarf does

INTRODUCTION

Milk produced for human consumption is usually obtained from cattle, goat and sheep (Mitra *et al*. (2014). However, there is a growing awareness of the importance of goat milk as a good source of milk off-take for home and domestic consumption (Bawala *et al.* 2006). Goat milk has various unique qualities over those of other animals because it is nearest to human milk in its contents of fat and protein, and also serves as a good dietary source of minerals which makes it a complete food for new born animal and humans. Ibeawuchi *et al.* (2003) stated that goat milk is more easily digested than cow milk since the fat in goat milk is not only finer but more easily assimilated. They also reported that goat milk is found to be particularly rich with antibodies and is usually prescribed in the treatment of several human ailments. In Nigeria, it is recorded that the West African Dwarf goat is ranked next Red Sokoto goat in terms of milk yield (Kalscheur *et al*. 2006). One of the common practices by indigenous goat farmers is the feeding of concentrate supplements which is cost effective and can be made locally available. Milk quality is majorly dependent on the nutrients of the feed consumed by the animal. Holter *et al.* (1982) This study was designed to evaluate the effect of turmeric and black pepper-based diets on milk yield and milk quality of West African Dwarf does.

MATERIALS AND METHODS

Site of the experiment: The experiment was done at the University of Ilorin Teaching and Research farm, Ilorin, Kwara state, Nigeria.

Experimental animals: A total of 12 apparently healthy pregnant West African Dwarf goats between the age 13 and 15 months old were used. The experiment followed a completely randomized design (CRD). The goats were randomly assigned into three groups; the first group was Treatment 1 (Control) comprising 4 does fed non-turmeric based diet, while the second group was Treatment 2 (Experimental) also comprising of 4 does fed 0.5kg of turmeric powder and black pepper powder-based diet and the third group was Treatment 3 comprising 4 does fed 1kg of turmeric powder and black pepper-based diet.

Preparation of turmeric and black pepper powder: *Curcuma longa* rhizomes and *Piper nigrun* were obtained from Ipata market, in Ilorin, cleaned and air dried. They were milled into powdery form and kept in a labelled container for feed composition.

Animal and management: Apparently healthy animals were purchased from Ogbomoso, Oyo state. The animals were free from externals and internal parasites. The study was conducted during the dry season. Animals were housed in separate pens and were given the experimental diets prior to blood sampling. The pens, feeders and drinkers were cleaned every morning. The animals were given fresh water *ad libitum.*

Table 1: Composition (100%) of the experimental diets

FEED (Kg)	Treatment 1	Treatment 2	Treatment 3
Cassava wastes	55.00	55.00	55.00
Rice husk	10.00	10.00	10.00
Palm kernel Cake	33.00	33.00	33.00
Salt	1.00	1.00	1.00
Premix	1.00	1.00	1.00
Total	100	100	100
EXPERIMENTAL DIETS	100	99.5	99
Turmeric and black pepper powder	-	0.5	1.0
CALCULATED VALUE			
Crude Protein (%)	9.90	9.94	9.99
Crude Fiber (%)	20.20	20.22	20.25

Milking of lactating goats: The does were milked twice daily (9:00 am daily and 5:00pm) by hand milking method for a period of 6 weeks. The kids were separated from their dams to enable the does retain enough milk for proper milk yield determination. The milk yield was measured with the measuring cylinder and average daily milk yield was recorded. 50g milk sample per treatment was stored in sterilized sample bottles and kept in a freezer at about -5^{o}C and then taken to the laboratory for the determination of milk proximate and mineral contents. Remaining milk was fed to the kids using feeding bottles.

Proximate composition of milk samples: Milk samples were analyzed for proximate composition as described by (AOAC, 2005). Percent protein was calculated N X 6.28. Solids-not-fat (%SNF) was calculated by difference (%SNF= %TS-%Fat). Percent lactose was determined by using Fehlings solution method (Triebold, 2000). Fat Corrected Milk (FCM) was obtained as: 0.4M+15F where: M- Milk Yield F- Fat content (Maynard *et al.,* 1979).

Statistical analysis: The data obtained were analyzed using one-way analysis of variance (ANOVA) model suitable for the design with the aid of SAS computer package (SAS, 2000). Means were separated using Duncan's multiple range test of the same package. Means differences were considered at significant of ($P<0.05$).

RESULTS AND DISCUSSION

The result obtained from West African Dwarf goats fed control (T_1) and with turmeric + black pepper (T_2 and T_3) is shown in Table 2.

Table 2: Average milk yield and milk yield interaction over 6 weeks of West African Dwarf goats fed turmeric and black pepper

	T_1	T_2	T_3	± SEM	Remark
Milk Yield (g/day)	173.42^{b}	161.35^{c}	177.18^{a}	0.41	*
Morning (g/day)	93.98	89.17	102	16.37	NS
Evening (g/day)	79.44	72.18	75.18	20.87	NS

^{a,b,c} means within the same row with different superscripts are significantly different ($P<0.05$). SEM: Standard Error of Mean, Not Significant *: Significant.

Results from milk yield shows that T_3 which is 177.18 g/day was significantly higher than T_1 and T_2 with 173.42g/day and 161.35g/day, respectively. *Okunlola et al.,* (2015) observed that the differences in milk yield may be attributed to feed intake. Tona, *et al*., (2017) reported that the milk yield of West African Dwarf goats was significant ($P<0.05$) different among different inclusion levels of *Moringa oleifera* leaf meal and seed meal, which are known to possess ethno medicinal properties like turmeric and black pepper. It is reported that the inclusion of the antioxidant in concentrate diets resulted in higher milk yield (Corrigan *et al*., 2008). Tona *et al*., (2015) observed average milk yield of between 40.00 and 205.00 g/day in West African Dwarf goats. The values of 185.30 to 340.05 g/day were also reported for West African Dwarf goats in another research (Bawala *et al*., 2006). There was no significant ($P<0.05$) difference between the milk yield obtained from morning and evening in the three treatment groups in the present study. The composition of milks produced by West African Dwarf goats that were fed the experimental diets are presented in Table 3.

Table 3: Composition of milks obtained from goats fed the experimental diets

[a,b,c] means within the same row with different superscripts are significantly different (P<0.05). Not Significant *: Significant, Na: Sodium, Mg: Magnesium, K: Potassium, Zn: Zinc, P: Phosphorus, Ca: Calcium SEM: Standard Error of Mean

The inclusion of both 0.5% and 1% of turmeric and black pepper in the diet significantly (P<0.05) influenced protein content of the milk when compared with the control (T_1). Similarly, turmeric and black pepper powder at both 0.5% and 1% inclusion levels increased (P<0.05) fat, lactose, FCM, phosphorus and zinc content of goat milk. Earlier study has revealed that the concentration of lactose in milk cannot be easily altered by nutrition (Ahamefule *et al.* 2012). According to (Okunlola *et al.* 2015), the inclusion of baobab pulp and seed meal recorded the highest values for Total solids, fat and lactose (17.38%, 5.78% and 6.64%, respectively) which is similar to the values obtained in the present study (17.64%, 5.92% and 7.59%, respectively).

There were no significant (P>0.05) difference in ash, and calcium content of the milk at both 0.5% and 1% inclusion level of turmeric and black pepper powder. Ash values were 0.69%, 0.67% and 0.72% for T_1, T_2 and T_3, respectively, which is not in conformity with the report of Ahamefule *et al.* (2003) and (Ibeawuchi *et al.* 2003). Okunlola *et al.* (2015) reported that ash values were not influenced by graded level of baobab pulp and seed meal in the experimental diets. Among macro-minerals, potassium accounts for the greatest percentage in milk, followed by calcium, phosphorus, sodium and magnesium (Ahamefule, 2012). Milk produced by animals recorded the overall best results in term of mineral composition.

Milk Content	**T_1**	**T_2**	**T_3**	**± SEM**	**Remark**
%Total Solid	17.64^a	16.36^b	16.38^b	0.10	*
%Protein	6.87^b	9.78^a	9.34^a	0.14	*
%Fat	4.79^b	5.82^a	5.90^a	0.62	*
FCM	140.95^c	151.84^b	158.40^a	8.82	*
%Solid Not Fat	12.85^a	10.54^b	10.48^b	1.35	*
%Lactose	7.23^b	7.59^a	7.59^a	0.06	*
%Ash	0.69	0.67	0.72	0.08	NS
pH (mg/L)	6.47^a	6.23^b	6.49^a	0.02	*
Na (mg/L)	4.54^a	3.63^b	3.55^c	0.09	*
Mg (mg/L)	0.30^a	0.19^b	0.25^{ab}	0.01	*
K (mg/L)	5.35^a	5.30^a	4.58^b	0.18	*
Zn (mg/L)	0.26^b	0.35^a	0.34^a	0.01	*
P (mg/L)	4.21^b	5.19^a	4.99^a	0.10	*
Ca (mg/L)	0.16	0.14	0.15	0.01	NS

The solid not fat, sodium, magnesium and potassium contents of the milk significantly decreased (P<0.05) with the inclusion of turmeric and black pepper powder. Tona *et al*. (2017) documented that the highest percentages of milk nutrients (total solids, fat, protein and solids-not-fat) were observed in the experimental goats fed the diet without the inclusion of *Moringa oleifera* leaf meal and defatted *Moringa oleifera* seed meal.

CONCLUSION AND RECOMMENDATION

1% turmeric and black pepper-based diet increased the milk yield of West African dwarf does.

I recommend that more studies be carried out in order to determine the optimum inclusion level of turmeric and black pepper. More studies should be carried out to ascertain the full effect of turmeric and black pepper on rumen activates.

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Assessessment of Water Salinity and Microbial Status of Livestock Farm in Semi-Arid Environment

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Abstract: The study was conducted to assess water salinity and microbial status of livestock farm in a semi-arid environment. The study was carried out at the Teaching and Research Livestock Farm of Animal Science Department, University of Maiduguri. Different water sources were considered for this study (the farm borehole and the metropolitan water supply system). Two (2) concrete dams of 2340 litres and 2360 litres capacity respectively and four galvanized (4) watering troughs of 840 litres capacity were tested for water salinity and microbial load. Sterile sample bottles were used in collecting the water samples from two sources and the reservoirs. Samples were collected from 2 sources at the beginning and after 30 minutes of flow and from the reservoirs before and after cleaning. Samples collected were sent to laboratory for analysis. The study revealed that the water pH, alkalinity, total dissolved solids, carbon dioxide, lead, and nitrites are normal and within the normal range, which signifies good quality water. The microbial results indicate that all the water sources are safe for livestock and human consumption. But the water in the dams and watering troughs needs to be regularly cleaned and treated with disinfectants. It is strongly advisable to conduct regular laboratory tests for all water sources and restraint animals from contaminating the watering troughs with urine and faeces.

Keywords: Water Salinity, Microbiology, Livestock Farm and Semi-Arid Environment.

INTRODUCTION

Water covers almost 98% of the molecules in the animal organism (NRC, 2001). It is distributed throughout the body including extra and intracellular fluids, which contains from 31 to 38% and 62 to 69% of the overall body water respectively. It is also considered the most abundant and vital chemical substrate of all living beings (NRC, 2007). Water is an essential nutrient for all animals. It is important for both animal welfare and business profitability. Amount and quality of water required vary between species of livestock, between classes of stock within the species, and in response to the environment in which the stock is running.

Water contains many different elements and compounds besides hydrogen and oxygen. These elements exist in water in a variety of forms, entering and leaving the water depending on the surrounding environment and sources (Andrew, 2009). The mineral composition of ground water is affected by the rock or soil type the water passes through or the amount of time it spends in an aquifer. Surface water can be affected by many of the same factors as ground water. In addition, surface water is influenced by airborne and soil pollutants, decaying organic matter and the removal of minerals (Andrew, 2009).

Water forms are subjected to pollution of organic and inorganic constituent. If water quality is poor, livestock might drink less than they need or, hardly, may stop drinking totally. When animals drink less, they will eat less and lose condition and if they are lactating, their milk production will reduce or cease. And is important water quality issues for livestock include water salinity and the presence of water contaminants such as heavy metals and chemicals. The objective of this paper is to provide information on water salinity and microbial status of livestock water in the semi arid environment.

MATERIALS AND METHODS

The study was conducted at the Department of Animal Science, Livestock Teaching and Research Farm, University of Maiduguri, Borno state of Nigeria. Maiduguri is located between latitude $11^0$5 and 12^0 north and longitude 13^0 05 and 14^0 east and at altitude of 354m (1161ft) above sea level (DNMA, 2013). The area falls within the semi-arid zone of West Africa characterized by short duration of rainfall (3-4 months) which varies from minimum of 478mm to 500mm and a maximum of 600mm to 621mm (Afolayan *et al*., 2013).the area has long dry season of 8 to 9 months, (Alaku, 1983; Afolayan *et al*., 2013). The mean relative humidity (RH) is 32% in the evening and 59% in the morning. The minimum RH is 11% in March and the maximum is 64% in august (Afolayan *et al*., 2013; DNMA, 2013; Weather Base, 2013). The mean temperature is 34^0C, the maximum being 40.6^0C in April and the minimum of 25^0C, in December. The average dew point is 52% the minimum being 32% in February and the maximum is 72% in August (Afolayan *et al*., 2013; DNMA, 2013; Weather Base, 2013).

Sample Collection: The water samples were collected from two different water sources, and seven (7) watering points which are termed as T1 (the farm borehole), T2 (the metropolitan water supply system), T3 (concrete dam 1), T4 (concrete dam 2), T5 (watering trough 1), T6 (watering trough 2), and T7 (watering trough 3). The water samples for water salinity and microbial load assessment were collected in a sterile sample bottles. Samples were collected at the beginning and after 30 minutes of flow from the boreholes and every 5 days from the reservoirs before and after cleaning.

Chemical Analysis: The samples were analyzed using CODEX, (2012) a NAFDAC standard procedures for water and water related analysis. The water samples for water salinity were analyzed for pH (hydrogen ions concentration), alkalinity, chloride, calcium, total dissolved solids, hardness, carbon dioxide, nitrites, cadmium and lead. The water samples were tested for microbial status (load)

RESULTS AND DISCUSSIONS

Table 1. Water quality parameters of different water sources

Parameters	T 1	T 2	T 3	T4	T5	T6	T7	Mean values	Normal
pH	8.143	6.654	8.172	8.262	8.147	8.459	8.127	7.99	6.5 to 8.5
Alkalinity	91.53 ppm	48.816 ppm	48.816 ppm	61.02 ppm	91.53 ppm	61.02 ppm	73.224 ppm	48.81	3.3 to 84
Chloride	20.0 ppm	14.0 ppm	10.0 ppm	12.0 ppm	11.0 ppm	11.0 ppm	12.0 ppm	11.08	<250 ppm
Hardness	48.0 ppm	52.0 ppm	48.0 ppm	52.0 ppm	52.0 ppm	44.0 ppm	44.0 ppm	46.80	0 to 60 ppm
CO_2	18.0 ppm	12.0 ppm	7.0 ppm	13.0 ppm	16.0 ppm	4.0 ppm	6.0 ppm	10.6	
Total solid	40.0 ppm	40.0 ppm	40.0 ppm	60.0 ppm	80.0 ppm	100.0 ppm	100.0 ppm		
TDS	100.0 ppm	80.0 ppm	80.0 ppm	100.0 ppm	120.0 ppm	140.0 ppm	140.0 ppm	120.9	<500 ppm
Nitrate	0.050 ppm	0.181 ppm	0.010 ppm	0.019 ppm	0.074 ppm	0.011 ppm	0.070 ppm	0.050	<10ppm
Lead	-0.20 ppm	-0.10 ppm	-0.60 ppm	0.10 ppm	0.30 ppm	-0.40 ppm	-0.20 ppm		<015 ppm
Cadmium	0.003 ppm	0.003 ppm	0.002 ppm	0.020 ppm	0.010 ppm	0.001 ppm	0.001 ppm		<005 ppm

Footnote TDS = Total dissolved solids, EPA =

Table 2: Water microbiology (Microbes)

Parameters	T 1	T 2	T 3	T4	T5	T6	T7	Range values	Normal
Coliform	3cfuf/ml	3cfu/ml	2cfu/ml	3cfu/ml	2cfu/ml	2cfu/ml	1cfu/ml	1-3cfu/ml	<100
E. coli	1cfu/ml	1cfu/ml	0cfu/ml	1cfu/ml	0cfu/ml	1cfu/ml	0cfu/ml	0-1 cfu/ml	<100
Pseudomonas	0cfu/ml	0cfu/ml	0cfu/ml	0cfu/ml	0cfu/ml	0cfu/ml	0cfu/ml	0-1 cfu/ml	<100

cfu = colony forming unit

Water quality parameters of different water sources: In this experiment the mean values for hardness was 46.80ppm (Table 1). This shows that there was no hardness in the water, because the mean values were below 60ppm which is not hard (Andrew, 2009). Carbon dioxide was present and has a mean value of 10.6ppm in the form of a dissolved gas. Surface waters normally contain less than 10 ppm free carbon dioxide, while some ground waters may easily exceed that concentration. The result obtained showed that the mean water pH value was 7.99, (Table 1), treatment 2 was slightly acidic (6.65), and however it was within the normal range. This finding was similar to that reported by EPA (2018) that an average pH value of 6.5 to 8.5 was a normal water pH level in livestock feeding. Basically, the pH value is a good indicator of the hardiness or softness of water. Alkalinity is a measure of the capacity of water to resist change in pH that tends to make water more acidic. The measurement of the alkalinity and pH is needed to determine the corrosiveness of the water. In general water with a pH <6.5 could be acidic, soft and corrosive. Acidic water could contain metal ions such as iron, manganese, copper, lead and zinc. The ideal pH level of drinking water should range from 6 to 8.5; the body maintains pH equilibrium on a constant basis and will not be affected by water consumption (EPA, 2018).

A water alkalinity level of 48.88 ppm obtained in this study (Table 1) supports the report of Jaglin (2002) that alkalinity of water was 45.87 - 100.43 for livestock in North central Nigeria. Alkaline water has been compared to acidic water and alkaline water has been shown to have a deficient effect on some health issues. Acidic water has been shown to have a negative effect on health. Alkaline is better than acidic water for calcium nutrition as the World health organization (WHO) recommends 10-20% water for daily need of essential minerals such as calcium from drinking water.

The mean Total Dissolved Solids (TDS) value of 120.9 reported is within the normal range and did not exceed 500ppm maximum. TDS is a measure of all constituents dissolved in water. The inorganic anions dissolved in water include carbonates, chlorides, sulfates and nitrates. The inorganic cations include sodium, potassium, calcium and magnesium. Thus, sulfate is a constituent of TDS and may form salts with sodium, potassium, magnesium and other cations. Sulfate (SO_4^{2-}) is widely distributed in nature and may be present in natural waters at concentrations ranging from a few to several hundred milligrams per liter. Higgins *et al*. (2008) reported that water sources may have similar salinity levels but different effects depending on the salts present.

The results showed that the mean chloride value of 11.08ppm was normal. Treatment 2 was found to be slightly higher (14.8), however it is within the normal range. This agrees with Ali *et al.,* (2012) who reported 11.00 - 15.08 chloride value. Carbon dioxide is readily soluble in water. Over the ordinary temperature range (0 - 30 C) the solubility is about 200 times that of oxygen. Calcium and magnesium combine with carbon dioxide to form carbonates and bicarbonates (Andrew, 2009). Calcium was not analyzed in this study but, Calcium occurs in water naturally. Seawater contains approximately 400 ppm calcium. One of the main reasons for the abundance of calcium in water is its natural occurrence in the earth's crust. Calcium is also a constituent of coral. Rivers generally contain 1-2 ppm calcium, but in lime areas, rivers may contain calcium concentrations as high as 100 ppm and it has no harmful effect on livestock (Andrew, 2009). The mean nitrate value of 0.050ppm was within the normal range and less than 10ppm maximum level. The presence of nitrates or nitrites in water often indicates contamination of the water supply with fecal material or seepage from a septic field. Nitrates themselves are not very toxic, but when reduced to nitrites, problems can develop. Nitrites that get into the blood stream convert the red pigment, hemoglobin, to a dark brown pigment, methemoglobin. Hemoglobin is responsible for carrying oxygen from the lungs to other tissues of the body. Oxygen cannot be carried in the methemoglobin form. When about 50 per cent of the hemoglobin is in the form of methemoglobin, the animal shows signs of distress suggesting a shortage of breath. Above this level, respiratory distress may result in death. At 80 per cent or more, the animal usually dies from a type of suffocation (Andrew, 2009). In this experiment the mean value for lead

was -0.20ppm, which is less than 0.1ppm which was normal range for livestock. The recommended maximum concentration in water is 0.1. Young animals tend to be more susceptible to lead poisoning than adults.

Microbiology: This study focused on only three most important livestock microbes that is commonly found within the study location. The results revealed that the mean values for the microbes found in the water in the study area were 0-3cfu per ml (Table 2). These values are within the normal range for livestock feeding. Importantly, sample of water obtained directly from boreholes and those collected after cleaning showed no evidence of the microbes. This revealed that frequent cleaning and direct supply from water source minimizes the presence of microbes in the water and should be very safe for livestock consumption.

Pseudomonas: The mean value of *Pseudomonas spp.* found in the water samples in this study was 0-3cfu per ml (Table 2), similar to the values of 1 - 4cfu/ml reported by Atlas and Richard (1993) and Ford (1993). The laboratory result showed no evidence of *Pseudomonas aeruginosa* (0.01ppm) or other species of *Pseudomonas.* Though it is wide spread in the environment. It can be found in any water supply. This includes wells, troughs, ponds, parlor wash hoses, and sprinkler pens (Andrew, 2009). This bacterium has also been isolated from waste feed, soil, manure, and animal skin. The real challenge in the control of this bacterium is not only that it is widespread, but it tends to protect itself from antibiotics and the cow's immune system by covering itself.

Coliforms

***Escherichia* coli**: The mean value of *Escherichia* coli and other species found in the water samples in this study was 0-3cfu per ml which also support the report of Atlas and Richard (1993) and Ford (1993) who reported 2-5cfu/ml in livestock water trough with no adverse effect on livestock health. . This shows that the water is safe from *E. coli* and other species of coliforms. Notably, a very important (and probably most likely), cause of biological contamination of water sources is associated with the animal industry itself. For instance, in the situation of intensive livestock operation, the risk of water source contamination with animal waste may be very high. One way to assess water quality for microbial contamination with pathogens of animal origin is to measure numbers of bacteria that are likely associated with animal waste. For this purpose, indices such as water counts of coliform bacteria or *E. coli* are most commonly used, because these kinds of microorganisms are common in animal feces. Excessive presence of these bacteria in drinking water indicates poor hygiene. However, strict tolerance values for livestock have not been investigated. In most jurisdictions, it is generally recommended that drinking water for livestock should contain less than 100 coliforms/100 mL (Andrew, 2009).

CONCLUSION AND RECOMMENDATION

The study showed that the water pH, alkalinity, total dissolved solids, carbon dioxide and nitrites are normal and within the normal range. The microbial results indicate that all the water sources are safe for livestock and human consumption. But the water in the dams and watering troughs needs to be regularly cleaned and treated with disinfectants. It is strongly advisable to conduct regular laboratory tests for all water sources restraint animals from contaminating the watering troughs.

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Nutrients Intake and Utilization by West African Dwarf goats fed *Azadirachta indica* (Neem) Leaf Meal Diets

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Abstract: A study was conducted to assess the performance of West African Dwarf goats fed neem leaf meal diets for ninety-one days. Twenty (20) goats aged 6 to 9 months with body weight of 4.51 ± 0.35kg were used. Five diets were formulated such that the basal diet was substituted with neem leaf meal at ratio 0 (A), 20 (B), 40 (C), 60 (D) and 80% (E). basal diet contained: Cassava peels (40%), Wheat offal (15%), Brewer's dried grain (15%), Palm kernel cake (25%), Urea (1.0%), Bone meal (2.0%), Salt (1.0%) and Grower's premix (1.0%). Four goats were randomly assigned to each of the five diets in a completely randomized design. Chemical composition, nutrients intake, digestibility, weight gain and feed to gain ratio were determined. Dry matter ranged 90.61 – 92.55%, crude protein ranged 12.61 – 18.64% and soluble carbohydrate ranged 43.71 – 54.28%. crude protein increased with increased substitution of neem leaf meal in the diets, the nutrients intake was significantly ($p<0.05$) influenced by the treatments, the dry matter intake ranged 118.61 - 313.36g/day and crude protein intake ranged 22.11-3 9.51g/day. Dry matter digestibility ranged 71.33 - 53.36% and crude protein digestibility ranged 83.75 - 51.79%. Nitrogen balance, weight gain and feed conversion ratio were significantly ($p<0.05$) influenced by the diets. Goats fed diet E converted their diet to flesh better than other goats. Conclusion could be drawn that neem leaf meal has a good potential to serve as source of protein and fibre supplement for growing goat.
Keywords: *Azadirachta indica*, basal diet, goats, nutrients, performance,

INTRODUCTION

This paper reports to show the significance of substituting neem leaf meal in the diet of goats with respect to their growth performance. The conventional cereal and vegetable protein sources being used in animal feeds are under pressure of competition through their use in human diets (1). However, there is increased interest by livestock farmers in Nigeria to substitute conventional feed ingredients with the non-conventional types thus include leaf meal of ethno-medicinal plant like neem (2). Browses of neem trees are cheap, readily available and less competitive sources of protein, vitamins and minerals compared to conventional feed concentrate sources. The neem leaf has a proximate composition of 92.42% dry matter; 20.68% crude protein; 7% ash; 4.13% ether extract; 16.60% crude fibre; and 43.91% nitrogen-free extract (2). Hence, feeding air-dried neem leaf meal may elicit different nutritional responses in the performance of WAD goats

MATERIALS AND METHODS

The experiment was conducted at the small ruminant unit of the Teaching and Research Farm of the Federal University of Technology, Akure Nigeria. Dried cassava peels were collected from 'gari' processing industries in Igbatoro road, Akure. Neem leaves were harvested within the university campus, air-dried under shade for 3 weeks to preserve the green colour and nutrients. Five diets were formulated such that the basal diet was substituted with neem leaf meal at ratio 0 (A), 20 (B), 40 (C), 60 (D) and 80% (E). Basal diet contained: Cassava peels (40%), Wheat offal (15%), Brewer's dried grain (15%), Palm kernel cake (25%), Urea (1.0%), Bone meal (2.0%), Salt (1.0%) and Grower's premix (1.0%). Twenty (20) goats aged 6 to 9 months with body weight of 4.51 ± 0.35kg were used and experimental period was ninety-one days. Four goats were randomly assigned to each of the five experimental diets in a completely randomized design. Basal diet and neem leaf meal were mixed together thoroughly and fed to the goats, water was offered *ad libitum* at 8.00am each day of experimental period. Nutrients intake, digestibility, nitrogen balance, weight gain and feed to gain ratio were determined. Samples of feed, faeces and urine were analyzed for dietary nutrients according to methods of (3) and (4). All data obtained

were subjected to analysis of variance using (5) version 15.0, the means were compared using Duncan Multiple Range Test.

RESULTS AND DISCUSSION

The chemical composition of the experimental diets was shown in Table 1, The crude protein ranged between 12.61 and 18.64% while the fibre fractions determined include; NDF (58.27 – 67.24%) and ADF (49.65-58.36%). The table 2 presents nutrient intake of goats and inclusion of neem leaf meal significantly (p<0.05) influenced nutrients intake. the low intake of dm, crude protein (CP), crude fibre (CF) and fibre fractions of goats fed diet E might be due to the astringent taste of the neem leaf (2). However, the dry matter intake (313.36g/day) of goats fed diet A was highest, indicating that the diet was more palatable and acceptable than other diets. The apparent digestibility of the nutrients was significantly (p<0.05) influenced by the inclusion of neem leaf meal (6) and the digestion coefficient values of DM and CP varied from 53.36 (diet D) to71.33 (diet B) and between 51.79 (diet C) and 83.75% (diet A) respectively. The observed digestibility coefficients of DM and CP might be due to laxative, medicinal potentials and protein quality of neem leaf meal supplementation in the diets as indicated by (7). The fibre fractions' digestibility coefficient were significantly (p<0.05) influenced by the treatments, observed NDF values ranged 55.71 (diet E) – 81.59% (diet A). The weight gain, nitrogen balance, feed to gain ratio were shown in table 3. The improved weight gain of the goats might be due to the adequate protein in the diets, which was comparable to the protein requirement for small ruminant growth according to (7). the goats fed diet E (5.42) converted their diet to flesh better than other goats.

Table 1: Chemical composition of the Neem Leaf Meal and Basal Diets fed to West African Dwarf goats

Parameters	Diets				
	A	B	C	D	E
Dry matter	92.55	90.61	92.48	91.33	91.65
Crude protein	12.61	14.03	16.88	18.63	18.64
Crude fibre	13.59	12.01	12.00	13.00	14.60
Ether extract	9.18	10.56	11.34	10.66	11.56
Ash	10.34	12.76	12.52	11.33	11.49
Nitrogen free extract	54.28	50.64	47.26	46.38	43.71
Neutral detergent fibre	58.27	67.24	61.08	62.42	62.37
Acid detergent fibre	49.65	58.36	57.86	54.66	53.45
Acid detergent lignin	25.35	30.11	31.32	32.13	31.73
Cellulose	24.30	28.25	20.54	22.53	21.72
Hemicellulose	8.62	8.88	9.22	7.76	8.92

Diet A = Basal Diet (Control); Diet B = 80% Basal diet and 20% neem leaf meal; Diet C = 60% Basal diet and 40% neem leaf meal; Diet D = 40% Basal diet and 60% neem leaf meal; Diet E = 20% Basal diet and 80% neem leaf meal.

Table 2: Nutrients Intake (g/day) of WAD Goats Fed Neem Leaf Meal and Basal Diets.

Parameters	Diets					
	A	B	C	D	E	SEM
Dry matter (Concentrate)	313.36^{a}	198.33^{b}	85.37^{c}	52.56^{c}	23.72^{c}	12.99
Dry matter (Neem leaf meal)	ND	49.58^{c}	56.92^{b}	78.84^{b}	94.89^{a}	5.41
Total dry matter	313.36^{a}	247.91^{b}	142.29^{c}	131.40^{c}	118.61^{c}	18.40
Crude protein	39.51^{a}	34.78^{b}	24.02^{c}	24.48^{c}	22.11^{d}	6.99
Crude fibre	42.54^{a}	29.77^{b}	17.07^{c}	17.08^{c}	17.32^{c}	2.77
Ether extract	28.73^{a}	26.18^{a}	16.14^{b}	14.01^{b}	13.71^{b}	1.92
Ash	32.36^{a}	31.63^{a}	17.81^{b}	14.89^{bc}	13.63^{c}	2.24
Nitrogen free extract	170.09^{a}	125.54^{b}	67.25^{c}	60.94^{cd}	51.84^{d}	7.05
Neutral detergent fibre	182.59^{a}	166.69^{a}	88.74^{b}	82.02^{b}	72.45^{b}	11.22
Acid detergent fiber	155.58^{a}	144.68^{a}	76.06^{b}	71.82^{b}	61.51^{b}	9.63
Acid detergent lignin	79.44^{a}	74.65^{a}	45.15^{b}	42.22^{b}	37.15^{b}	4.36
Cellulose	76.15^{a}	70.03^{a}	30.91^{b}	29.60^{b}	24.37^{b}	5.29
Hemicellulose	27.01^{a}	22.32^{b}	12.70^{c}	10.05^{c}	10.94^{c}	1.62

abc= Means within the same row with different superscripts are significantly (P<0.05) different

Table 3: Apparent digestibility, nitrogen balance, weight gain and feed to gain ratio of WAD Goats Fed Neem Leaf Meal and Basal Diets

Parameters	Diets					
	A	B	C	D	E	SEM
App. Digestibility (%)						
Dry matter	71.32^{a}	71.33^{a}	54.17^{b}	53.36^{b}	53.55^{b}	2.24
Crude protein	83.75^{a}	77.95^{a}	51.79^{c}	71.02^{b}	64.92^{b}	2.66
Crude fibre	85.46^{a}	61.08^{c}	77.73^{ab}	76.56^{b}	50.08^{d}	3.12
Ether extract	58.23	58.88	54.07	50.48	53.56	1.52
Nitrogen free extract	53.39^{d}	83.43^{a}	74.85^{b}	60.60^{c}	74.32^{b}	2.61
Neutral detergent fibre	81.59^{a}	78.97^{a}	59.13^{b}	59.19^{b}	55.71^{b}	2.66
Acid detergent fibre	61.15	55.10	59.62	59.84	60.82	1.24
Acid detergent lignin	85.78^{a}	86.11^{a}	71.94^{b}	71.47^{b}	72.81^{b}	1.51
Cellulose	75.45^{a}	76.17^{a}	56.12^{b}	53.66^{b}	53.81^{b}	2.58
Hemicellulose	92.41^{a}	63.70^{b}	56.91^{bc}	53.64^{c}	61.90^{bc}	3.38
Nutrients utilization						
Nitrogen balance (g)	5.84^{a}	5.11^{b}	3.47^{c}	3.62^{c}	3.30^{c}	1.20
Weight gain (g/day)	26.59^{a}	14.07^{c}	14.12^{c}	15.10^{c}	21.87^{b}	1.41
Feed to gain ratio	11.78^{b}	17.62^{b}	10.08^{b}	8.70^{bc}	5.42^{c}	1.15

abc = means within the same row with different superscripts are significantly ($p<0.05$) different

CONCLUSION AND APPLICATION

From foregoing, it could be concluded that:

1. *Azadirachta indica* (neem) leaf meal diets have potential protein content that ranged 12.61 - 18.64% and good fibre source (58.27 – 67.24% NDF) that would enhance rumination and growth performance of goat
2. Substituting the basal diet with neem leaf meal at ratio 20.00 – 80.00% was acceptable to the goats however; the goats fed diet E convert their feed (5.48) to flesh better than other goats. Thus, the diet could be a source of protein for growth and enhance the use of neem leaf for goat nutrition.

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Accuracy of Weight Estimation Methods in Small Ruminant

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Abstract: The study was conducted to evaluate the accuracy of weight estimation methods (weighing scale, weighing band, weight estimation formula and regression equation method) commonly used in sheep. It was carried out in some selected local government areas of Kano State, namely, Bebeji (BBJ), Dawakin Kudu (DKD), Wudil (WDL), Shanono (SNN) and Dambatta (DBT). The animals were aged by dentition, weighed using a scale while linear body measurements were taken using measuring tape, the physiological status considered include male, dry pregnant and lactating ewes. Data collected was analyze using SAS (1999), the relationships between body weight obtained using the different methods of weight determinations were determined using the Pearson correlation analysis, in addition, accuracy of the methods relative to actual body weight was assessed using an index. Differences exist between the weighing methods and regression equation method of weight determination appeared to be second to weighing scale in terms of accuracy. The use of regression procedure to estimate body weight is recommended in the absence of scale.
Accuracy, weighing, methods, regression, sheep

INTRODUCTION

In sub-Sahara Africa particularly Nigeria, livestock play important role in agriculture contributing about 12.7% of the entire agricultural domestic product (CBN, 1999). The country is one of four leading livestock producers in the region with growing population of cattle (15.2 million), sheep (23 million) and goat (28 million) as reported by FAOSTAT (2006). The economic importance of sheep in developing nations cannot be over-emphasized. Sheep with their small body size, high productive capacity and rapid growth rates are ideally suited to production by smallholders. They thrive in a wide variety of environments in the tropics and sub-tropics. It requires less capital as they can be completely maintained on pastures, browse, and agricultural waste products. In sub-saharan Africa, sheep provide almost 30% of the meat consumed and around 16% of the milk produced, (FAO, 2012).

Morphometric measurements are simple and easy to conduct, and allow estimating the animal's body weight with reasonable accuracy. However, these approaches are prone to errors in the localization of reference points and may be biased by anatomical distortion due to animal movement, (Sowande & Sobola, 2008). Estimating the live weight using body measurements is practical, faster, easier and cheaper in the rural areas where resources are insufficient for the breeder (Nsoso, Aganga, Moganetsi and Tshwenyane, 2003). However, this fundamental knowledge of body weight estimation is often unavailable to farmers due to unavailability of weighing scales. Hence, the farmers have to rely on questionable estimates of the body of their animals leading to inaccuracies in decision-making and husbandry (Moaeen-ud-Din Ahmad, Iqbal & Abdullah, 2006).

MATERIALS AND METHODS

The study was carried out in some selected local government areas of Kano State. Multistage sampling was adopted in the study: selection of five local governments areas (Shanono, Dawakin Kudu, Bebeji, Wudil and Dambatta). Body weight was determined using weighing scale and the linear body measurements were measured by one person using flexible measuring tape graduated in centimeter. stepwise multiple regression models were fitted to obtain prediction equations of body weight from body measurement, Pearson correlation analysis was used to determine the relationship between the weighing methods as contained in SAS (1999). In addition, accuracy of the methods relative to actual weight was assessed using an index calculated as the ratio of estimated weight to the actual weight expressed in percentage, mathematically given as:

$= BW_{estimated}/BW_{actual} \times 100$

RESULTS

Table 12: Accuracy of Weight Estimation Methods in Sheep Relative to Actual Body Weight

BW_{Actual}	BW_{Tape}	$BW_{Regression}$	$BW_{Formula}$

Age			CV			CV	INDEX			CV	INDEX			CV	INDEX
	X	SD		X	SD			X	SD			X	SD		
1	17.75	2.99	16.85	20.11	3.90	19.40	114.26	17.61	4.30	24.42	99.53	18.74	3.92	20.9	106.4
2	24.94	6.63	26.58	29.43	6.25	21.24	121.12	25.17	5.04	20.03	103.37	27.36	6.07	16.3	112.21
3	31.33	7.56	24.16	36.87	5.68	15.41	121.73	30.74	4.91	15.97	100.75	35.91	6.42	17.9	117.49
PS															
1	21.50	5.69	26.47	25.57	6.86	26.83	121.61	21.58	4.87	22.57	102.82	23.41	5.98	25.5	111.53
2	22.09	5.51	24.94	26.20	6.34	24.19	119.77	22.38	5.39	24.08	102.29	24.52	6.32	25.4	111.68
3	30.11	6.29	20.59	35.53	5.81	16.35	120.42	29.88	4.23	14.61	100.96	33.65	6.23	18.5	113.38
4	30.35	8.34	27.48	34.01	6.01	17.67	116.33	29.97	5.74	19.15	102.42	33.43	7.06	21.1	113.25
R^2	1			0.80**				0.85**				0.83**			

X= mean, SD= standard deviation, CV= Coefficient of variation, PS= physiological status, **= P<0.0

Table 13: Relationship Between Different Methods of Weight Determination in Sheep

	BW_{Actual}	BW_{Tape}	$BW_{Regressiom.}$	$BW_{Formula.}$
BW_{Actual}	1			
BW_{Tape}	0.80	1		
$BW_{Regression.}$	0.85	0.89	1	
$BW_{Formula.}$	0.83	0.96	0.90	1

BW= BodyWeigh

DISCUSSIONS

Relationship Between Different Methods of Weight Determination in Sheep and Their Accuracy Relative to Actual Body Weight

Relative to the actual body weight of sheep as measured on the scale, the index on Table 7 also demonstrated the abilities of the different methods to estimate an animal's live weight. In this regard, the regression equation method with the lowest ratio to the actual body weight, was also the most accurate predictor of body weight across all the age groups and physiological statuses, followed by weight estimation formula, while the least accurate was the use of tape. This fact was similarly documented by Stajnko *et al.* (2009) in cattle as well as Enevoldsen and Kristensen (1997).

It is assumed that weighing scale used to determine the weight of the experimental animal was the most accurate method of weight determination. The fact that weights estimated using the regression method had the highest correlation (0.85) with the actual weights compared to the correlation coefficients between the latter and those derived using the small ruminant weight estimation formula is (0.83) and small ruminant weighing tape (0.80), could probably be due to the fact that regression method entails the use of several body measurements than the other methods. Afolayan *et al.* (2006) in their research on Yankasa sheep, discovered that the addition of other measurements to chest girth in multiple regression analyses would result in significant improvements in accuracy of prediction even though the extra gain was small. However, under field conditions, live weight estimation using chest girth alone would be preferable to combinations with other measurements because of difficulty of proper animal restraint during measurement. This thus reduces the practical usefulness of using other body measurements in conjunction with chest girth (Berge, 1977).

CONCLUSION AND RECOMMENDATION

Regression method of weight determination was found to be the most accurate other than scale followed by weight estimation formula and tape method was the least accurate. Therefore, the regression method of weight determination should be used in the absence of a weighing scale.

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Effect of Feeding Different Ratios of Soymilk on Blood Parameters of Friesian X Bunaji Dairy Calves

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Abstract: The study was carried out to evaluate the effect of feeding different ratios of soymilk on some haematological and serum biochemical parameters of Friesian x Bunaji dairy calves. Sixteen calves with initial body weight of 34.8±0.7kg were randomly assigned to four dietary treatments (which consisted of 0:100, 25:75, 50:50 and 75:25 ratios of soy: cow milk) with four calves per treatment in a Completely Randomized Design. Each calf received two litres of the mixture of soy: cow milk daily. *Digitaria smutsii* hay and clean drinking water were provided to the calves *ad libitum*. Results showed significant (P<0.05) difference in packed cell volume (PCV) across the treatments. Calves fed 75:25 ratio of soy: cow milk had higher (19.53) PCV percentage compared with those on the control diet which had the lowest (15.01%). While for white blood cell (WBC) calves fed diets containing 75:25 and 50:50 ratios of soy: cow milk had higher (11.65 and 12.46 x109/l) WBC compared with those on 0:100 and 25:75 which had lower (10.28 and 10.66 x109/l) WBC values, respectively. Haemoglobin concentration also followed similar pattern. Serum total protein was significantly (P<0.05) higher (6.32g/dl) in calves fed 75:25 ratio of soy: cow milk though not statistically different from calves fed 50:50 (6.28g/dl) and 0:100 (6.1228g/dl). The lowest serum protein (5.51g/dl) was observed in calves fed 25:75 ratio of soy: cow milk. Albumin, glucose and creatinine also followed similar pattern. But the amount of globulin was significantly (P<0.05) higher (2.44g/dl) in calves fed 0:100 ratio of soy: cow milk (the control) compared with calves on the other treatments. Calves fed 50:50 ratio of soy: cow milk had the highest (9.79mg/dl) blood urea nitrogen (BUN) compared with calves on 25:75, which had the lowest (7.13mg/dl) concentration of BUN but statistically similar to those on 0:100 (7.60mg/dl). All the blood parameters measured were within the normal range for healthy calves. Therefore, it was concluded that soymilk can be used to replace cow milk in the diet of calf up to 75% inclusion level without any detrimental effect on health status of the animals.
Keywords: Blood, Friesian-Bunaji, Soymilk, Calves.

INTRODUCTION

Milk, almost a complete food for human, can be spared provided good quality cheap substitute is available for calves. Usage of milk replacers has increased tremendously during the past 60 years. Milk replacer is used to replace or substitute in part or whole the milk for calves. Soy proteins have been used in milk replacers with good results and are used in large amounts in present day formulations (Jiang *et al*., 2000). At least 50% of milk protein can be replaced by soy protein in milk replacer without adverse effect Suitable substitutes for milk such as soymilk can improve the nutrition and survivability of infant pre-ruminants (Khan *et al*., 2012). If good quality milk replacer is used, there will not be any need for feeding whole milk. A milk replacer almost always will be cheaper than saleable whole milk for calf raising. Other advantages of milk replacer feeding are flexibility of storage, day to day constancy of product, easy to carry over and control of diseases in the calves. The present study was intended to evaluate the effect of milk replacer with the use of Soybeans. Soybeans have been a significant source of proteins of plant origin for both livestock feed and human industries for many years because of its high protein content and wide availability. Blood is an important and reliable medium for assessing the health status of animals because it is particularly sensitive to changes in nutrition and environmental temperature (Etim *et al*., 2014). The study therefore investigates the impact of feeding soymilk replacer on some blood parameters of Friesian x Bunaji dairy calves.

MATERIALS AND METHODS

Location of the Study: The study was conducted at the National Animal Production Research Institute (NAPRI), Ahmadu Bello University, Shika-Zaria, Nigeria. Shika is located within the Northern Guinea Savanna ecological zone of Nigeria between latitude 10°11'N and longitude 7°8'E, at an altitude of 650m above sea level (Ovimaps, 2017).

Source of Feed Materials: Soybeans (Samsoy II) were purchased from an open market in Giwa Local Government Area of Kaduna State, Nigeria. While the other feed materials were obtained from NAPRI, Shika-Zaria, Nigeria.

Preparation of Experimental Diets: The soybeans were cleaned by winnowing and hand picking of stones and debris. The cleaned soybeans were soaked in excess water in plastic containers for 72 hours. The water was changed twice after every 24 hours during the soaking period. After which the soybeans were rinsed with clean tap water and sun-dried for 8 days. The dried soybeans were milled into flour and sieved with the aid of 0.04mm sieve. The resultant soyflour was stored in polythene bags and samples were taken to the laboratory for chemical analyses. The experimental diets were prepared immediately after fresh cow milk collection. Soymilk was prepared in batches according to standard procedure.

Experimental Animals, Design and Management: Sixteen (16) Friesian x Bunaji dairy calves of mixed sexes (8 males and 8 females) aged between 2 – 3 weeks, with initial live weight of 34.8±0.7kg from the National Animal Production Research Institute (NAPRI), Shika-Zaria were used. The calves were identified with ear tags, weighed and randomly distributed into four (4) dietary treatments consisting of 4 calves per treatment in a Completely Randomized Design (CRD). Proper sanitary measures were obeserved to protect the calves against parasitic infestations and other contagious diseases.

Blood Collection: Blood samples were collected from all the experimental animals (16) at the end of the experiment. Five (5) mls of blood sample was drawn through the jugular vein using hypodermic needles with syringe and was emptied into two separate sets of vacutainer tubes. Two (2) mls of the collected blood sample was collected in a plastic bottle containing anti-coagulant [ethylene diaminetetracetic acid (EDTA)]. While the remaining 3mls was emptied into another plastic bottle that do not contain EDTA. Blood parameters were determined according to methods described by Etana *et al*. (2011).

RESULTS AND DISCUSSION

The result of the effect of feeding different ratios of soy:cow milk on haematological parameters of Friesian x Bunaji calves is presented in Table 1. There was significant ($P<0.05$) difference in all the haematological parameters measured except red blood cells. Packed cell volume in this study (15.01%), (18.67%) and (17.67%) for calves fed 0:100, 25:75 and 50:50 ratios of soymilk and cow milk, were lower than 27.30%, 26.90% and 27.50% reported by Sarker *et al*. (2015) for goat kids fed the aforementioned ratios of soymilk and cow milk. The PCV values obtained in this study fell within the normal range of 24 – 46% for healthy calves as reported by (Merck Veterinary Manual, 2016). This implies that the inclusion of soymilk in the diets of calves was ideal and adequate and the animals were not anaemic. White blood cells (WBC) followed similar pattern but were still within the normal range (4 – 12%) reported by (Merck Veterinary Manual, 2016). The WBC counts obtained in this study agrees with the findings of Sarker *et al*. (2015) who observed elevated serum antibody in calves fed soy products. The values of red blood cells in this study were within the normal range of (0 – 20 $x10^{12}$/l) reported for healthy calves (Merck Veterinary Manual, 2016). This could be due to the fact that soybean is a rich source of minerals and vitamins (such as iron, zinc, copper, thiamine, riboflavin, niacin and patholenic acid) which are well-known hematinics and are essential in the formation of RBCs (Ganong, 2005). Haemoglobin, Mean corpuscular volume (MCV), Mean corpuscular haemoglobin (MCH) and Mean corpuscular haemoglobin concentration (MCHC) were all within the normal ranges of 8 – 15g/dl, 40 – 60 fl, 11 – 17pg and 30 – 36g/dl, respectively reported for healthy calves (Merck Veterinary Manual, 2016).

This means that the addition of soymilk in the diets of calves increased the protein content and its utilization. Differential WBC observed in this study fall within the normal range for healthy calves. This agrees with Chineke *et al.* (2006) who found that lymphocytes, neutrophils and basophils offer protection against toxins and infectious organisms in the body of the animal.

Table 1: Effect of Feeding Different Ratios of Soy:Cow Milk on Some Haematological Parameters of Friesian x Bunaji Calves

	Ratios of Soymilk to Cow Milk (%)					
Parameters	0:100	25:75	50:50	75:25	SEM	Range[1]
PCV (%)	15.01^{c}	18.67^{ab}	17.67^{b}	19.53^{a}	0.85	24 – 46
WBC ($x10^{9}$/l)	10.28^{b}	10.66^{b}	11.65^{a}	12.46^{a}	0.49	4 – 12
RBC ($x10^{12}$/l)	6.52	7.22	6.44	7.40	0.51	0 – 20

Hgb (g/dl)	9.81[b]	9.61[b]	10.43[a]	10.78[a]	0.25	8 – 15
MCV (fl)	49.93[b]	49.15[b]	54.55[a]	50.27[b]	0.71	40 – 60
MCH (pg)	15.47[a]	15.36[ab]	15.18[b]	15.91[a]	0.25	11 – 17
MCHC (g/dl)	29.91[a]	28.58[a]	25.08[b]	21.66[c]	1.02	30 – 36
Differential WBC (%)						
Lympocytes	68.88[a]	66.44[ab]	67.08[a]	64.78[b]	1.48	45 – 75
Neutrophils	26.82[a]	18.11[c]	20.97[b]	24.40[a]	1.42	15 – 33
Basophils	0.68[b]	0.94[a]	0.81[ab]	1.10[a]	0.08	0 – 2

abc means with different superscripts within the same row differed significantly (P <0.05). PCV = Packed Cell Volume; WBC = White Blood Cells; RBC = Red Blood Cells; Hgb = Haemoglobin; MCV = Mean corpuscular volume; MCH = Mean corpuscular haemoglobin; MCHC = Mean corpuscular haemoglobin concentration; SEM = Standard Error of Mean. 1Source: Merck Veterinary Manual (2016).

The results of feeding different ratios of soy:cow milk on some serum biochemical indices of Friesian x Bunaji calves are presented in Table 2. All the serum biochemical indices studied differed significantly (P<0.05) across the treatments. The serum total protein (5.51 to 6.12 g/dl) obtained in this study were within the range (6.12 to 6.49 g/dl) reported by Geiger *et al*. (2014) in Holstein calves fed varying milk replacers with or without direct-fed microbial supplementation. The improvement of serum total protein observed in this study might have been associated with improved dietary intake as a result of the inclusion of soymilk. The serum albumin (3.34 to 4.32 g/dl) obtained in this study were similar to the range (4.1o to 4.80 g/dl) reported by Lee *et al*. (2009) in Holstein calves fed milk replacer containing different amount of energy and protein. But the values of albumin obtained in this study were slighlty above the normal range (2.5 – 3.8 g/dl) for healthy animals which suggest that the calves were not dehydrated. The globulin concentrations obtained in this study were within the normal range (3.0 – 3.5 g/dl) for healthy calves (Merck Veterinary Manual, 2016). The blood glucose concentration observed in this study which ranged between 73.87 to 96.20mg/dl was higher than the range of (40.00 to 49.75mg/dl) reported by Roy *et al*. (2016). The high blood glucose observed in this study could be attributed to the treatment effect of soymilk used in the diet of the calves. This increment could also be attributed to the physiological shift in the primary energy source from glucose to volatile fatty acids (VFA) when the rumen in young calves becomes functional (Hammon *et al*., 2002). The significant (P<0.05) increase in blood urea nitrogen levels (9.79 mg/dl) obtained in calves fed 50:50 ratio of soymilk and cow milk could be attributed to the high utility value of the diet. The serum creatinine (0.47 to 0.60 mg/dl) obtained in this study were lower than the values (1.50 to 2.2 mg/dl) reported by Lee *et al*. (2009) in Holstein calves fed milk replacer containing different amount of energy and protein but fell within the normal range (0.5 – 2.2 mg/dl) reported for health calves (Merck Veterinary Manual, 2016) suggesting normal liver and renal functions in calves.

Table 2: Effect of Feeding Different Ratios of Soy:Cow Milk on Serum Biochemical Indices of Friesian x Bunaji Calves

	Ratios of Soy to Cow Milk (%)					
Serum Indices	0:100	25:75	50:50	75:25	SEM	Range[1]
Total Protein (g/dl)	6.12[a]	5.51[b]	6.28[a]	6.32[a]	0.17	6.7 – 7.5
Albumin (g/dl)	3.68[b]	3.34[c]	4.11[a]	4.32[a]	0.15	2.5 – 3.8
Globulin (g/dl)	2.44[a]	2.17[b]	2.17[b]	2.00[b]	0.09	3.0 – 3.5
Glucose (mg/dl)	81.72[b]	73.87[c]	76.38[bc]	96.20[a]	2.87	40 – 100
Blood Urea Nitrogen (mg/dl)	7.60[c]	7.13[c]	9.79[a]	8.99[b]	0.30	10 – 25
Creatinine (mg/dl)	0.47[b]	0.46[b]	0.60[a]	0.58[a]	0.03	0.5 – 2.2

[abc] means with different superscripts within the same row differed significantly (P <0.05). SEM = Standard Error of Mean. [1]Source: Merck Veterinary Manual (2016).

CONCLUSION

All the blood parameters measured were within the normal range for healthy calves. Therefore, soymilk could be used to replace cow milk in the diet of calf up to 75% inclusion level without any detrimental effect on health status of the animals. Further study is recommended on the use of other ingredients as milk substitute and to compare the results with this study.

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In Vitro Methane Gas Production and Rumen Fermentation Kinetics of Diet Containing Fermented Baobab Seed Meal

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Abstract: The use of alternative feed resources with less competition in feeding of livestock must also address the problem of enteric methane production since these alternative feed resources are usually poorly digested by ruminants. This research seeks to investigate methane output and other fermentation kinetics of diet containing fermented baobab seed meal. Three diets: Control (No baobab seed meal inclusion), WBb-15 (15 % inclusion of water fermented baobab seed meal), PBb-15 (15 % inclusion of palm-wine fermented baobab seed meal) were used in the experiment in a completely randomized design. Rumen fluid was collected from cattle and put in a thermo flask pre-warmed to a temperature of 39°C.The experimental diet was used as the substrate and the samples were incubated for 24 hours at 39°C after which 4 ml NaOH was introduced to estimate methane production. Results obtained indicate that fermented baobab seed meal inclusion did not significantly ($p>0.05$) influence methane output, pH, total gas volume (GV), short chain fatty acid, *in vitro* dry matter digestibility (IDMD), potential gas production from soluble fraction (b), gas production rate constant (c) and time of incubation (lag). However, CH_4/GV production significantly ($p<0.05$) decreased with inclusion of palm-wine fermented baobab seed meal. It was concluded from this study that inclusion of fermented Baobab seed meal in diet of ruminants did not increase methane output under *in vitro* condition, while the proportion of methane in the total gas produced (CH_4/GV) decreased with inclusion of palm-wine fermented baobab seed meal.

Keywords: Baobab seed**,** Fermentation, Fermented, Methane, Rumen

DESCRIPTION OF PROBLEM

The need for use of local natural feed resources with less competition with man is advocated as sustainable alternatives for livestock feeding (1, 2). One of these less popular native crops species is Baobab which is high in nutrients. Baobab young leaves, fruits, seeds and the oil meal are consumed by livestock either as fodder or as feed ingredients in concentrate diet. Baobab seed is rich in protein and contains substantial amount of energy (3). It has been reported that baobab as feed for livestock can possibly relieve critical food shortages if given adequate promotion and research attention (4). Baobab seed has been used in formulating livestock feed by different researchers (5, 6, and 7). Water fermented baobab seed inclusion at 15 % in diet of West African Dwarf goats gave an optimum cost/kg body weight gain when compared to control diet (7). (5) recommended maximum inclusion level of 10 % baobab whole fruit for optimum performance of WAD goats. (6) reported that baobab pulp and seed at 30% level of inclusion gave better milk mineral composition from Red Sokoto goats whereas the highest milk yield was recorded at 20 % inclusion level. However, reports on methane output from feeding of baobab seed meal is scarce.

Sustainable livestock feeding, should also address the problem of methane production from enteric fermentation. One way of evaluating different feed sources for methane emission is the *in vitro* gas production methods. The *in vitro* gas production technique (IVGPT) has been used to simulate ruminal fermentation of feed and feedstuffs (8) for decades. With the increasing interest in green house gas (GHG) emissions in recent years, the traditional IVGPTs have been modified to include measurement of methane

production (9, 10). This research therefore evaluated the methane gas production output and other fermentation kinetics of diet containing fermented baobab seed meal.

MATERIALS AND METHODS

Experimental Site: The research was carried out at the Pasture and Range Management Laboratory, College of Animal Science and Livestock Production, Federal University of Agriculture, Abeokuta. Located within latitude 7° 13' N and longitude 3° 26' E (Google Earth, 2017).

Processing of Baobab Seed: Baobab seed were gathered from rural community in plateau state, Nigeria between the months of December and January, 2017.The seeds were sun-dried for a week. A part of the seeds was fermented in clean water for a period of 24 hours under airtight conditions. After 24 hours it was removed, dried under the sun to a constant moisture content and milled-water-fermented baobab seed meal (WFBSM). A second part was fermented in palm wine: water mixture (1:10 litres) also for a period of 24 hours under airtight conditions. After 24 hours, it was removed, dried under the sun to a constant moisture content and milled- palm-winefermented baobab seed meal (PFBSM)

Experimental Design and Procedures: The study was a complete randomized design with three dietary treatment groups consisting of Control (No baobab seed meal inclusion), WBb-15 (15 % inclusion of water fermented baobab seed meal), PBb-15 (15 % inclusion of palm-wine fermented baobab seed meal) (Table 1). Rumen fluid was collected from cattle using suction tube as described by (11), into a thermo flask that has been pre- warmed to a temperature of 39°C. The buffer solution used was 9.8$NaHCO_3$ + 2.77 $NaPO_4$ + 0.57 KCl + 0.47 NaCl +2.16 $MgSO_4.7H_2O$ +0.16$CaCl_2.2H_2O$. Incubation procedure was as reported by (12) using 100 ml calibrated transparent glass syringes fitted with silicon tube. Eight replicates each of 200 mgDM oven-dried and milled samples of experimental diet (Table 1) was loaded in the syringes, the rumen fluid and the buffer were mixed together in ratio 1:2(v/v). 30 ml of inoculum were drawn and dispensed into the calibrated transparent syringes containing the substrate (grass/concentrate mixture) under continuous CO_2 flushing. Air bubbles were removed from the syringes by gently tapping the syringes and pushing the piston upwards to expel the air. The silicon tubes on the syringes were properly clipped to prevent escape of gas. The glass syringes were placed in the incubator at a temperature of 39°C for gas production, which was measured at 3, 6, 9, 12, 18, 24, hrs.

Data Collection: At post incubation period, pH of samples was determined using a pH meter (Universal PH Test Kit – Digital PH Meter®), Also 4ml NaOH was introduced into incubated samples (three replicates per treatment) to estimate methane production as reported by (13). SCFAs were calculated as reported by (14). Total gas volume (GV) was expressed as ml/200mgDM, Cumulative gas production data were fitted to the model 4 Ruminal Digestion of Philip H. Sherrod (NLREG Version 6.5) - Nonlinear Regression Analysis package program. The function is: Gas=b*(1-exp (-c*(t-lag))) Where variables are t, gas; parameters are b, c, lag

In vitro dry matter digestibility (IDMD) was estimated from five replicates per treatment using the formular:

$$\text{IDMD (\%)} = \frac{\text{Weight of sample before incubation} - \text{Weight of sample after incubation} \times 100}{\text{Weight of sample before incubation}}$$

Statistical Analysis: All the data generated were subjected to analysis of variance using SAS (2000) statistical software and differences in means were seperated using Duncan's Multiple Range Test at ($p<0.05$) level of probability.

RESULTS AND DISCUSSION

The result of in vitro fermentation is shown in Table 2. The volume of gas produced under *in vitro* condition reflects the end products of the fermentation of the substrate to volatile fatty acids (VFA) thereby

demonstrating nutritional value of such feed (15). Gas volume was not significantly ($p>0.05$) different across the treatments.

Table 1: Gross composition of experimental diet

Item (Kg)	Control	WBb-15	PBb-15
Fixed Ingredients	70	70	70
PKC	30	15	15
WFBSM	-	15	-
PFBSM	-	-	15
Total	100	100	100

Fixed items: Maize offal-46 Kg, Rice offal-10 Kg, Soyabean meal-10 Kg, Bone meal-3 Kg, Vitamin premix-0.5 Kg, Salt-0.5 Kg. WBb-15 (15 % inclusion of water fermented baobab seed meal), PBb-15 (15 % inclusion of palm wine fermented baobab seed meal), WFBSM- water fermented baobab seed meal, PFBSM- palm wine fermented baobab seed meal

Table 2: *In vitro* methane gas production and fermentation kinetics of diet containing fermented Baobab seed meal

Parameter	Control	WBb-15	PBb-15	SEM
Ph	6.29	6.29	6.29	0.01
SCFA (µmol/g DM)	1.12	1.12	1.12	0.02
IDMD (%)	19.51	15.78	18.21	0.87
CH_4 (ml/200mgDM)	37.67	35.00	35.33	0.65
GV (ml/200mgDM)	49.33	49.33	49.33	0.79
CH_4/GV (%)	75.33[a]	70.20[ab]	68.42[b]	1.28
B	43.87	48.85	48.08	2.96
C	-18.14	-14.29	-13.64	2.48
Lag	27.22	26.65	57.03	10.44

[ab]Means with different superscript along the same row differ ($p<0.05$) significantly

WBb-15 (15 % inclusion of water fermented baobab seed meal), PBb-15 (15 % inclusion of palm wine fermented baobab seed meal), WFBSM- water fermented baobab seed meal, PFBSM- palm wine fermented baobab seed meal

SCFA- short chain fatty acids

IDMD- In vitro dry matter digestibility

This implies that inclusion of fermented baobab seed meal in the diet did not affect the volume of gas production. Methane production was also not affected by inclusion of fermented baobab seed meal. However, there was a marginal decrease ($p>0.05$) in methane output with inclusion of fermented baobab seed meal. Methane production from enteric fermentation is not only considered a waste (loss of energy), it also contributes to global warming. This is to say fermented baobab seed meal rather has potential of reducing methane production in ruminant feed. The action of fermented baobab seed meal on methane production should be investigated further especially if it has any effect on ciliate protozoa which has a symbiotic relationship with Methanogens which are responsible for 9.25 % of methanogenesis in the rumen (16). Methane to gas volume (CH_4/GV) production significantly ($p<0.05$) decreased across the treatments. While the highest volume was observed in the control (75.33 %), the least volume was found in palm-wine fermented baobab seed meal group (68.42 %). The value of CH4/GV obtained in the water fermented baobab seed meal group (70.20 %) was not significantly different from the control group. This implies that the treatment methods adopted had effect on the amount of total gas produced that was methane. Inclusion of fermented baobab seed meal did not influence pH, short chain fatty acids (SCFA), *in vitro* dry matter digestibility (IDMD) and other fermentation kinetics measured.

CONCLUSIONS AND APPLICATIONS

From this study, it can be concluded that

1. The use of fermented baobab seed meal in diet of ruminant will not aggravate the production of methane from enteric fermentation.

2. Fermentation of baobab seed meal in palm wine for 24 hrs before incorporation in the diet of ruminant will reduce the amount of total gas produced that is methane (CH_4/GV ratio).

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Growth Performance and Nutrient Digestibility of Red Sokoto Bucks Fed Varying Inclusion Levels of Sun-Dried Mango (*Mangifera Indica*) Fruit Waste Meals in Rice Offal Based Diets

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Abstract: This study evaluated the effects of different inclusion level of sun-dried mango fruit waste meals (SMFWM) in rice offal-based diets on intake, growth performance and digestibility of Red Sokoto bucks. Four growing Red Sokoto bucks with average body weight of 11kg and age between 8-10 months old were randomly allotted into four dietary treatments with each animal serving as replicate in a 4x4 Latin Square Design with 0 (control), 10, 20 and 30% inclusion levels of SMFWM. The results showed that Final weight of 0%, 10% and 20% SMFWM were significantly ($P<0.05$) higher than 30% inclusion levels. Weight gain (0.75kg/head) and Average weight gain (53.57g/head/day) were numerically higher in bucks fed diet containing 20% SMFWM compared to bucks on 0% and 10% dietary treatments. Dietary inclusion of 0 and 20% SMFWM both recorded significantly ($P<0.05$) higher concentrate intake. The 20% inclusion of SMFWM had numerically lower FCR and cost/kg gain of 6.28 and N368.80 respectively, while the dietary treatment with 0% SMFWM had the poorest feed conversion ratio (7.28). The dry matter digestibility of 10% SMFWM (89.45%) was significantly higher ($P<0.05$) than 0% and 30% dietary inclusion levels. The control had the least (70.56%) significant coefficient of digestibility for Ether extract while the 10% dietary inclusion levels of SMFWM was statistically ($P<0.05$) low for NFE than other treatments. However, there was no significant ($P>0.05$) differences observed in crude protein and crude fibre level. It was therefore concluded that SMFWM can be included up to 20% level in rice offal-based diet of growing Red Sokoto bucks for improved weight gain, better FCR and also cost effective.

Keywords: Mango fruits, Feed intake, Digestibility, Growth, Red Sokoto bucks.

INTRODUCTION

Many more non-conventional feed resources are yet to be incorporated into the feed bank for low cost animal production. This is because most of them could be gotten free or at very low costs [1]. Agro-industrial by-products such as mango fruit waste [2], mango fruit pulp [3] mango fruit peel and mango seed kernel [5, 6, 7] have been identified as feed resources.

Mango *(Mangifera indica*) fruit is one of the most popular, nutritionally rich fruits with unique flavor, fragrance, taste, and health promoting qualities. These qualities make it a common ingredient in new functional foods. However, the fruit could be considered unfit for human consumption due to bruises, infections, improper handling, and activities of animals (especially birds) on the fruit, and as such rejected. These rejected fruits, also known as cull fruits [12] litter the ground during its season, constituting environmental hazard. Emphasis on the processing of mango fruit has been to generate products for human consumption.

According to [2], dried mango waste included in finishing pig diets at 10% had no deleterious effect on feed conversion ratio, animal performance and was cost effective. Although the seed and peel of mango fruits have been utilized in animal feeding, a large quantity of the pulp and peel of rejected fruits wastes are thrown away in Nigeria. However, considering the high nutrients (energy, vitamin A, vitamin C and polyphenols) value of mango fruits [4], these rejected fruits could serve as a feed resource in animal feeding, mainly as a source of energy because of its high energy - 100 kcal/oz (3527.34 kcal/kg) DM [12], and at the same time check its negative impact on the environment. Mango can be found in several locations in Nigeria in its improved and native forms but little is known about its potential for feeding livestock. This study therefore evaluated the feed intake, growth performance nutrient digestibility of red Sokoto buck fed diets containing different inclusion levels of SMFWM.

MATERIALS AND METHODS

Study Site and Sourcing of mango fruits wastes and diet formulation: The study was conducted at the Small Ruminant unit of the Department of Animal Science Teaching and Research Farm, Ahmadu Bello University, Zaria. The mango fruits wastes were collected without reference to varieties from mango tree

stand within Kaduna town during its season, between April and May. The composite comprising improve and local mango varieties were cleaned, cut open and sun dried for seven days after which they were stored in a polythene sacks pending diet formulation. Before the composite mango fruits wastes were incorporated into the diets, it was milled using a hammer mill to obtain SMFWM. Other feedstuffs were purchased from a reputable feed miller. Four diets were formulated with SMFWM at 0% 10%, 20%, and 30% inclusion levels.

Experimental setup: Four healthy growing Red Sokoto bucks of about 8 to 10 months old (9–14kg) were used for the experiment. The animals were randomly allotted into four dietary treatments with every animal serving as replicate of the dietary treatment in a 4x4 Latin square design.

The experimental animals were housed in individual metabolic crate and treated against endo and ecto parasites using Ivomec according to the manufacturer recommendation, after which the animals were placed on experimental diet and allow for 14 days adjustment period during which they were fed with the dietary treatments before the commencement of the experiment. At the commencement of the experiment, the animal's body weights were taken using a spring balance for three consecutive times and the average value recorded. After balancing for weight, they were fed the concentrate diets at 2% of live weight daily at 8:00 am in a single dose and the left over recorded while the cowpea husks were provided at 1% body weight. Each phase of the feeding trial consists of two weeks followed by another 14days adjustment period. At the end of each phase of the trial, the body weight changes and faecal samples were taken and recorded. Cleaned drinking water was also provided daily *ad- libittum*. Daily faecal outputs collected during this period were weighed, sub sampled and sun dried for 48hrs for dry matter determination before changing to the next phase.

Sample analysis: The proximate analysis of samples of SMFWM, experimental diets and faeces was conducted according to standard methods [14]. The residual dry matter of the samples was determined by oven-drying at 60^{o}C for 48h. Nitrogen was determined by the micro Kjeldahl method with Tecator Product apparatus (Kjeltec^{TM}2100), while crude protein was calculated by multiplying N×6.25. The Soxhlet extraction procedure was used for determination of crude fat (ether extract) using electromantle ME. The ash was measured by combustion of the dried material in a muffle furnace at 600^{o}C for 8h. Crude fibre, sequential neutral detergent fibre (NDF) and acid detergent fibre (ADF) were determined using Tecator Line (FT 122 Fibertec^{TM}) according to the method described by [15]. The concentration of phytic acid was determined according to [16]. A standard curve of ferric nitrate was plotted. Phytate phosphorus was calculated from the standard curve assuming a 4:6 Fe to P molar ratio. The concentration of total tannins present was determined colorimetrically as described in [14], whereby tannic acid was used as a reference standard. The total oxalates concentration was determined by calcium oxalate precipitation (titrimetric method) of [18]; the method involved titration of acidic aqueous extracts of the sample with a standard solution of potassium permanganate. The content of metabolisable energy (ME) in each diet was determined using the equation of [13].

ME (Kcal/kg DM) = 37 × %CP + 81.8 × %EE +35 × %NFE

All data collected during the experiment were subjected to statistical analysis using the general linear models (GLM) procedure of SAS version 9.13 [17] according to a completely randomized model. Significance was declared at $P<0.05$. Significantly different means were compared using Duncan multiple range test [19].

RESULTS AND DISCUSSIONS

Table 1 Chemical composition of experimental diets and test material.

Parameters (%)	(0%)	(10%)	(20%)	(30%)	SMFWM	CPHK
Dry matter	87.33	86.77	86.47	86.45	92.65	89.92
Crde protein	11.01	10.68	10.56	10.08	6.56	12.97
Crude fibre	21.64	24.12	25.67	25.35	4.89	33.40
Ether extract	4.15	4.20	4.51	4.09	2.04	5.65
Ash	10.74	10.79	8.26	10.68	7.37	7.14
Nitrogen free extract	52.46	50.21	51.00	49.80	72.76	53.09
Acid detergent fibre	39.10	37.98	39.50	38.88	29.88	29.44
Neutral detergent fibre	48.76	46.99	49.80	40.08	58.40	62.58

Lignins	12.14	15.03	10.70	17.04	11.72	21.67
Hemicellulose	40.40	42.17	42.14	50.10	49.59	37.28
Tannin	-	-	-	-	3.40	-
Phytate	-	-	-	-	0.09	-

SMFWM=Sun Dried Mango Fruit Wastes Meal

Table 2 Performance of Red Sokoto bucks fed varying inclusion levels of sun-dried mango fruit waste meals in rice offal-based diets

	Inclusion levels of SMFWM				
Parameters	(0%)	(10%)	(20%)	(30%)	SEM
Initial weight (kg/head)	11.38	11.38	10.88	10.38	0.38
Final weight (kg/head)	12.00^{a}	11.93^{a}	11.63^{a}	10.60^{b}	0.40
Weight gain (kg/head)	0.63^{a}	0.55^{ab}	0.75^{a}	0.38^{b}	0.10
Average weight gain (g/head/day)	44.64^{ab}	39.29^{bc}	53.57^{a}	27.15^{c}	6.18
Total feed intake (g/head)	4577.50^{a}	3522.50^{c}	4091.30^{ab}	3660.00^{bc}	255.60
Average feed Intake (g/head/day)	326.97^{a}	251.61^{c}	291.99^{b}	261.43^{c}	18.28
Concentrate Intake (g/head/day)	220.54^{a}	163.31^{b}	207.14^{a}	172.86^{c}	12.65
G/Haulms Intake (g/head/day)	106.43	88.31	98.84	88.57	11.67
Feed conversion ratio	7.28	6.44	6.28	6.76	1.87
Feed cost N/kg gain	535.13	434.27	386.80	535.99	100.37

SMFWM= Sun Dried Mango Fruit Wastes Meal

Table 3 Nutrient digestibility of SMFWM in rice offal based diets. Fed to Red Sokoto bucks.

	Inclusion levels of MFW				
Parameters (%)	0%	10%	20%	30%	SEM
Dry Matter	82.25^{b}	89.45^{a}	86.15^{ab}	81.15^{b}	2.98
Crude Protein	72.02	73.76	73.22	71.55	3.11
Crude Fibre	82.12	81.34	81.28	81.92	0.62
Ether Extract	70.56^{c}	80.11^{ab}	84.61^{a}	77.25^{b}	3.04
Ash	73.25^{a}	67.58^{b}	72.09^{a}	70.05^{ab}	1.99
Nitrogen Free Extract	69.52^{a}	68.56^{c}	69.52^{a}	68.68^{b}	0.41

SMFWM= Sun Dried Mango Fruit Wastes Meal

Chemical Composition of Mango fruits wastes and Experimental Diets: The proximate composition of the experimental diets and mango fruits wastes are presented in table 1. The crude protein contents of mango fruits waste in this study was 6.56% which is within the range of values of crude protein (4.6 to 9.1%) of mango fruit peel reported by [8]. It was slightly higher than the crude protein of<5% reported by [10]. [9] reported the proximate of mango fruit pulp alone as 4.2% CP, 6.9% crude fibre, 2.4% EE, and 83.3% NFE. The crude fiber, EE and NFE obtained in this study were slightly lower than that reported by [9]. [10] reported that mango fruit composition varies greatly. It may therefore be normal to have differences among different reports. It is also likely that the factors making the mango fruits to be rejected by humans such as bruises, infections, premature ripping and or premature fallen from the tree etc contribute to variation in the protein contents. It could also be due to varietal differences. The ADF, NDF, Hemicellulose and Lignin obtained from the study were 29.88%, 58.40%, 49.59% and 11.72% respectively while the tannin and phytate levels were recorded to be 3.40% and 0.09% respectively.

Growth Performance of Red Sokoto Bucks Fed SMFWM in Rice offal-based Diets: Table 2 shows the effects of inclusion levels on growth performance of Red Sokoto bucks fed SMFWM in rice offal based diets. The weight gain and feed intake obtained in this study were significantly ($P<0.05$) higher for 0%, and 20% and numerically higher for 10% inclusions of SMFWM than for the dietary inclusion level of 30%. The 20% SMFWM inclusion level had statistically ($P<0.05$) lower feed cost per kg gain and FCR while treatment with 30% inclusion level had the highest Feed cost per/kg gain. Feed cost/kg diets reduced as the inclusion level of mango fruit waste increased implying some cost reduction on the feeds. [4] reported an improvement in chemical composition and higher feed intake for mango peels and kernels by sheep. The weight gain obtained for 20% inclusion level (53.57g/head/day)as reported in this study is slightly higher than the

50g/head/day observed for sheep by [4].The improved weight gain up to 20% inclusions of SMFWM may be attributed to the better digestion of the diet. The drops in voluntary intake and weight gain of bucks fed 30% SMFWM was due to reduction in the dietary quality which may be linked to antinutrients in the SMFWM as earlier observed by [11] who stated that mango kernels were fairly rich in tannin, oxalates, cyanogenic glycosides and trypsin inhibitors which could progressively lead to reduced growth rates and less efficient feed digestion and utilization as a major component in the diets if fed unprocessed.

Nutrient digestibility of Red Sokoto bucks fed SMFWM in rice offal base diets: Table 3shows the effect of inclusion levels on nutrient digestibility of Red Sokoto bucks fed SMFWM in rice offal based diets. The highest dry matter (DM) digestibility of 89.45% was observed in 10% which was statistically similar to 86.15% in 20% inclusion, but significantly ($P<0.05$) higher compared to diet containing 0% and 30%. These DM values were above the range of 63.25-74.15% reported by [12]. The dietary inclusion level of 10% and 20% SMFWM was observed to have significantly ($P<0.05$) higher ether extract digestibilty with 0% inclusion level having statistically lowest value. The values for Ash and NFE as observed in this study were statistically similar for 0%, 20% and 30% dietary inclusion levels of SMFWM while 10% recorded the least value. There was no significant ($P>0.05$) differences observed in Crude protein and Crude fibre.

CONCLUSION

It could be concluded that processed SMFWM hold potential for feeding Red Sokoto bucks as an energy source. Therefore, SMFWM can be included up to 20% in the diets of growing Red Sokoto buck for improved weight gain. The use of this non-conventional feed ingredient of no human value had led to lower production cost and more revenue will be accrued to the farmers thus encouraging them to produce more and ultimately making more animal proteins to the populace.

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Performances and Haematological Parameters of West African Dwarf Goats Fed Diets Containing Varying Levels of Fermented Malted Sorghum Sprout

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Abstract: A twelve weeks trial was conducted to investigate the effects of feeding different levels (0%, 25% and 50%) of fermented sorghum sprout (FMSP), using Guinea grass (*Panicum maximum*) as basal diet, on the performance and haematological parameters of West African Dwarf (WAD) goats. A total of twelve (12) WAD goats were randomly assigned to three (3) dietary treatments consisting of four replicates in a completely randomized design. Results obtained showed that there were no significant ($p>0.05$) difference in all the growth parameters observed. It was observed that forage Dry Matter Intake (g/day) and Total Dry Matter Intake (g/day) decreased as the inclusion levels of fermented malted sorghum sprout increased across the dietary treatment. Although there was no significant difference but animal on T_3 had the lowest (9.48) feed conversion ratio followed by the T_1 (10.74) and T_2 (11.13) respectively. There were no significant differences ($p>0.05$) in all the haematological parameters observed expect the monocytes, eosinophils and Mean Corpuscular Haemoglobin contraction (MCHC) in all the treatments. It was observed as FMSP increased, eosinophil values decreased across the dietary treatment. It can be concluded, fermented malted sorghum sprout can be included at 25% in the diets of West African Dwarf goats without any adverse effect on their performance characteristics and haematological parameters.

Keynote: Sorghum Sprout, Goats, and haemtological.

INTRODUCTION

In most developing countries, the livestock industry is having difficulty in supplying the much needed animal protein to the growing populace and this has largely been due to the high cost of livestock feeds. Shortage of the conventional feedstuffs like maize and soybeans (which has led to the high cost of feeds for livestock) is associated with the competition between man and livestock for these vital feed sources (1;2). Current research efforts in most developing countries are therefore aimed at identifying potential feed sources that has little or no competition demand by humans. Such could be cheap and readily available for livestocks rations as the competition between man and livestock will reduce drastically. Some of such potential feed materials that are being investigated include by-product from sorghum breweries processing industry and

wastes. Malted sorghum is a by-product of sorghum malting. The separated roots and shoots which are left after malt extraction from the young germinating sorghum seedlings are collectively called sorghum sprout (3). Haematological parameters are related to the blood and blood-forming organs. The haematological and lipid serum-examination is among the methods which may contribute to the detection of some changes in health status, which may not be apparent during physical examination but which affect the fitness of the animal (4). There is need to investigate the influence of fermented Malted Sorghum Sprout based diet on the growth performance and haematological indices of West African Dwarf Goats.

MATERIALS AND METHODS

Experimental site and duration: The experiment was carried out at the Teaching and Research farm of Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan and it lasted for a period of twelve weeks.

Source and Processing of the test Ingredient: Malted Sorghum Sprout (MSP) used in this study was the brown type as against the white one reported to be low in tannin (5). The MSP was purchased in its dried form from Life care ventures limited, Sango Otta, Ogun State. It was then fermented naturally. Fermentation involved the use of water and polythene bag; water was mixed with the dried malted sorghum sprout at a ratio of 2:1 so that the entire sprout was moistened. The mixture was then transferred into an air-tight nylon and fermented under room temperature for 96 hours (4 days). Thereafter, it was spread on concrete floor for sun drying (6).The fermented MSP was stored in a dry place for further analysis.

Experimental animals, diet and design*:* A total of twelve WAD goats were obtained from Olorunda village in Ibadan, Oyo state**.** Experimental animals were randomly allotted into three dietary treatments in a completely randomized design. The fermented MSP was later incorporated into three dietary treatments at varying levels of 0%, 25% and 50% respectively to formulate three experimental diets. Fresh cool clean water was also made available throughout the experiment. After the adaptation, the animals were balanced on weight equalization into three dietary treatments.

Table 1: Chemical composition of experimental concentrate diet containing varying levels of fermented malted sorghum sprout

Parameters (%)	**FMSP Inclusion Levels**		
	T_1 (0%)	**T_2(25%)**	**T_3 (50%)**
Dry Matter	91.04	90.96	91.02
Crude Protein	15.92	17.06	17.21
Ether Extract	3.66	3.90	4.05
Ash	8.91	9.19	9.32
Nitrogen Free Extract	42.19	44.40	44.60
Neutral Detergent Fibre	25.70	29.66	29.80
Acid Detergent Fibre	7.91	8.19	8.32
Acid Detergent Lignin	9.28	11.11	11.16
Cellulose	16.42	18.55	18.64
Hemi-cellulose	16.49	14.74	14.80

Data Collection

Blood Samples*:* Blood samples of approximately 3ml were collected at the end of the experiment from the three (3) randomly selected experimental goats per treatment via the jugular vein using hypodermic needle and syringe. Blood sample collected was released into the sample bottles containing Ethyl Diamine tetra Acetic Acid (EDTA) as anticoagulant and the bottles were gently shaken to ensure proper mixing of the blood with EDTA to prevent coagulation and these samples were then analyzed for packed cell volume (PCV), haemoglobin (Hb) concentration, red blood cells (RBC), and white blood cells (WBC) from EDTA bottle.

Statistical analysis: Data obtained were subjected to one-way analysis of variance (ANOVA) using (7). Significant means were separated using the Duncan multiple range test of the same software.

RESULTS AND DISCUSSION

Indicated in Table 2 is the performance characteristic of West African Dwarf goat fed diet containing varying level of fermented malted sorghum sprout. There were no significant ($p>0.05$) difference in all the parameters observed. The final body weight gain (FBW) values observed in this study increased and later decreased as the inclusion levels of FMSP increased across the dietary treatment. This could probably due to the presence of some residual toxic components in FMSP that could have acted as anti-nutritional factors and then interfered with nutrient utilization and therefore influenced the final body weight (8). The higher Body Weight gain observed in goats on diet T_1 and T_3 compared with T_2 was an indication of nutrient intake from the diets that they were well utilized consequently improved total body weight gain (TBWG). This corroborate with the earlier reports of (9) that good level of diets supplementation will leads to better utilization of the diets by goats. Daily weight gain (DWG) followed a similar pattern of variation as observed in TBWG and it ranged from 24.82 to 26.40g/day. Animals on T_3 had the lowest values in TDMI (229.11) and FCR (9.48). The efficiency at which goats convert feeds for body weight in the present study compared unfavourably with the previous study of (10) when West African dwarf goats of similar body weights were fed shed leaves-based diets.

Table 2: Performance characteristics of West African Dwarf goat fed diet containing varying levels of fermented malted sorghum sprout

Parameters (%)	FMSP Inclusion Levels			SEM ±
	T_1 (0%)	T_2(25%)	T_3 (50%)	
Initial Weight (Kg)	5.61	5.79	5.67	0.19
Final weight (Kg)	7.83	7.87	7.79	0.24
Total weight gain (Kg)	2.22	2.08	2.12	0.14
Average daily Weight gain (g/day)	26.40	24.82	25.24	1.70
Metabolic Weight gain (g/day $W^{0.75}$)	11.63	11.03	11.21	0.57
Concentrate DMI (g/day)	134.05	122.47	136.42	5.13
Forage DMI (g/day)	146.54	130.39	92.69	10.95
Total DMI (g/day)	280.59	252.87	229.11	10.82
FCR	10.74	11.13	9.48	0.80

FMSP: Fermented Malted Sorghum Sprout, DMI: Dry matter intake, FCR: Feed conversion ratio, SEM: Standard error of mean

Haematological parameters of West African dwarf goat fed diet containing varying levels of fermented malted sorghum sprout is presented in Table 3. There were no significant ($p>0.05$) difference except Monocytes, Eosinophils and MCHC. The Red blood cell counts (9.10 to $10.53x10^{12}$/L) reported in this study were within the range (9.25-$10.85x10^{12}$/L) of values reported by (11), The red blood cell (RBC) counts values increased across the treatment as the inclusion of fermented malted sorghum sprout increased and it falls within the normal range reported for healthy goats (12). This suggested that fermented malted sorghum sprout may not have had any negative effect on the haematology of goats. The white blood cell did not significantly ($p>0.05$) differ between animal on diet T_1 (2.00) and T_2 (2.04) but T_3 (3.56) was significantly ($p>0.05$) higher than T_1 and T_2 respectively. The white blood cell counts values increased across the treatment as the inclusion of fermented malted sorghum sprout increased across the treatment. The lower values for white blood cell concentration might be indicative of possible stress and anaemic conditions in the goats as earlier reported by (13). The range of values of MCH (29.5 to 37.21 g/dm), MCV (9.73 to 11.59 g/dm), MCH (30.51 to 34.54g/dm) were consistence with the range of values for sahel goats earlier reported (14).

Table 3: Haematological Parameters of West African Dwarf goat fed diet containing varying levels of fermented malted sorghum sprout

Parameters (%)	FMSP Inclusion Levels			SEM ±
	T_1 (0%)	T_2 (25%)	T_3 (50%)	
Parked Cell Volume (%)	26.00	31.67	24.67	1.47
Haemoglobin (g/dl)	8.67	10.67	8.17	0.53
Red blood cell (×1012/L)	9.10	10.26	10.53	0.26
White blood cell (×109/L)	2.00	2.04	3.56	1.16
Lymphocyte (%)	75.00	71.00	70.67	3.50
Neutrophils (%)	33.33	30.50	36.50	1.48
Monocyte (%)	0.50^{b}	3.00^{a}	3.00^{a}	0.43
Eosinophils (%)	3.80^{ab}	2.00^{ab}	1.00^{b}	1.50
Mean cell volume	9.73	9.32	11.59	0.68
Mean Cell Haemoglobin (g/dm)	9.57	9.41	23.60	0.68
Mean cell haemoglobin concentration	33.32^{b}	33.68^{a}	33.11^{b}	0.14

^{a,b,c} means in the same row with different superscripts are significantly different ($p<0.05$)

CONCLUSION

It can be concluded that fermented malted sorghum sprout can be included up to 25% to the concentrate diet of West African Dwarf goats without any adverse effect on their performance characteristics and haematological parameters.

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Nutritional potential of composite diets comprising of Rumen waste, Poultry waste and Cassava peels, using *in vitro* gas production technique

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Abstract: Rumen waste, poultry waste and cassava peels are sources of environmental pollutions. This study was carried out to investigate the nutritive value of composite diets comprising of rumen waste (RW), poultry waste (PW) and cassava peels (CP) using *in vitro* gas production technique. Four experimental diets were formulated in which diet 1 was a standard (control); diets 2, 3 and 4 contained the three wastes in varied proportions of 5%, 15%, and 25% respectively. These diets (*200mg each*) were incubated at 39^0C in a 100ml syringes containing a buffered solution of rumen fluid for 24 hours. Gas productions were recorded. Methane production, Dry matter digestibility (DMD), Short Chain Fatty Acids (SCFA) production, Organic matter digestibility (OMD) and Metabolizable energy (ME) production were determined. Samples of the diets were collected and stored for chemical analysis. The result showed that diets 2 and 3 have the highest values for total gas production (31.00 ml/200 mg DM and 28.50ml/200mg DM respectively), DMD (4.82% and 31.11% respectively), OMD (69.93% and 70.87% respectively), SCFA (0.68 Mmol and 0.62 Mmol respectively) and ME (6.87 MJ/Kg DM and 7.28 MJ/Kg DM respectively). An Indication that diets 2 and 3 has higher nutritive value and better potential as feed for ruminant animals.

KEY WORDS: Nutritional value, agricultural waste, *in vitro* technique

INTRODUCTION

Production of animal feed from agricultural waste which is available in quite reasonable amounts is one of the alternatives that make use of inexpensive local materials and at the same time help to dispose of these materials in an economical and environment friendly manner (Oman, 2010). When wet, these wastes constitute breeding ground for microbes and maggots, thereby posing an environmental health hazard to people living in such environment. This study was carried out to investigate the nutritional value of composite diets containing different proportions of rumen wastes, poultry droppings and cassava peels using *in vitro* gas technique.

MATERIALS AND METHOD

The experiment was carried out at the Small Ruminant Unit of the University of Benin Farm Project. Rumen contents, poultry waste and cassava peels were collected and dried on concrete slabs until it was gritty to touch with moisture content of about 10%, after which they were milled and bagged separately.

Four (4) feed types were formulated with mixtures of dried rumen contents, poultry wastes and cassava peels at 0%, 5%, 15% and 25% inclusion levels respectively. About 200mg of each experimental diet formulated were milled and weighed into incubation bags, sealed and put into 100ml calibrated syringes containing 30ml of rumen liquor and buffer. *In vitro* incubation was carried out for 24 hours and gas production recorded at 3hours intervals (i.e. 3, 6, 9, 12, 15, 18, 21 and 24 hours). Dry matter digestibility was calculated using the following formula:

$$\% \text{ DMD} = \frac{\text{Wt. of sample before incubation} - \text{Wt. of sample after incubation}}{\text{Wt. of sample before incubation}} \times \frac{100}{1}$$

Metabolizable energy, Short chain fatty acid and organic matter digestibility (OMD %) were estimated using the equation established by Menke and Steingass (1988) and Getachew *et al.,* (1999) as stated below.

SCFA = 0.0239 GV – 0.0601; OMD % = 14.88 + 0.88 GV + 0.45CP + 0.651XA;

ME = 2.20 + 0.136 GV + 0.057 CP + 0.00029 CF; Where, GV = net gas production (ml/200 mg DM) at 24 hour incubation time,CP = crude protein sample at 24 hour incubation time; XA = ash of the incubated sample; CF = Crude Fibre

Samples were weighed and oven dried at 65^0C for a period of 24 hours to a constant weight for determination of dry matter and proximate analysis (AOAC, 2000). Data obtained were analysed using statistical analytical

system software (SAS, 2000) and variations among treatment means that are significant were computed using Duncan Multiple Range Test (1955).

RESULTS AND DISCUSSION

The results from Table 4 showed that the composite diets comprising of Rumen Waste, Poultry Waste and Cassava Peels, at varied proportions of 5%, 15% and 25% respectively, had significant effect on gas production during *in vitro* gas production study. It was observed that Diet 2 and 3 had the highest values of gas production (31.00 ml/200 mg DM and 28.50ml/200mg DM respectively), dry matter digestibility (4.82% and 31.11% respectively), organic matter digestibility (69.93% and 70.87% respectively), short chain fatty acid (0.68 Mmol and 0.62 Mmol respectively), metabolizable energy (6.87 MJ/Kg DM and 7.28 MJ/Kg DM respectively) and Net Gas volume (17.00 MJ/Kg DM and 14.15 MJ/Kg DM respectively). While diets 1 (control) and diet 4 had lower values for these parameters and however, there was no significant difference between the values. Methane production was highest in diet 2 (3.50 ml/200 mg DM), though similar to diet 1 (3.17 ml/200 mg DM) and diet 4 (3.00 ml/200 mg DM). Blummel and Becker (1997) asserted that gas production is a function of and a mirror of degradable carbohydrate and therefore, the amount depends on the nature of the carbohydrate. It has been reported that gas production was negatively correlated with less degradable carbohydrate or NDF and positively correlated with starch (De Boever *et al*., 2005). This observation was also corroborated by Njidda and Nassiru (2010) that cell wall content (NDF and ADF) are negatively correlated with gas production at all incubation times and estimated parameters. However, the similarities of gas production characteristics reported in this study for diet 1 and 4 may be partly due to similarities in crude protein, NDF and ADF contents.

Thus, the study indicates that diet 2 and 3 had higher nutritive value and better potential as feed for ruminant animals.

Table 1: Composition of experimental diets (g/kg)

Ingredients	DIET1	DIET 2	DIET 3	DIET 4
Cattle rumen waste	-	5.00	15.00	25.00
Poultry waste	-	15.00	25.00	5.00
Cassava peels	-	25.00	5.00	15.00
Palm kernel meal	23.00	-	-	-
Wheat Offals	18.00	-	-	-
Maize	4.00	-	-	-
Brewer Dried Grains	51.00	51.00	51.00	51.00
Bone meal	1.00	1.00	1.00	1.00
Limestone	1.00	1.00	1.00	1.00
Salt	0.50	0.50	0.50	0.50
Vit./Min Premix	1.50	1.50	1.50	1.50
Total	100.00	100.00	100.00	100.00

Table3: **Chemical composition (%) of experimental diets**

Variables	[1]DIET 1	[2]DIET 2	[3]DIET 3	[4]DIET 4	SEM
DM (%)	88.08a	81.71a	84.33a	79.92a	8.94
OM (%)	70.41a	62.73b	67.04ab	67.06ab	6.05
CP (%)	14.53a	14.00a	21.00b	16.98b	5.12
NDF (%)	51.00a	52.00a	61.00b	51.00a	3.38
ADF (%)	27.00a	40.00b	39.00b	33.00ab	10.12
ASH (%)	29.05	31.27	32.96	32.94	3.06
***ME(MJ/kg DM)**	7.05a	3.91b	5.65c	5.99c	1.27

ME (MJ/Kg DM) = 13.5 — 0.15 X ADF% ÷ 0.14 + CP% — 0.15 × ASH% (MAFF, 1984) DM - Dry Matter, OM - Organic Matter, CP - Crude Protein

NDF - Neutral Detergent Fibre, ADF - Acid detergent Fibre, ME – Metabolizable Energy SEM – Standard error of mean;

a,b,c,d – means along the rows with the same letters are not significantly different [1]Diet 1- Control

[2]Diet 2- 5% Cattle Rumen Content, 15% Poultry Droppings, 25% Cassava Peels [3]Diet 3 - 15% Cattle Rumen Content, 25% Poultry Droppings, and 5% Cassava peels [4] Diet 4 - 25% Cattle Rumen Content, 5% Poultry Droppings, and 15% Cassava Peels

Table 4: *In vitro* gas production parameters of the experimental diets

Variables	[1]DIET 1	[2]DIET 2	[3]DIET 3	[4]DIET 4	SEM
TGV(ml/200mg DM)	23.83a	31.00b	28.50bc	23.67ac	2.23
AVG (ml/200mg DM)	2.98a	3.88b	3.56bc	2.96ac	0.74
Methane(ml/200mg DM)	3.17ab	3.50a	2.67b	3.00ab	0.55
DMD (%)	37.1a	40.82b	31.11a	23.59a	7.96
OMD (%)	61.63a	69.93c	70.87bc	64.46a	1.96
SCFA (Mmol)	0.51	0.68	0.62	0.51	0.05
ME (MJ/Kg DM)	3.46a	6.87bc	7.28b	6.39c	0.33
Net GV (ml/200g DM)	9.83a	17.00b	14.5b	9.67a	2.33

DMD – Dry matter digestibility; OMD – Organic matter digestibility; SCFA - Short chain fatty acid; ME – Metabolizable energy; GV - Gas volume; AVG – Average gas volume. a,b,c,d – means along the rows with the same letters are not significantly different

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The Performance of West African Dwarf (WAD) Goats Fed Graded Levels of *Rhizopus oligosporus*-Treated Rice Husk (RoTRH)

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Abstract: A study was carried out to determine the effect of graded levels of *Rhizopus oligosporus*-treated rice husk (RoTRH)on the feed and nutrient intake, body weight gain and nutrient digestibility of WAD goats using thirty-six (36) West African Dwarf (WAD) goats. They were randomly assigned to four (4) treatments of three (3) replicates with three (3) animals per replicate in a Completely Randomized Design Model and fed the experimental diets for a period of eight (8) weeks. Data collected were subjected to analysis of variance using a Completely Randomized Design Model ($p < 0.05$). The findings of the study were that dry matter and nutrient intake, body weight gain and nutrient digestibility of the WAD goats were comparable across the treatments. It was concluded that fungal treatment of rice husk using *R. oligosporus* improved its nutritional value thus making *RoTRH* a valuable feedstuff for ruminant nutrition and thus its use was recommended in the diets of WAD goats.
Keywords: *Rhizopus oligosporus,* goats, nutrient, digestibility

INTRODUCTION

Goats have been reported by Ayoade *et al*. (1993) to constitute about thirty-four million and five hundred thousand (34,500,000) of the small ruminant population in Nigeria. They provide meat, milk, skin and are used as a ready source of cash, means of exchange for labour, ceremonies and ritual sacrifices. The productivity of goats just like any other animal is influenced by its nutrition which is in turn affected by breed, feed and environmental factors. Natural pastures and crop residues available for ruminants during the dry season are usually fibrous and devoid of most essential nutrients including proteins, energy, minerals and vitamins which are required for increased rumen microbial fermentation and improved performance of the host animal. Aina (1996) observed that dietary supplementation generally increases feed intake and live weight gain in ruminants. Maize and other conventional feed ingredients are both expensive and subjects of strong competition between livestock and human population. Large amounts of lignocellulosic by-products are generated through forestry and agricultural practices, paper-pulp industries, timber industries and many agro-industries and they pose an environmental pollution problem. One of such lignocellolosic waste of great importance and produced in abundance in the tropics and sub-tropics where rice is grown is rice (*Oryza sativa*) husk. They contain enough cellulose to make them excellent sources of energy for ruminants but they are poor quality feeds due to low digestibility, poor palatability, low protein content and bulkiness. Therefore, this study was to investigate the performance (dry matter and nutrient intake, body weight gain and nutrient digestibility) of WAD goats fed graded levels of *RoTRH*.

MATERIALS AND METHODS

The study was carried out at the Teaching and Research Farm of the Department of Animal Production, University of Ilorin, Ilorin, kwara State. Feed ingredients used in formulating the diets were obtained from feed millers in Ilorin, Kwara State. Rice husk was collected from rice millers in Minna metropolis, Niger State. It was soaked in water for twenty-four hours after which the excess water was strained using a muslin cloth. The soaked rice husk was then packaged in polythene bags at 1kg per bag ready for autoclaving at 121^0C, 15psi for 30 minutes so as to get rid of any microbes that could be present in the husk. The *Rhizopus oligosporus* which was obtained from the Department of Microbiology, University of Ilorin, Kwara State, Nigeria was sub-cultured on Potato Dextrose Agar (PDA) by transferring the spores aseptically from the cultures to freshly prepared PDA-containing Petri-dishes. The PDA was amended with streptomycin^R to suppress any bacterial growth and later autoclaved at 121^0C, 15psi for 15 minutes to sterilize it. The Petri-dishes were later incubated at ambient temperature for four (4) days to stimulate the fungal growth. The cooled autoclaved rice husk was replicated thrice. Suspension of actively growing mid-log phased culture of *R. oligosporus* was individually adjusted to 5×10^4 spores/ml with distilled water in line with the methods of Sani *et al*. (1992). Twenty (20) ml from the suspension was used to inoculate one (1) kg of cooled autoclaved rice husk in layers in a container, covered and incubated at room temperature for eight (8) days

when the fungus had enveloped the substrate. Growth was terminated by oven-drying at 80^0C for twenty-four hours. Four different diets were formulated for the animals designated as T_1, T_2, T_3 and T_4. T_1 was the control diet with 0 % inclusion of *RoTRH* while T_2, T_3 and T_4 had the palm kernel cake (PKC) fraction replaced with *RoTRH* at 10 %, 20 % and 30 % respectively.

Thirty-six (36) apparently healthy weaned WAD goats of mixed sexes with average weight of 7.12 kg were randomly assigned to four Treatment groups each having nine (9) animals in a Complete Randomized Design (CRD). Prior to their arrival, the pens were washed, disinfected and allowed to dry. On arrival, the animals were given prophylactic treatment and were allowed a pretreatment period of two (2) weeks to enable them acclimatize after which they were fed twice daily; in the morning at 7:30 a. m. and in the evening at 16:00 p. m, with known quantities of the experimental diets and the left-over collected prior to introduction of the next feed. Salt licks and water were provided ad-libitum. The body weights were taken at the start of the experiment and at the end of the experiment which lasted eight (8) weeks. At the end of the eighth (8) week of the experiment, representative goats were taken and subjected to a seven-day digestibility trial in metabolic cages to enable faecal collection. The faecal samples were weighed after which they were packaged, labeled and stored for laboratory analysis. Data collected were subjected to analysis of variance (ANOVA) by means of general linear procedure (GLM) of SAS 9.2 Version 6. Where means were significant, they were separated using Duncan Multiple Range Test of the statistical package SAS 9.2.

RESULTS AND DISCUSSION

The proximate composition and energy values of the experimental diets containing graded levels of *RoTRH* are presented in Table 2. The decline in the crude protein and ether extract contents of the experimental diets with increase in dietary levels of *RoTRH* can be attributed to the variation in these nutrients' contents of the *RoTRH* when compared to that of the palm kernel cake which was substituted for the *RoTRH*. The said nutrients of the rice husk were improved by fungal fermentation with *R. oligosporus* thereby making it meet up with the minimum requirements for ruminant animals. On the contrary, the crude fiber and ash contents of the fungus – treated diets increased with increase in the dietary levels of the *RoTRH*. The crude fiber and Ash contents of the *RoTRH* (21.85 % and 24.09 % respectively) were much higher than the crude fiber and ash values for palm kernel cake (15.93 % and 4.51 % respectively) from this study. Oloche *et al*. (2015) reported an increase in crude fiber content of diets when high fiber-containing sweet orange peel meal was used to replace maize offal. According to Mbata *et al*. (2009), there was a decline in the carbohydrate content of maize-based foods due to the addition of legumes.

The nutrient intake and body weight gain of WAD goats fed diets containing graded levels of *RoTRH* is presented in Table 3. Feed intake according to Ahamefule and Elendu (2010) is affected by palatability, gut fill and retention time in the rumen. The high feed intake suggests that the fungal treatment of the rice husk did not reduce palatability of the diets. The crude protein content of the experimental diets were higher than 7 % requirements for goats, hence its adequacy supported the high feed intake recorded in this study. The degradation of the secondary metabolites could have equally enhanced palatability and by extension the feed intake. However, the feed intake reduced in animals fed T_4 (30 % inclusion of *RoTRH*) diets. The crude protein, ether extract, crude fiber, ash and nitrogen free extract intakes increased with increase nutrient content of the diets. Belewu *et al*. (2010) reported an increase in crude protein intake with increase in dietary crude protein content. The high crude fiber intake with increase in the dietary levels of the *RoTRH* might be due to the increased solubility of the crude fiber fractions hence making it readily absorbable by the system (Yahaya, 2008). Higher protein contents of diets have been reported to positively enhance intake of other nutrients. The weight gain reported for the animals fed dietary levels of *RoTRH* compared favourably with those fed the T_1 (Control) diets. This positive performance could be as a result of the increased amount of protein reaching the small intestine in line with the findings of Belewu *et al*. (2003). The availability of the nutrients above the minimal dietary requirements could be responsible for the high growth performance and weight gain of the experimental animals.

The Dry matter and nutrients digestibility of WAD goats fed diets containing graded levels of *RoTRH* is presented in Table 4. The digestibility of feedstuffs is the major determinant of the quality of the feedstuff. According to Oloche *et al*. (2015), high dry matter digestibility of a feed material is an indication that the feed material did not impact negatively on the rumen microbes nor decrease digestibility. The high dry matter and crude protein digestibilities reported in this study may be attributed to degradation and detoxification of the rice husk prior to inclusion in the experimental diets. Belewu and Yahaya (2008) reported high dry matter and crude protein digestibilities in Red Sokoto Goats which they attributed to the degradation and

detoxification of the shea butter cake with *Aspergillus niger* prior to inclusion in the diet. The high crude fiber digestibility in this study could be due to the availability of soluble carbohydrates for rumen microbes which helped in promoting an efficient and healthy microbial population. This microbial population helped in achieving more efficient and more complete fiber digestion thereby bringing about higher digestibility. (Arigbede *et al*., 2011). However, the low NFE digestibility in animals fed T_4 (30 % inclusion of *RoTRH*) could be due to an increase in the dietary levels of the secondary metabolites with increase in the dietary level of *RoTRH* above 20 %. According to Olajide *et al*. (2009), a decrease in the dry matter and nutrient digestibility with increase in the secondary metabolites in a diet might be as a result of increase in substitution levels of feed ingredients in the diet. Hu et al. (2005) reported that in ruminants, there's a strong link between decreased rumen motility and frequency of bloat due to saponin-rich feeds. According to Nupo *et al*. (2013), tannins are known to be bitter and form high polyphenol complexes with proteins thereby making it unavailable in the diet. The effects of tannins on ruminants varies from beneficial to adverse depending on the nature and amount consumed (Makkar, 2003). The findings in this study suggest that *RoTRH* can serve as a very valuable alternative and cheap feed ingredient for feed production. The encouraging performances by the animals can be attributed to the improvement in the physical and nutritive quality of the rice husk via fermentation with *R. oligosporus* fungus thereby aiding improved utilization of the diets containing the *RoTRH*.

CONCLUSION AND RECOMMENDATION

It can be concluded from this study that the inclusion of *RoTRH* in the diets of goats is an effective means of reducing the level of dependence on and competition for conventional feedstuffs between man and livestock.

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Table 4.1 Composition of Experimental Diets

Ingredients (%)	T_1	T_2	T_3	T_4
Cassava peels	62.00	62.00	62.00	62.00

Palm kernel cake	35.00	25.00	15.00	5.00
RoTRH	0.00[a]	10.00[b]	20.00[c]	30.00[d]
Bone meal	1.00	1.00	1.00	1.00
Salt	1.00	1.00	1.00	1.00
Vitamin/Mineral premix	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00

RoTRH - *Rhizopus oligosporus* – Treated Rice husk
a - Control
b - 10 % *RoTRH*
c - 20 % *RoTRH*
d - 30 % *RoTRH*

Table 2: Proximate Composition and Energy values of Experimental Diets containing Graded levels of *RoTRH*

Parameters (%)	T_1	T_2	T_3	T_4	±SEM	Remarks
Dry matter	91.35[a]	90.72[b]	91.38[a]	90.41[c]	0.13	*
Crude protein	11.37[a]	9.84[b]	9.64[c]	8.09[d]	0.35	*
Crude fiber	23.55[d]	25.15[c]	25.94[b]	26.89[a]	0.37	*
Ether extract	2.79[a]	2.30[c]	2.57[b]	1.58[d]	0.14	*
Ash	10.93[d]	13.53[c]	15.82[a]	14.84[b]	0.55	*
NFE	42.70[a]	39.90[b]	37.41[d]	39.07[c]	0.58	*
NDF	47.84[a]	42.95[b]	39.01[c]	33.28[d]	1.61	*
ADF	36.76[a]	34.79[b]	32.36[c]	30.54[d]	0.72	*
ADL	18.63[b]	18.77[ab]	18.79[ab]	18.99[a]	0.04	*
Hemicelluloses	11.07[a]	8.16[b]	6.65[c]	2.75[d]	0.91	*
Cellulose	18.13[a]	16.02[b]	13.57[c]	11.54[d]	0.76	*
TDN	73.84[a]	61.41[b]	64.69[ab]	63.42[b]	0.08	*

T_1 - Control T_2 - 10 % *RoTRH* T_3 - 20 % *RoTRH* T_4 - 30 % *RoTRH* NFE - Nitrogen Free Extract NDF - Neutral Detergent Fiber ADF - Acid Detergent Fiber ADL - Acid detergent Lignin NS- Not Significant ($p > 0.05$) *- Significant ($p < 0.05$) SEM- Standard Error of Means

Table 3: Nutrient intake and Body Weight Gain of WAD Goats fed diets containing graded levels of *RoTRH*

Parameters intakes (g/animal/day)	T_1	T_2	T_3	T_4	±SEM	Remarks
Dry matter	362.01[a]	355.02[c]	360.00[b]	359.92[b]	1.32	*
Crude protein	41.16[a]	33.76[c]	35.06[b]	29.11[d]	1.30	*
Crude fiber	85.25[d]	89.29[c]	93.38[b]	96.78[a]	1.33	*
Ether extract	10.10[b]	7.56[c]	11.23[a]	4.93[d]	0.73	*
Ash	39.57[d]	48.03[c]	56.95[a]	53.41[b]	1.98	*
NDF	144.50[a]	125.49[b]	117.27[c]	97.92[d]	5.07	*
ADF	111.05[a]	101.65[b]	97.28[c]	89.81[d]	2.35	*
ADL	56.28	54.84	56.49	55.87	0.29	NS
Hemicellulose	33.45[a]	23.84[b]	19.98[c]	8.10[d]	2.77	*
Cellulose	54.77[a]	46.81[b]	40.78[c]	33.93[d]	2.33	*
NFE	154.60[a]	143.43[b]	132.33[c]	141.16[b]	2.43	*
Initial body weight (kg)	7.390	7.220	7.250	7.190	0.03	NS
Final body weight (kg)	8.020[a]	7.910[ab]	8.010[a]	7.840[b]	0.05	*
Body Weight Gain (kg)	0.63[c]	0.69[b]	0.76[a]	0.65[c]	0.02	*

Table 4: Dry Matter and Nutrients Digestibility of WAD Goats Fed Diets Containing Graded Levels of *RoTRH*

Parameters digestibility (%)	T_1	T_2	T_3	T_4	±SEM	Remarks

Dry matter	87.43[a]	74.87[b]	81.51[ab]	81.41[ab]	0.021	*
Crude protein	89.02[a]	76.85[b]	85.11[ab]	83.50[ab]	0.019	*
Crude fiber	85.88[a]	75.71[b]	81.60[ab]	84.04[a]	0.019	*
Ether extract	86.91[a]	73.35[b]	87.03[a]	82.93[ab]	0.022	*
NFE	89.08[a]	77.74[b]	80.96[a]	79.80[b]	0.021	*
NDF	77.21[a]	70.67[b]	72.54[b]	69.67[b]	0.013	*
ADF	75.34[a]	71.78[b]	71.23[b]	73.35[ab]	0.006	*
ADL	69.33[b]	68.27[b]	70.87[b]	74.38[a]	0.015	*
Hemicellulose	73.67	75.33	75.87	76.31	0.009	NS
Cellulose	79.52[a]	76.85[ab]	76.24[ab]	75.97[b]	0.015	*

T_1-Control T_2 - 10 % *RoTRH* T_3 - 20 % *RoTRH* T_4 - 30 % *RoTRH* NFE - Nitrogen Free Extract NDF- Neutral Detergent Fiber ADF- Acid Detergent Fiber ADL- Acid detergent Lignin NS- Not Significant ($p > 0.05$) *-Significant ($p < 0.05$) SEM-Standard Error of Mean

attail Drying Process for Animal Feed

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Abstract: *Typha domingensis* **(**Cattail) contains 80-90% water, and may be fed to animals as forage. It may be advantageous to dry Typha for storage before subsequent use. This study investigated different drying processes. Typha plants were either chopped, split longitudinally, or dried whole, in a forced air oven at 35°C or outdoors at 29-33 °C and 54-67% ambient humidity. Chopped samples were dried for up to 6 days outdoors in pans in open air, in a greenhouse tent made of black plastic, or spread thinly on top of black plastic. Results show that chopped cattail dried outdoors on top of black plastic with a large surface area dried the fastest, and attained 30-40% DM in 15-18 h, and 90% DM by 48 h. Chopped cattail reached 100% DM in 144 h when drying in a forced-air oven at 35 °C. Drying outdoors in a pan was faster than drying in the greenhouse. Whole-plant Typha did not dry beyond about 60% DM over 144 h. Split plants dried to 35% DM by 48 h, and to 90% DM by 120 h. When Typha is to be use for silage it can be chopped and pre-wilt for 15 to 18 h on black plastic. Alternatively, the plant can be dried prior to shredding either split or un-split for 24 to 72 h at 29-33 °C and 54 to 67% humidity to reach 30 to 40% DM. Splitting or chopping made it possible to dry Typha enough to store it as hay.

Keywords: Typha grass; drying processes; animal feed; ensiling and hay

INTRODUCTION

Grass is the cheapest source of food for most livestock, and is the best way to offer them the base of energy, protein, vitamins, and minerals they require. *Typha grass* is a macrophytic plant that occupies much of the wetland areas of Africa. Rivera (2017), reported that Typha grass is an acceptable source of forage, and when it is properly ensiled with addition of urea and molasses, it has an adequate nutritional value to replace nearly 50% of the daily ration of cattle. The plant contains 80-90% water, and high content of ligno-cellulosic fiber. Water content of plants is one of the most critical factors affecting the ensiling processes (AFDA, AFIA and John M. 2005). Silage microbes need water in order to thrive and multiply but if the water content is too high will encourage the growth of unwanted microorganisms. On the other hand, if silage is too dry, there will not be enough moisture to exclude air, and to support sufficient microbial growth to produce the acids which decrease the pH and preserve the crop.

Many authors (Mcallister and Hristove. 2010, Demarquilly et al., 1977, and Thoma et al., 1961) reported silage should be put up at 60 to 70% moisture for best preservation activity. Higher moisture silage will be more prone to nutrients being lost through seepage, particularly protein that has been broken down by microbes in the silage. Therefore, optimum plant dry matter content is needed for good silage processes. Achieving optimum dry matter content (30-40%), in most forage crops is achieved by wilting prior to ensiling. Alternatively, forage crops can be preserved as hay by drying to less than 20% moisture. Therefore, this study investigates different drying methods of Typha grass.

MATERIALS AND METHODS

Sample collections: Typha grass (*Typha domingensis***)** was harvested from a biological pond experimental field at the University of Maryland on July 14, 2018. Pre-bloom plants had dry matter content of 16.4% for leaf and 6.15% for stem (Plate 1).

Plate 1: Harvested Typha

Analytical method

Dry matter content (DM): Dry matter content was established by drying in a Koster™ crop forage tester and weighing with an electronic balance before and after drying. The dry matter content was calculated using equation 1.

$$Dry\ matter\ percentage\ =\ \frac{Final\ weight-Pan}{Initial\ weight-pan}\ \text{x}\ 100\ (1)$$

Experimental Method

Experimental factors and treatment: The experiment evaluated two factors: forage particle size reduction and the drying environment: the forage was either chopped, split longitudinally, or used as a whole plant, and each sample was dried in a forced-air oven at 35 °C, or dried outside in direct sunlight. Chopped forage was also dried in a greenhouse made of black plastic, or spread thinly over black plastic in direct sunlight.

Experimental Set up: An electric shredder was used for chopping the Typha (Plate 2) and samples were distributed to stainless-steel pans (20-by-20 cm and 5 cm depth). Shredded sample was divided into four parts for drying: 1) forced-air oven at 35 °C, 2) direct sunlight, 3) inside a greenhouse made of black plastic; or 4) spread thinly on black plastic in direct sunlight. Chopped forage in the first three treatments was dried in identical pans at about 5 cm depth, but the 4th treatment was spread more thinly. Oven temperature was 35 ˚C for 144 h. Daily maximal outside temperature peaked at 29-33 °C and 54-67% humidity. In addition to chopped forage samples, whole plants and longitudinally split plants were dried either in a forced-air oven or stacked outside (Plate 3). Three plants of each treatment were used.

Samples were weighed daily for 6 days, and moisture content of each plant or sample was determined at the end of the experiment. The moisture content at each day was determined from the daily weights adjusted to the final moisture content by assuming all decreases in weight over time were due to loss of water.

Plate 2: Shredded Typha before drying

Plate 3: Un-shredded Typha

Plate 4: Drying shredded Typha with large surface area on black plastic

RESULT AND DISCUSSION

Effect of drying process on chopped Typha: Typha grass contained more moisture in the stem than the leaf. The initial DM content of leaf was 16.4 % and stem was 6.2 %. Figure 1 shows that chopped sample dried outdoors on top of black plastic with a large surface area was the fastest method, and attained 30-40% DM in 15-18 h and 90% DM by 48 h. This treatment reached 100% DM at 78 h. The greater surface area and lower packing density increase air circulation through materials and increase rate of drying. Also, the black plastic absorbs solar radiation and enhances moisture content evaporation to the atmosphere. This treatment was also lightest in color and smelled fresh, indicating that heat damage from excessive heating is not expected. Chopped sample dried in the forced air oven at 35 °C attained 100% DM in 144 h. Drying outside in a pan was nearly as fast as the oven, and faster than in the greenhouse. See Figure 1.

The density of the chopped sample in the pan (e.g. 5 cm deep) appears to limit the drying rate whether drying in the oven or outside. All chopped samples in the pans reached 20% DM by 60 h, but thereafter the greenhouse sample drying rate slowed compared to the oven or sunlight dried sample. The chopped samples reached 80% DM content by 120 hours, except when drying in a greenhouse. The greenhouse is a tent environment where water content cannot easily escape to outside.

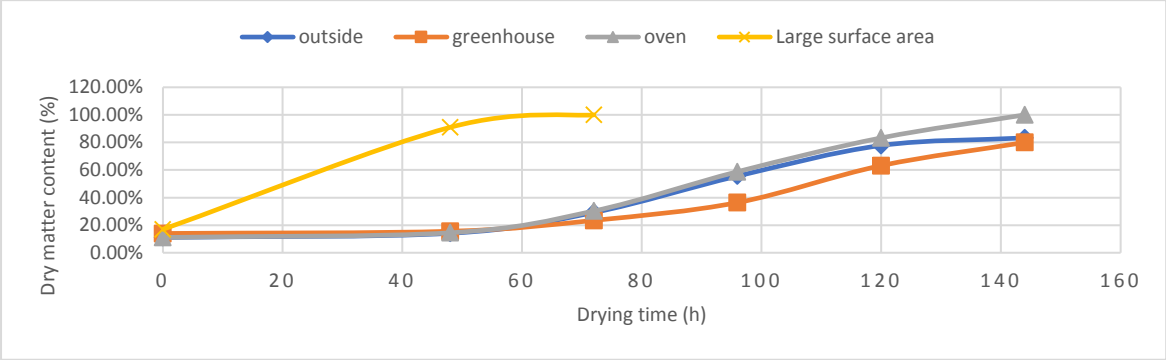

Figure 1: Effect of drying process on dry matter content

Effect of splitting plants on drying process

Split plants dried faster than whole plants both for outdoors (direct sun drying) and oven drying. Whole plant did not dry beyond 60% DM over 144 h either out doors or in the oven. The Typha stem contains many concentric layers of tissue that appear to conserve water. Split plants dried to 35% DM by 48 h and to 90% DM by 120 h in the direct sun. However, with oven drying split plant dried to 40% DM at 55 h and 80% DM at 144 h (Fig. 2 and 3).

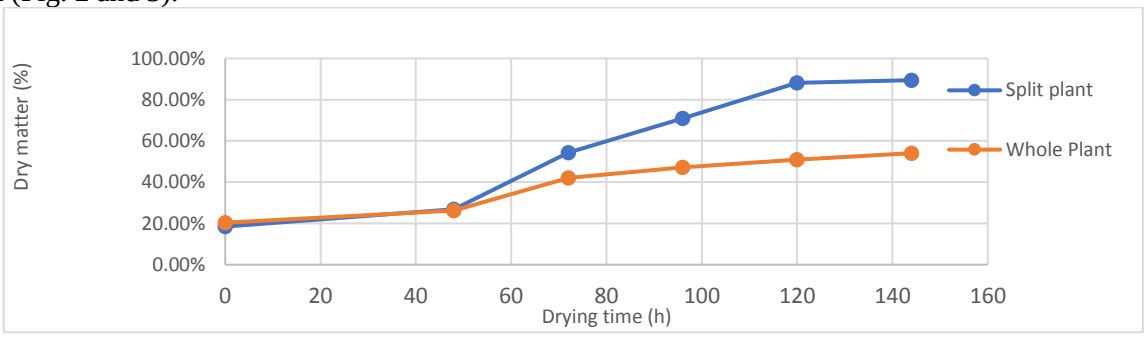

Figure 2: Effect of plant processing on direct sun drying

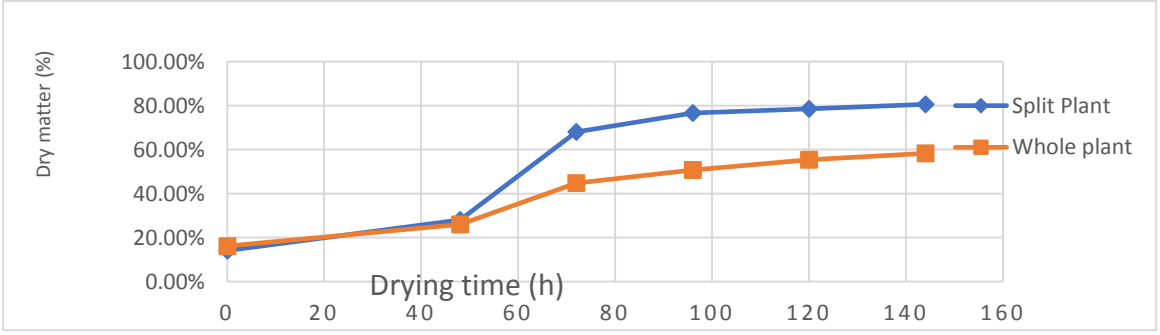

Figure 3: Effect of plant processing on oven drying

Effect of drying environment: Figure 4 shows that both sun drying and oven drying are similar but direct sun drying is faster at 0-48 h while oven drying overtakes it at 48-110 h. These differences may be due to variation of ambient temperature and humidity. Lower humidity and higher temperature increase the rate of drying processes.

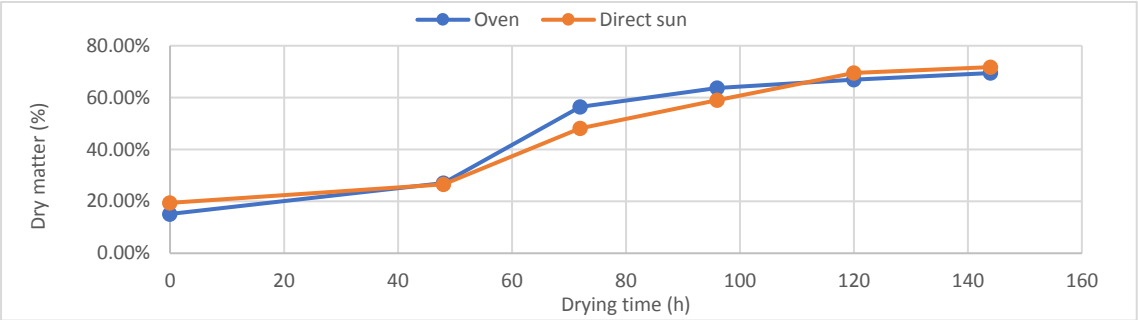

Figure 4: Effect of drying environment on drying process

CONCLUSIONS AND RECOMMENDATIONS

Chopped Typha dried fastest outdoors with large surface area on top of black plastic. When Typha is to be used for silage it can be chopped and pre-wilted for 18 h spread thinly on black plastic, or it can be dried prior to shredding for 24 to 72 h. When Typha is to be used for hay, it can be chopped and dried for 40-120 hours, or split longitudinally and dried in a stack for at least 70 h. Whole plant Typha does not dry adequately to use as hay.

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Composition of Browse Plant Species Utilized by Camels (*Camelus dromedarius*) in Semi-Arid Part of Nigeria

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Abstract: The current study was conducted to evaluate the nutritive value of browse plant species utilised by heifer-camels in a semi arid zone. A Survey of common browse species per unit area was conducted in the zone. The data obtained was analyzed in a one-way analysis of variance. The result revealed a plant composition of predominantly (44.4%) browse trees compared to annual grasses (5.7%). The highest plant density of >150 stands/ha was recorded for *Acacia sieberiana, Centaurea praecox,* and *Ziziphus mauritiana* and the least of <10 stands/ha recorded on *Parkia biglobosa, Adansonia digitata* and *Bauhinia rufescens*. The crude protein level of browse species showed significant difference (P<0.001) and ranged between 19.14% on *Acacia nilotica* to 8.75% on *Dichrostachys cinerea*. The crude fibre and ether extract were highest in *Centaurea praecox* and *Bauhinia rufescens,* respectively. The concentration of tannins and oxalates were significantly (P<0.001) high in *Acacia nilotica.* However, *Tamarindus indica* and *Crotalaria pallida* had the highest concentrations of saponins and phytates, respectively. The lowest values of tannins, saponins, phytates and oxalates were recorded on *Ziziphus spina-christi, Bauhinia rufescens, Centaurea praecox* and *Piliostigma reticulatum,* respectively. It was concluded that the browse plant species in the study area are able to provide the nutrients required by heifer-camel for growth and maintenance. Further studies into the agronomic practices required for cultivation of the browse plant species should be conducted in the study area.

INTRODUCTION

Camels are pseudo ruminants that have one or two humps. Camels are well adapted to dry climates and are classified into Bactrian that has two-humps and Dromedary or Arabian camel that has one hump (11). The life expectancy of camel is between 40 and 50 years. A fully-grown camel stands 1.85m to the shoulder and 2.15m to the hump. The hump rises about 76.20cm out of its body (1). Camels can run at a speed of up to 65km/h in short bursts and can sustain the speed for up to 40km/h (4 and 15). Camels tend to spread over large areas of land and select only a few leaves from each plant during foraging. A feeding behavior which reduces stress on the plant community and competition with other livestock species especially in the arid region (5). Plant species found in arid zones could be categorized into xerophytes which are adapted to aridity and hydrophytes that show virtually no adaptation to the harsh climatic conditions (18).The perennials common to dry areas of West Africa include *Faidherbia albida, Leptadenia hastata, Balanites egyptiaca* and *Acacia tortilis.*

Nutritional deficiency of plants in different environments were due to difference in soil nutrient composition and mineral transmittance from soil to plants which can be affected by environmental conditions. Such environmental conditions include temperature, rainfall, soil pH, soil organic matter and calcium carbonate content (16). Camels like other herbivoures grazing arid rangelands are seasonally challenged with feed and water deficiencies, both in quantity and quality. (7) reported that camels out-performed other species in utilizing nutritionally lower quality diets. However, low quality diet affect camel's feed intake capacity, diet selection and live weight changes in relation to type of roughage offered and concentrate supplementation. The current study was conducted to identify browse plant species utilised by camel and to evaluate their nutritive value.

MATERIALS AND METHODS

Study Area: The experiment was conducted at the faculty of Agriculture Research and training farm, Bayero University, Kano. Kano State lies between longitude 8^0E and 9^0E and latitude 12^0N and 13^0N. The state lies mostly in the Sudan Savanna zone of Nigeria bordering the Guinea Savannah to the South (12). The area is characterized by tropical wet (May- September) and dry (October- April) season (13). The annual rainfall varies from 600 – 1000mm and the temperature ranges between 20^0C and 40^0C (8).

Experimental Procedure: A Survey was conducted to identify common browse species in the study area. Forage selection and behavior were determined by direct observation. The plant species were identified based on the description of (3) and (7). The populations of identified browse species were determined by enumeration per unity area. The leaves/twigs of the identified plant species were sampled for analyses. The dried leaves/twigs samples were analyzed for dry matter, crude protein, ether extract, crude fiber and ash content according to (2). The anti- nutritional factors like saponins were determined according to procedure outlined by (15). Tannins

and Oxalate were determined according to (2) and Phytates were determined according to method designed by (18).

Data obtained were analyzed in a one-way analysis of variance (ANOVA) using Completely Randomized Design. The student t-test was used to compare means between treatments and periods, while the Duncan multiple range test (7) was used to separate the means.

RESULTS AND DISCUSSION

Table 1: Shows identified Browse plants species in the study area.

Family	Scientific Name	Percentage occurance
Trees		44.4
Meliaceae	*Azadirachta indica*	
Balanitaceae	*Balanities aegyptiaca*	
Bombacaceae	*Adansonia digitata*	
Papilonoideae	*Tamarindus Indica*	
Ebenaceae	*Diospyros mespiliformis*	
Mimosaceae	*Acacia nilotica*	
	Faidherbia albida	
	Parkia biglobosa	
Parennial shrubs		38.8
Mimosaceae	*Acacia ataxacantha*	
	Dichrostachys cinerea	
	Acacia sieberiana	
Caesalphinioideae	*Piliostigma reticulatum*	
	Bauhinia rufescens	
Rhamnaceae	*Ziziphus mauritiana*	
	Ziziphus spina-christi	
Perennial herbs		11.1
Asclepidaceae	*Leptadenia hastata*	
Papilonoideae	*Crotalaria pallida*	
Annual grass		5.7
Asteraceae	*Centaurea praecox*	

Table 2 shows the chemical composition of the identified browse species. *Acacia nilotica* had significantly ($P < 0.001$) higher CP content (19.14%) while *Dischrostachys cinecea* had the lowest (8. 75 %). The CF value was significantly ($P < 0.001$) highest in *Centaurea praecox* (34.10%) and lowest on *Ziziphus spina-christi* (4.92%). *Bauhinia rufescens* (12.89%) had statistically ($P < 0.001$) highest ether extract (EE) concentration and the lowest value was recorded on *Acacia ataxacantha* (1.32%). The Ash content was significantly ($P< 0.001$) highest in *Adansonia digitata* (16.03%) and lowest in *Azadirachta indica* (5.46%). The Dry matter (DM) composition was significantly higher ($P < 0.001$) in *Balanites aegyptiaca* (97.73%) and the least value was recorded in *Adansonia digitata* (91.86%).

Table 2: Chemical Composition of Identified Browse Plants.

	Components				
Plant Species	CP	CF	EE	Ash	DM
Acacia ataxacantha	10.39^{gh}	21.11^{b}	1.32^{i}	12.14^{e}	93.54^{l}
Acacia nilotica	19.14^{a}	9.50^{ij}	1.86^{hi}	13.74^{de}	94.48^{j}
Acacia sieberiana	17.50^{bc}	9.60^{ij}	1.76^{hi}	10.71^{hi}	95.37^{d}
Adansonia digitata	16.95^{c}	8.83^{j}	4.24^{c}	16.03^{a}	91.86^{m}
Azadirachta indica	12.97^{f}	10.21^{hi}	1.47^{i}	5.46^{k}	95.00^{g}
Balanites aegyptiaca	16.95^{c}	7.73^{k}	2.26^{gh}	14.18^{cd}	97.73^{a}
Bauhinia rufescens	13.67^{e}	19.30^{c}	12.89^{a}	11.75^{fg}	94.94^{h}

Centaurea praecox	12.57^{f}	34.10^{a}	1.91^{hi}	15.47^{ab}	95.19^{f}
Crotalaria pallida	15.85^{d}	19.30^{c}	2.34^{gh}	13.13^{e}	95.03^{g}
Dichrostachys cinerea	8.75^{i}	19.89^{c}	2.81^{fg}	13.80^{de}	94. 45^{j}
Diospyros mespiliformis	9.29^{i}	10.80^{h}	1.66^{i}	15.80^{ab}	95.68^{c}
Faidherbia albida	9.57^{hi}	18.28^{de}	1.60^{i}	7.03^{j}	95.28^{e}
Leptadenia hastata	9.29^{i}	19.09^{cd}	4.13^{cd}	10.24^{i}	94.19^{k}
Parkia biglobosa	10.93^{g}	17.41^{e}	9.23^{b}	14.90^{bc}	95.38^{d}
Piliostigma reticulatum	12.57^{f}	16.17^{f}	3.35^{ef}	14.03^{cde}	95.29^{e}
Tamarindus Indica	10.93^{g}	10.92^{h}	3.50^{e}	10.82^{ghi}	94.75^{h}
Ziziphus mauritiana	18.04^{d}	15.02^{g}	4.08^{cd}	13.19^{de}	97.33^{b}
Ziziphus spina-christi	15.85^{d}	4.92^{l}	3.08^{ef}	11.61^{fgh}	94.59^{i}

$^{a-l}$Means with different letters are significantly different (P< 0.001) CP = crude protein; CF = Crude Fiber; EE =Ether extract; DM = Dry Matter

Table 3 shows the mean concentration of some anti-nutritional factors in the identified browse plants of the study area. The mean tannin concentration was significantly (P < 0.001) highest in *Acacia nilotica* but lowest in *Ziziphus spina-christi.* The saponins value was statistically (P < 0.001) higher among the browse species but lowest in *Bauhinia rufescens. Adansonia digitata* and *Piliostigma reticulatum. Crotalaria pallida* had significantly (P < 0.001) higher phytates content while *Acacia sieberiana* has the lowest. The oxalates concentration was significantly (P < 0.001) highest in *Acacia nilotica* while *Piliostigma reticulatum* had the lowest.

Table 3: Mean Concentration (mg/100g) of some Anti-nutritional factors in the identified browse plants of the study area.

Plant Species	Tannins	Saponins	Phytates	Oxalates
Acacia ataxacantha	42.00^{cdef}	484.60^{g}	140.33^{d}	323.20^{f}
Acacia nilotica	111.20 ^{a}	786.92^{c}	207.50^{ab}	2128.60^{a}
Acacia sieberiana	57.20^{bcde}	333.20^{j}	42.07^{h}	165.30^{ghi}
Adansonia digitata	44.60^{cdef}	855.32^{b}	187.40^{bc}	913.00^{b}
Azadirachta indica	68.00^{bcd}	394.12^{i}	108.25^{ef}	889.30^{b}
Balanites aegyptiaca	26.00^{ef}	257.60^{l}	206.75^{ab}	153.30^{hi}
Bauhinia rufescens	66.60^{bcde}	228.00^{m}	194.25^{bc}	892.60^{b}
Centaurea praecox	70.60^{bc}	529.80^{f}	40.50^{h}	154.00^{hi}
Crotalaria pallida	48.60^{cdef}	427.20^{h}	226.00^{a}	436.60^{e}
Dichrostachys cinerea	86.60^{ab}	571.80^{e}	138.25^{d}	568.00^{d}
Diospyros mespiliformis	16.60^{f}	283.00^{k}	172.32^{c}	688.00^{c}
Faidherbia albida	34.60^{def}	619.46^{d}	117.6^{de}	325.30^{f}
Leptadenia hastata	108.60^{a}	613.20^{d}	88.50^{fg}	243.30^{g}
Parkia biglobosa	54.00^{bcde}	444.80^{h}	191.50^{bc}	222.00^{gh}
Piliostigma reticulatum	48.00^{cdef}	852.80^{b}	79.32^{g}	118.00^{i}
Tamarindus indica	56.60^{bcde}	1065.00^{a}	89.25^{fg}	164.60^{ghi}
Ziziphus mauritiana	84.60^{ab}	272.40^{kl}	88.75^{fg}	538.60^{d}
Ziziphus spina-christi	15.20^{f}	389.80^{i}	134.83^{d}	424.00^{e}

$^{a-m}$Means with the same letter within a column are not significantly different (P< 0.001)

Moataz (11) in a study conducted at Butana district of Sudan reported that the most important camel browse plants belong to three families of Balanitaceae, Rhamnaceae and Mimosaceae similar to results obtained in the current study. Also, Le Houerou (10) reported that the Sudano-sahelian zone of West Africa was dominated by browse species of mimosaceae family Le Houerouas obtained in the current study.

CONCLUSION/RECOMMENDATION

It was concluded that the browse plant species in the study area are able to provide the nutrients required by heifer-camel for growth and maintenance. Further studies into the agronomic practices required for cultivation of the browse plant species should be conducted in the study area.

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Effects of Phosphorus Fertilizer Rates on Dry Matter Yield of Three Lablab Varieties

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Abstract: A study was conducted in Maiduguri to determine the effects of phosphorus fertilizer rates on dry matter yield of the three of lablab varieties. The treatments consist of factorial combination of four P rates (0, 12, 24, and kg/ha) and three lablab variety (Grif 1246, black ILRI 147 and brown NAPRI 3) laid out in a randomized complete block design (RCBD) replicated 3 times. Plants were harvested at 12 weeks after planting. The net plot area was harvested, measured and converted to herbage yield (t/ha). All data collected were subjected to analysis of variance and where means differed, Duncan Multiple Range test (DMRT) was used to separate them. Dry matter yield was affected ($P<0.05$) by phosphorus rates for 2014 and 2015 with phosphorus rates of 24 and 36kgP/ha giving 27.40 and 29.50t/ha respectively. Brown variety produced highest yield of 28.10t/ha compared to black and white varieties (24.66 and 24.50t/ha) respectively. It was concluded that application of phosphorus fertilizer to white, black and brown lablab varieties at the rate of 36 kg/ha improves dry matter yield.

Keywords: Lablab, Variety, Fertilizer, Phosphorus, Dry matter

BACKGROUND OF STUDY

Lablab purpureus (L) sweet is a fodder legume that combines a great number of qualities that can be used successfully under various conditions. It is palatable; possess the ability to out yield other crops, especially during the dry season and serves as cover crop (1). In Nigeria, *Lablab purpureus* is a recent addition to the forage crop and is grown mostly in research and experimental farms. Despite the importance of lablab in our diets and as feed for livestock, the yield obtained by farmers in Nigeria is low (2) because of the problem of neglecting good cultural practices such as seedbed preparation, correct seed rates, adequate plant spacing, good timing of planting and fertilizer application.

In order to obtain lablab of high quality during the dry season, there is need for adequate supply of water and nutrients (fertilizer) to enhance its growth and be able to provide maximum profit for farmers throughout the year. All plants require phosphorus for growth and development in significantly large quantity. The application of phosphorus in relative quantities therefore, plays a vital role in plant growth (2, 3). This study therefore aims to determine the effects of phosphorus fertilizer rates on dry matter yield of the three of lablab varieties.

MATERIALS AND METHODS

The study was conducted in Maiduguri, the Borno State capital during the 2014 and 2015 raining seasons. Borno State lies between latitude $11^{0}32^{1}$ and $11^{0}41^{1}$ north and longitude $13^{0}20^{1}$ and $13^{0}25^{1}$ east. It is on an elevation of 345m above sea level and located in the semi-arid region of Nigeria. It is characterized by short raining season of 3-4 months (June – September) annual rainfall ranges from 500-600mm. the mean temperature of this region ranges from 39.8 – 40.7^{0}C while during the wet season the temperature drops to 31^{0}C (4).

The land was cleared, ploughed and harrowed to soften the soil for ease of planting and germination and to get a clean seed bed. Ridges were made at 0.75m apart with hoe. The experimental area was divided into plots by an alley of 50 X 50cm between and within rows. Each plot size measured 3 X 4m ($12m^2$). Each consists of 8 rows with 6 plants per row with a total of 48 plants per plot. While the net plot size was $3m^2$. The treatments consist of factorial combination of four P rates (0, 12, 24, and kg/ha) and three lablab variety (Grif 1246, black ILRI 147 and brown NAPRI 3) laid out in a randomized complete block design (RCBD) replicated 3 times.

Two seeds were planted at 50cm intra row spacing. Stands were thinned to one plant per stand at two weeks after planting. About 15kg of N/ha was applied as starter N, while P was as per treatments. Weeding was done manually by hoe at two weeks after sowing. Plants were harvested at 12 weeks after planting that is at the blooming stage. The net plot area was harvested, measured and converted to herbage yield t/ha.

All data collected were subjected to analysis of variance (ANOVA) using the SPSS version 19. Where significantly different among treatments were, indicated, Duncan Multiple Range test (DMRT) was used to separate the means.

RESULTS AND DISCUSSION

Table 1: Effects of phosphorus rates on Dry matter yield (kg/ha)

Phosphorus rates						
Year	0	12	24	36	SEM	LS
2014	23.03[b]	23.10[b]	27.40[a]	29.50[a]	1.68	*
2015	12.10[b]	15.53[a]	14.53[a]	15.26[a]	0.92	*

SEM = Standard error of means, LS = Level of significance and *= Significant (P<0.05)

Table 2: Effect of varieties on dry matter yield (kg/ha)

Varieties					
Years	White	Black	Brown	SEM	LS
2014	24.50	24.66	28.10	1.63	NS
2015	15.10	13.93	14.03	1.94	NS

SEM = Standard error of means, LS = Level of significance

Table 3: Interaction between fertilizer rates (%P) and varieties on dry matter yield (kg/ha)

Fertilizer rates (2014)							Fertilizer rates (2015)					
Varieties	0	12	24	36	SEM	L	0	12	24	36	SEM	LS
White	5.75[a]	6.87[b]	78.[b]	9.07[a]	0.50	*	3.51	4.29[b]	5.63[a]	4.71[b]	0.33	*
Black	7.23[b]	5.70[c]	8.45[a]	8.23[a]	0.50	*	3.72	5.33[a]	3.51[b]	3.90[b]	0.33	*
Brown	7.73[c]	8.38[b]	8.33[b]	9.27[a]	0.50	*	3.47	4.37[b]	3.94[b]	5.06[a]	0.33	*

SEM = Standard error of means, LS = Level of significance and *= Significant (P<0.05).

Mean dry matter yield affected by phosphorus rates for 2014 and 2015 is presented in Table 1. Dry matter yield in this study was affected by phosphorus rates for 2014 and 2015 showed significant (P<0.05) difference respectively. In 2014, highest yield was obtained at phosphorus rates of 24 and 36kgP/ha were 27.40 and 29.50t/ha respectively while 15.53, 14.53 and 15.26t/ha were obtained at 12, 24 and 36kgP/ha respectively during 2015. Highest yield was obtained at 36%p/ha and increased as rates of fertilizer increased. In other words, dry matter yield was better in plots applied fertilizer compared to plots without fertilizer. This agrees with (2) who reported high dry mater yield at 40 and 80kgp/ha. It also agrees with (5) who obtained herbage yield of 46.6 tons/ha when 60kgp/ha was applied to lablab. However, (6) reported that there was no response recorded in white lablab dry matter yield in his first year to fertilizer applied alone or in combination of nitrogen, potassium and phosphorus. The differences recorded in the yield in this study with other works of different authors could be attributed to the levels of soil fertility, climatic zones, seasons and agronomic practices adapted.
Mean dry matter yield as affected by varieties for 2014 and 2015 is presented in Table 2. There was no significant (P>0.05) difference observed in both 2014 and 2015 respectively. However, brown variety produced highest yield of 28.10t/ha compared to black and white varieties (24.66 and 24.50t/ha) respectively in 2014. It's been observed that brown variety was better than black and white. This agrees with (7), who reported that the brown variety is an accession developed for both grain and fodder production. However, dry matter yield obtained in this study is much lower than yield obtained by (6) who reported a value of 6.59 ton/ha for white variety in the semi-arid region of Nigeria. Most research works were done with black variety and was found to be excellent in yield (2). Similarly (8) obtained a dry matter yield of 10kg/ha for black variety in the semi-arid region of Nigeria.
Mean values on interaction between fertilizer rates and varieties on dry matter yield for 2014 and 2015 is presented in Table 3. There was significant (P<0.05) difference in 2014. Highest yield were 9.07, 8.22 and 9.27 kg/ha at 36%P for white, black and brown respectively. All varieties recorded lowest at 0%P with yield values of 5.75, 7.73 and 5.70 kg/ha for white, brown and black respectively, similarly, there was significant (P<0.05) difference in the interaction of (2015). Although values obtained were much more lower than values in 2014, white variety obtained the highest yield at phosphorus rate of 24%P with 5.65kg and 4.71kg/ha at 36%P respectively. However, black variety recorded its highest yield of 5.33 kg/ha at 12%P and brown had its highest

yield at 36%P with 5.06kg/ha. It was observed that the interaction between fertilizer rates and varieties on dry matter was significantly (P<0.05) different. The rate of 36%p/ha produced the highest dry matter yield for all the three varieties of lablab. It has shown clearly that phosphorus application at higher level had a positive effect on the dry matter yield. This agrees with (9) which stated that lablab established, well and it's a fast growing legume that provide fodder in less than 3 months after sowing. Similarly, the significant effect could be due to plant maturity, stem vigour and less competition and proper utilization of available plant nutrients. The interactive effect in this study agree with (10) who reported highest yield of *Stylosanthes guianenes* when he applied high quality of 55kg p/ha at 14 weeks after sowing.

CONCLUSION

It was concluded that application of phosphorus fertilizer to white, black and brown lablab varieties at the rate of 36 kg/ha improves dry matter yield.

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Evaluation of Nutritional Composition of Ensiled Sugarcane Waste with Varying Levels of Rumen Digesta in Adamawa State, Nigeria

Abstract: An experiment was conducted to determine the proximate composition of ensiled sugarcane waste mixed with varying levels of rumen digesta. Four silo pits were dugged of 2m length,1m wide and 3.5m depth for the ensiling process. The sugarcane waste was properly chopped (sugarcane scrapings and tops) in to small pieces and mixed with the rumen digesta at varying levels to form four different dietary treatments; treatment 1(SCW +0kg RD), treatment 2 (SCW +4kg RD), treatment 3 (SCW +8kg RD) and treatment 4 (SCW + 12 kg RD). The inner part of the silo was lined with polythene sheet. The diets were conveyed in to a conventional grain sack, trampled to remove air and put in to silo pit, covered with polythene sheet and the soil was returned to cover the pit. It was ensiled under anaerobic condition for 30 days. At the end of the experiment the temperature of the ensiled material was determined and a sample from each treatment diet was taken for proximate analyses. The result showed a significant (p<0.05) difference between all the treatment groups with T4 having the highest CP of 3.75 and T1 the lowest (2.43), the trend was the same for EE and ash contents. T1 had the highest CF value and lowest in T4, the trend was also the same with DM value for all the treatment diets. Rumen contents should be incorporated in to sugarcane waste at higher levels in order to increase it nutritive value.

Keywords; Rumen, Digesta, Silo, Sugarcane

INTRODUCTION

Nigeria is endowed with a variety of animal protein sources with livestock population of 13.8 million cattle,23 million sheep, goats 34.5 million, 104.3 million poultry and 1.7 million rabbits (FAO, 2006). Despite this, many Nigerians consume less than 10 grams of animal protein as against minimum requirement of 54 g/person/day (FAO, 2007). Increasing the dietary animal protein intake at a reasonable cost using micro-feeds stuff has been part of National Agricultural policy, (Sabayo, *et al.*, 2007). The key to abundant animal production is the availability of cheap and balance feed. Another constraint to production is poor feeding condition either due to lack of knowledge of what to feed, non-availability of the desired feeding material or due to competition between man, animal or industries for conventional feed materials which made feed to account for more than 70% of cost of production (Akinmutimi, 2004). There is therefore the need to intensify research in to alternative feed resources that are affordable and available to cut down cost of production. There is a global concern for the proper disposal of waste, hence the conversion of agro-waste to flesh as a means of reducing environmental hazard, (Teguia, 1993). In 2010, world sugarcane production was about 1685 million tones resulting in approximately 252-421 million tones of tops (FAO, 2012). Rumen digesta is also a substantial waste, about 50,000 metric tones are available every year generated daily at Nigerian abattoirs (Odunsi,2004). It is a plant material at various stages of digestion, rich in microbial protein and is one of the wastes that pose a problem to the environment (Maigandi, 2004). A range of 9.20-20% crude protein has been reported for rumen digesta (Odunsi, 2003). Rumen digesta has not been reported to contain any anti-nutritional factor, therefore it may not only serve as a food but recycling it will enhance proper disposal and reduce environmental problems. The study is aimed at determining the nutritional composition of ensiled sugarcane waste and rumen digesta at various levels and the temperature of the ensiled products which determines the rate of fermentation.

MATERIALS AND METHODS

The study was conducted at the Teaching and Research farm of the Department of Animal Science and Range Management, Modibbo Adama University of Technology, Yola. It lies on latitude 9-14^0 N and longitude 12-38^0 E at an altitude of 158.8m above sea level (Adebayo and Tukur, 1999). Sugarcane waste was collected from processing/ selling points within Yola, Adamawa state capital. Foreign materials such as stones and polythene were removed. Rumen digesta from cattle, sheep and goats was obtained from Yola modern abattoir, foreign materials were also removed from the digesta. The rumen digesta was thoroughly mixed with the sugarcane waste. One conventional sack of sugarcane waste was chopped with a cutlass in to 2-3cm lengh to ease mixing and compaction. Four silo pits were dugged using digger and shovel measuring 3ft deep,1m wide and 2m length. Four different diets were prepared; T1 (control) contained only sugarcane waste with no rumen digesta, T2 contained sugarcane waste and 4 kg rumen digesta, T3 8kg and T4, 12kg rumen digesta respectively. The two different feeds after mixing was put into the silo lined with polythene sheet and trampled to remove air and then covered with polythene sheet and the soil was returned for proper covering. After 30 days of ensiling, the silo was opened and temperature of the silo was recorded as described by AOAC,2005 and samples were taken from each experimental diet for laboratory analyses. The representative samples were analysed for proximate composition (DM, CP, CF, EE, Ash and NFE) according to AOAC, 2005 procedures. The data generated were subjected to analyses of variance (ANOVA) using completely randomized design (CRD) according to steel and Torrie, 1980. Where significant differences between means are detected, least significant difference (LSD) was used to separate the means according to Steel and Torrie, 1980.

RESULT AND DISCUSSION

The result of proximate analyses of sugarcane waste mixed with different levels of rumen digesta after 30 days of ensiling showed significant ($p< 0.05$) difference in all the proximate components evaluated except dry matter content. The result indicate that CP, EE and Ash were significantly ($p< 0.05$) higher in T4 compared to other treatment groups and least values was obtained in the control group. The CF value was higher in the control and least in T4. The highest NFE value was obtained in T2. The DM values which decreases with increasing level of inclusion of rumen digesta agrees with the report of Eniolorunda *et al*.,2010, who observed a decrease in DM as the days of ensiling increases. Increase in CP in this study is similar to the results obtained by Ngele *et al*, 2006 and Eniolorunda 2010, which is which is probably due to bioconversion of carbohydrates into protein. The CF content was higher than that reported by Ngyen and Ngyen, 2001. While the ash content are much more higher than the value of 1.00 as reported by Boda, 1990, but lower than that reported by Maigandi, *et al*.,2004. The result of temperature agrees with the report of Muck and Dickson 1988 who reported that increasing temperature enhance proteolysis which elevate ammonia concentration.

Table 1: Proximate composition and Temperature of ensiled sugarcane waste and rumen digesta

Treatments Parameters	T_1	T_2	T_3	T_4	SEM
Dry matter	**83.25^{a}**	**83.10^{ab}**	**82.93^{bc}**	**82.81^{c}**	**0.708**
Crude protein	**2.43^{c}**	**2.68c**	**3.13^{b}**	**3.75^{a}**	**0.007**
Ether Extract	**3.75^{d}**	**4.16^{c}**	**4.81^{b}**	**5.01^{a}**	**0.500**
Crude Fibre	**42.16^{a}**	**38.43^{b}**	**37.16^{c}**	**35.88^{d}**	**0.007**
Ash	**2.01^{d}**	**2.64^{c}**	**2.92^{b}**	**3.10^{a}**	**0.139**
NFE	**32.90^{d}**	**35.17^{c}**	**34.90^{b}**	**35.05^{a}**	**0.038**
Temperature(^{0}C)	**39.6**	**39.8**	**40.3**	**41.8**	

Key: a, b, c, d: Means in the same row with different superscripts are significantly different ($p<0.05$)

CONCLUSION

Ensiling sugarcane waste with different levels of rumen digesta has significantly improved the nutritional quality of sugarcane waste. Therefore, it is recommended that farmers can ensiled sugarcane waste with rumen digesta which is almost cost free which serve as a cheap source of protein for ruminants which reduce cost of feed and environmental pollution.

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Growth Performance and Digestibility of Rabbits Fed bitter Leaf (*Vernonia amygdalina)* Meal (VALM)

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Abstarct: The study investigated the growth performance and digestibility of rabbits fed diets containing bitter leaf (*Vernonia amygdalinia*) meal (VALM). Fifty-six weaner rabbits of both sexes (6-7 weeks old) were randomly allotted into four treatment diets of graded levels of VALM as; 0% (T1), 5% (T2), 10% (T3) and 15% (T4) in a completely randomized design. Data obtained were statistically analyzed with General Linear Model of SAS and means were separated using the Duncan's Multiple Range Test. The crude protein of diets T4, T3 and T2 were higher than T1. The crude fibre of T1 was higher than T2, T3 and T4. The ether extract of diets containing VALM were higher than T1. The metabolizable energy of T1 was higher than diets containing VALM. There were no significant ($p>0.05$) differences in the feed intake, final weight, live weight gain, daily weight gain and feed conversion ratio across the treatments. Furthermore, the digestibility of crude fibre, crude protein, ether extract, dry matter, nitrogen free extract and organic matter were not significantly ($p>0.05$) affected by the inclusion levels of VALM although there was variation in the values obtained. The digestible ash was significantly ($p<0.05$) highest in T4 (50.76%) and lowest in T1 (29.12%). It was concluded that *Vernonia amygdalina* leaf meal (VALM) up to 15% had no deleterious effect on the performance and digestibility of rabbits.

Key words: Performance, digestibility, rabbits, *Vernonia amygdalina*.

DESCRIPTION OF PROBLEM

Rabbits have been recommended as having the best productive advantages to bridge the protein deficiency gap (Taiwo *et al.,* 2005). The enormous potential of rabbits in alleviating animal protein inadequacy in developing economies is hinged on attributes such as ability to thrive well on forages, high reproductive potential with short gestation period, early maturity, highly prolificacy and ability to re–breed shortly after kindling (Odimba, 2006). Livestock feeding in terms of quality and quantity poses a major challenge in Nigeria especially during the dry season when forages are scarce and limiting in essential nutrients. This leads to search for non-conventional forages that are cheap and available all year round. An example of such forages that has not been popularized is bitter leaf *(Vernonia amygdalina)* meal. It is native to tropical Africa and commonly known as 'African bitter leaf' or bitter leaf plant. The leaf meal is a proteinous feed resource 20 – 34% CP (Owen *et al.*, 2009) and can serve medicinal purposes. Olosunde and Odeyinka (2017) observed that 15% bitter leaf meal inclusion level in WAD goat diets resulted into maximum performance without any detrimental effects. Aynalem and Taye (2008) also revealed that supplementation of *Vernonia amygdalina* have a positive effect on live weight gain of lambs but limited information is available on the utilization of bitter leaf as supplement in rabbit diets. Therefore, this study investigates the growth performance and digestibility of rabbits fed graded levels of *Vernonia amygdalina* leaf meal.

MATERIALS AND METHODS

The study was carried out at the Rabbit Unit of Teaching and Reseach Farm Obafemi Awolowo University Ile-ife, Osun State, Nigeria. The study lasted for 8 weeks. Fresh, young *Vernonia amygdalina* leaves were harvested. The leaves were removed from the stems and air dried for seven days, milled and stored for subsequent use. Four concentrate mash diets were compounded with VALM at 0%, 5%, 10% and 15% graded levels respectively (Table 1). Fifty-six cross-bred rabbits of mixed sexes (6-7 weeks old) were randomly allotted into four treatments in a completely randomized design. The rabbits were housed individually in iron net cages netted with wire mesh measuring 23 x 18 x 15 inch in dimension. The animals were weighed at the beginning of the trial and thereafter on weekly basis. Left-over feed was weighed daily to estimate the feed intake from feed offered. Seven days digestibility trials were carried out in which the animals were kept in metabolism cages for easy collection of faeces. The daily faeces voided were weighed and the during the digestibility period. Sample of faeces voided per day was dried in a force-drought oven at 70^{o}c for 24 hours and stored. The stored dried sample of faeces were bulked, thoroughly mixed, ground and sub-sampled for chemical analysis. Proximate component of VALM, experimental diets and faeces were determined using the standard procedures of the Association of Official Analytical Chemists (2000) while the metabolizable energy was calculated using

the equation of Pauzenga (1985). Data obtained were subjected to analysis of variance procedure of General Linear Model and the Duncan's New Multiple Range Test options of SAS (2008) was used to test treatment effect and detect significant differences among means.

RESULTS AND DISCUSSION

Table 1: Gross Composition of Experimental Diets

Ingredient (%)	T1	T2	T3	T4
Maize	25	23.75	22.50	21.25
VALM	-	1.25	2.50	3.75
Corn bran	26.00	26.00	26.00	26.00
Brewer's dried grain	35.00	35.00	35.00	35.00
Soyabean meal	5.00	5.00	5.00	5.00
Groundnut cake	5.00	5.00	5.00	5.00
Bone meal	1.50	1.50	1.50	1.50
Oyster shell	1.00	1.00	1.00	1.00
Palm oil	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25
Vitamin premix	0.25	0.25	0.25	0.25

Table 2: The proximate composition Experimental Diets fed to Rabbits

Parameter	VALM	T1	T2	T3	T4
Dry matter	94.70	96.05	95.40	94.95	94.05
Crude protein	20.48	13.03	14.08	14.20	14.50
Crude fibre	11.15	16.55	16.15	15.20	14.75
Ether Extract	7.05	7.65	8.30	8.55	8.70
Ash	13.30	29.90	29.50	32.25	34.35
Nitrogen Free Extract	42.72	28.92	27.37	24.75	21.75
M.E (kcal/kg)	2845.35	2131.42	2164.90	2096.58	2013.33

M.E: Metabolizable Energy

Table 3: Performance Characteristics of Rabbits fed Experimental Diets

Parameters	T1	T2	T3	T4	SEM	PROB.
Feed intake (g/day)	47.71	47.30	46.33	44.88	1.67	0.94
Initial weight (g)	774.58	786.75	815.33	798.00	19.85	0.91
Final weight gain (g)	1142.00	1108.58	1203.75	1118.00	27.32	0.62
Live weight gain (g)	398.67	321.83	388.42	320.00	16.14	0.17
Daily weight gain (g/day)	11.58	9.20	11.10	9.14	0.49	0.17
Feed conversion ratio	4.19	5.14	4.17	4.91	0.24	0.20

[abc:] Means in a row with different superscripts differ significantly ($p<0.05$)

Table 4: Apparent Digestibility Coefficient of Rabbits Experimental Diets

Parameters (%)	**T1**	**T2**	**T3**	**T4**	**SEM**	**PROB.**
DDM	61.76	67.39	61.76	67.56	1.23	0.09
DCP	73.03	81.73	75.03	80.33	1.57	0.10
DCF	38.62	45.97	39.73	55.25	4.13	0.57
DEE	82.71	85.05	82.31	84.41	0.76	0.63
DAsh	29.12^{b}	41.41^{ab}	38.52^{ab}	50.76^{a}	3.18	0.05
DNFE	99.14	93.32	87.17	88.18	2.62	0.42
DOM	77.40	77.94	71.85	85.90	2.90	0.48

[abc]: Means in a row with different superscript differ significantly ($p<0.05$)

The proximate composition of diets containing VALM is presented on table 2. The crude protein (CP) of diets T4, T3 and T2 were higher than T1. The crude fibre (CF) of T1 was higher than T2, T3 and T4. The ether extract (EE) of diets T2, T3 and T4 were higher than T1. The metabolizable energy (kcal/kg) of T1 was lower than T2 but higher than T3 and T4. The CP of diets in this study but fell within 12-16% reported by Mmereole *et al.*

(2011). The CF decreases with increasing level of VALM and was observed to fall within 11.0-16.0% reported by Ayandiran and Odeyinka, (2016) for diets containing bread waste and *Moringa oleifera* leaf. The metabolizable energy of all the experimental diets in this study were lower than 2588-2995kcal/kg reported by Mufwa *et al.* (2011) for growing rabbits fed diets containing graded levels of brewers dried grain. The performance characteristic of rabbits fed the experimental diets is shown in table 3. There was no significant difference ($p>0.05$) among the means of the daily feed intake, initial weight, final weight and live weight gain of rabbits fed the diets. The daily feed intake estimated in this study was similar to 43.14-48.43g/day reported by Ayandiran and Odeyinka, (2016) on diets containing bread waste and *Moringa oleifera*leaf for rabbits but lower than 60.10-63.40g/day reported for rabbits fed diet containing Moringa leaf meal (Federick, 2010). The factor for the decrease in feed intake could be due to the bitter properties in VALM when first chewed compared to control (T1). The daily weight gain recorded in this study was higher than 6.78-8.64g/day observed by Odeyinka *et al.* (2008) in a study where *Moringa oleifera* used to replace *Centrocema pubescens*. Table 5 shows the apparent digestibility of rabbits fed experimental diets. There was no significant difference ($p>0.05$) in the digestible dry matter (DDM), crude protein (DCP), crude fibre (DCF), ether extract (DEE) and organic matter (DOM) of animals fed the experimental diets. The animals fed diet T4 had significantly higher ($p<0.05$) digestible ash than other diets. The DDM was lower than 71.14-82.11% reported by Ayandiran and Odeyinka, (2016) but relatively similar to 65.02-78.40% reported by Federick, (2010). The DCP was similar to 65.10-87.80% reported by Federick (2010) for rabbits fed diets contained Moringa leaf meal. This implies that *Vernonia amygdalina* is an outstanding source of digestible.

CONCLUSION

It could be concluded that inclusion of *Vernonia amygdalina* leaf meal (VALM) up to 15% in the diet of rabbits had no deleterious effect on performance and nutrients digestibility.

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A Case for Smallholder Organic Goat Farming in Rivers State, Nigeria

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Abstract: History has it that for well over 10,000 years, livestock production practices and indeed goat production have been carried out without the use of synthetic chemicals and other non-natural inputs. The introduction of synthetic compounds into goat production processes has boosted goat production to satisfy the growing animal protein needs of the world's teeming population. However, these new technologies have their disadvantages. They include chemical residues on goat products which constitute threat to human life and the entire ecosystem. Hence, consumers today seek goat products free of such chemicals and that are produced in a way that is environmentally friendly. Organic goat production offers an approach that has been suggested as the solution to this quest for goat products without synthetic residues and that does not negatively affect the environment. The aim of this paper was to explore literature for evidence of existence and possibility for introduction of organic goat farming to Rivers State. Findings could be useful baseline information for use by stakeholders to empower smallholders and produce goat products that are free of chemical residues and whose environmental footprint will be negligible.
Key words: Chemical residues, environment, food security, sustainability, synthetic Drugs.

INTRODUCTION

Organic agriculture implies the method of food production that sustains promotes and enhances agro- system health. It is a system that is said to be holistic due to the emphasis on sustainability of agricultural processes and improves the health of ecosystems and organisms for the production of quality food (Codex Alimentarius Commision, 2007, NOSB, 2016, Coffey and Baier, 2012, Fernando, 2016). Smallholder farmers are the drivers of many economies (Escribano, 2015, Chander, Subrahmanyeswari, Mukherjee, and Kumar, 2011). This is true as the bulk of livestock produced in Nigeria and indeed Rivers State can be attributed to smallholder farmers. However, these farmers are poor resourced, hence, cannot afford the cost of huge external inputs needed for increased food production under conventional systems. They rely on the traditional methods of livestock production which is unable to support large-scale livestock production (Aid Environment, 2013).

As the demand for animal source foods is on the increase due to the rising world population (Chander *et al*., 2011), the role of conventional methods in satisfying this rising demand for food of animal origin becomes indispensable. Though conventional livestock production supports high yield from livestock it does not guarantee products safety and sustainability of productivity.

The alarming concern of consumers on the effect of chemical residues in livestock produce on human health due to the use of synthetic drugs, chemical fertilizers, pesticides and other agro-chemicals in conventional livestock production systems is a threat (Baroilhett, 2012).The environment is not spared either as these chemicals pollute the environment resulting in the death of some soil microbes. This distorts the ecological balance. Due to all these effects, the trend is consumers of livestock products today are increasingly seeking to know how the food they consume is produced. This is presently a huge trend in developed countries of the Western hemisphere where such unfolding tendency has been exploited by producers and marketers of livestock products as a market opportunity. They certify their produce as organic and then sell at premium prices to earn huge profits compared to conventionally produced products. This trend, according to many reports is eminent in sub-Saharan Africa, such as Nigeria as the literacy level, population of middle class and income levels rise. Therefore, Nigeria and indeed Rivers State, being one of the biggest cities in Nigeria whose residents have high buying power, need to be proactive and key into this market opportunity before it manifests. However, there is lack of published information on the existence of or possibility of introducing organic livestock production into Rivers State. This information deficiency is even more acute on organic goat production even as Nigeria is said to be the largest producer and consumer of goat meat in the world.

Consequently, there is need to first evaluate from literature the existence of and possibility of introducing organic goat production into Rivers State to enhance the environmentally friendly, chemical residue free and sustainability of meat industry in Rivers State. This paper therefore aims at reviewing literature to seek whether

organic goat farming exists in the area and the possibility of its introduction as a better alternative farming method suitable for smallholder goat farmers in Rivers State and Nigeria.

MATERIALS AND METHODS

This work was a desk review of existing literature on the status of organic agriculture, livestock and indeed goat production in Nigeria and Rivers State. Review material include peer reviewed journal articles, reports, blogs, newspapers, websites, and books both online and offline. Results were collated and analyzed using thematic analysis.

RESULTS AND DISCUSSION

History: From the literature reviews made, the practice of organic farming in general is about 10 years old in Nigeria (Gain Report, 2014). This is quite young compared to developed countries where it has been in existence for more than 50 years. The International Federation of Organic Agriculture Movement (IFOAM) in a 2003 report on the evolution of agro-ecology movements in some parts of Africa particularly Senegal and Ghana resolved to create network centers in Africa to strengthen the organic movement. Consequently, there was the emergence of some network bodies in different parts of Africa. In Nigeria, Olusegun Obasanjo Centre for Organic Agricultural Research and Development (OOCORD) was established in 2007. This initiated the formation of Association of Organic Practitioners in Nigeria formally called Nigerian Organic Agriculture Network (NOAN) in 2008. This body serves as a link between organic agriculture stakeholders in Nigeria and international bodies interested in organic agriculture. Also, there is a network of professionals interested in organic agriculture called Organic Agriculture Project in Tertiary Institutions in Nigeria (OAPTIN), established in 2004 which focuses on capacity building and networking of academics in organic agriculture

Organic land in Africa and Nigeria: The world statistics of organic agriculture (Willer and Kiltcher, 2011) indicates that there are more than one million hectares of certified organic agricultural land in Africa with countries like Uganda having the highest (226, 954 hectares), followed by Tunisia and Ethiopia with 167,302 and 122, 727 hectares, respectively. Nigeria has about 3,154 hectares of documented cultivated organic land as at 2007 and 11,979 hectares in 2010. As at 2017, Nigeria had 5,023 hectares of cultivated organic land (Gain report, 2014)

Principles of organic farming: The four basic principles put in place by IFOAM are health, care, ecology and fairness.

Health: This principle denounces the use of synthetic drugs and emphasizes sustenance and health of ecosystems and organisms.

Fairness: It emphasizes the need for all parties in organic production process to be fair to each other. Such parties include farmers, distributors, workers and others.

Ecology: This principle encourages recycling, sustaining the natural ecosystem and cycles.

Care: This principle deals with being precautious and responsible so as to retain the organic essence.

Certification in organic agriculture: Certification is a pre-requisite in organic farming. Before a product can be labeled "organic", it must have been produced in compliance to some standards called organic principles. These principles are set by IFOAM and certification bodies are put in place to monitor farmers' compliance. Different countries have set up their certification bodies which must be accredited. For instance, in America, the United States Department of Agriculture (USDA) is responsible for certification. In Nigeria however, full certification is still in the process even though some kind of accreditation as recommended by IFOAM is being carried out. This is the Participatory Guarantee System (PGS). In PGS, farmers write down the standards they have complied based on IFOAM's standards.

Practice of organic agriculture in Nigeria: Presently, Nigerians are into organic herbs and crop production. Medicinal herbs and crops produced by a pioneer organic farm in Nigeria–Dara/Euro Bridge farm include lemon grass, turmeric, plantain and ginger. Others crops produced in Nigeria and the location they are grown are listed in Table 1.

Table 2: Organic food production in Nigeria and location

Name of farm	Location	Produce
Ajibode organic group	Akinyele LGA-Ibadan	Vegetable
Elekuru organic group	Elekuru-Ibadan	Vegetables, yam, cassava, maize, sweet potatoes
Ago-Owu organic group	Osun State	Plantain, banana, golden melon, pepper, cocoa, maize, oil palm

Evidence from literature does not indicate that organic livestock farming, let alone organic goat farming is taking place in Nigeria and indeed Rivers State. The commonest goat production system referenced in literature is traditional goat farming. Though close to organic farming, such practices cannot be said to be organic because of lack of certification. However, traditional goat farming can be a big stepping stone to organic goat production.

Need organic goat farming by smallholder farmers: As earlier stated, there is need for smallholders to embrace organic goat production because:

- Smallholder farmers are poor resourced and cannot afford huge capital for incurring large external input in conventional farming.

OrganicLivestock production emphasizes use of low input, locally sourced materialand recycling of used materials.

- Organic goat farming will enhance food sustainability, security and safety.
- Organic goat farming will result in good food quality, giving the farmer an advantage of selling his product in produce market or exporting his product thereby increasing income.
- It involves the use of non-competitive food materials such as forage grasses for feeding

Steps in adopting organic goat farming method: For smallholder goat farmers that intend to embrace organic goat farming, they should be aware that organic farming begins from the soil where the crops are planted to the animals that consume the crops and to man that consumes the animals. In adopting or converting to organic goat system, vegetation of browse shrubs, trees and grasses should be planted or existing ones can be converted and allowed a period of 1yr before use as feed material. Collaboration can also be made with organic crop farmers for feed ingredients. The steps to take include:

- Seek access to good and relevant information on organic farming
- Apply for certification
- Get breeding stock from a good farm that is managed organically.
- Put up a well aerated housing with enough space for exercise by the animals
- Avoid overcrowding of the goats

CONCLUSION AND APPLICATION

Based on evidence from literature, organic goat farming ensures quality, safety of products, sustainability and food security if the four basic principles of organic production are applied. The presence of natural rich vegetation on which browse herbs and grasses grow without fertilizer and pesticide application as is done in traditional goat farming offers a good potential for organic goat farming in Rivers State.

It is concluded that smallholder goat farmers in Rivers State are yet to embrace organic goat farming. Traditional goat farming currently practiced is a good stepping stone to organic production if certification can be done by the appropriate accrediting bodies.

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Carcass characteristic of West African dwarf bucks fed sole foliage of *Alchornea cordifolia, Aspilia africana Andropogon tectorum*

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Abstract: A study was carried out with eighteen (18) West African dwarf bucks aged 6-9 month to determine the effect feeding sole forages –*Alchornea cordifolia*, *Aspilia africana* and *Andropogon tectorum* on carcass characteristics of WAD bucks. The bucks were randomly assigned to three treatments as T_1-*Alchornea cordifolia*, T_2 – *Aspilia africana* and T_3- *Andropogon tectorum*. At the end of the 56 days trial, three bucks from each of the treatment were slaughtered for carcass evaluation. The results obtained revealed that bucks fed *Aspilia africana* (T_2) and *Andropogon tectorum(*T_3) had significantly ($P<0.05$) higher carcass weight and dressing percentages: 4.39kg(T_2); 4.24kg (T_3) and 50.05%(T_2), 48.48%(T_3) respectively than those fed *Alchornea cordifolia* (T_1) 3.42kg with 40.95%. The organ weights for bucks fed *Aspilia africana* and *Andropogon tectorum* T_2 (liver 221.01g, kidney 58.10) and T_3 (liver 210.81g, kidney 51.22g) were higher than those *Alchornea cordifolia* T_1 (liver 107.51g and kidney 42.29g). This suggests that among the three forages used, *Aspilia africana* was more suitable nutritionally when compared to the other forages.

Keywords: Carcass characteristics, WAD bucks, *Alchornea cordifolia, Aspilia africana, Andropogon tectorum.*

INTRODUCTION

Animal scientist in developing countries had for long identified the cost of finished livestock feed as the most economically limiting factor in the industry (Fasuyi and Aletor, 2005). Inadequate nutrition has been recognized as the major constraints to livestock especially goat production in Nigeria. In recent years goats have assumed greater importance in attempting to bridge the gap of protein intake deficiency resulting from high price of beef. The quantity and quality of grasses and other browse plants fluctuate with seasons and stage of maturity (Makkar, 2000). The availability of forages is influenced by seasonal fluctuations following unpredictable climatic conditions. This calls for brainstorming as nutrition is among the key factors in determining animal performance (Ilo *et al.,* 2010). The search for alterative feed ingredients for livestock feeding has continue to attract the attention of researchers especially in the developing nations of the world (Lamidi *et al,* 2008). Forages play important roles in being converted into useful products (Olaride, 2003). Forages are currently being relished by small ruminant for improved performance. They may be eaten directly from the natural growth of the plants, offered sole, or in a combination as in cut and carry system. Some of these forages include *Alchornea cordifolia, Aspilia African* and *Andropogon tectorum*(Eyoh *et al*.,2018).The green plants of various sources and types have long been recognized as the cheapest and most relatively abundant sources of feed for small ruminants (Akusu and Ajala, 2000). These three forages have been analyzed respectively. The quality of nutritional materials made available to an animal exerts influence on the value of its carcass (Fasanya and Yisa, 1999).Carcass is that part of animal which remains after slaughter and removal of external and internal by products and its understanding assists in the evaluation of meat quality (Omojola and Attah, 2006).Besides age, breed, plane of nutrition and dietary manipulation also influence the development of carcass, certain muscles and organs (Mahmood, 2010). However, the effects of feeding sole *Alchornia cordifolia, Aspilia africana and Adropogon tectorum* respectively on carcass characteristics of West African dwarf bucks has not been evaluated. The present study therefore seeks to asses this.

MATERIALS AND METHODS

Experimental site: The study was conducted at the goat and sheep unit of the Teaching and Research Farm of the Department of Animal Science, Akwa Ibom State University, Obio Akpa Campus. Obio Akpa Campus is located between latitude 5^0 17^1N and 5^0 27^0N between longitude 7^0 27^1N and 7^0 58^1E with an annual rainfall ranging from 3500mm - 5000mm and average monthly temperature of 25^0C. Akwa Ibom is a coastal state, lying between latitude 4^0 28^1N and 5^0 3^1N and between longitudes 7^0 27^1E and 8^0 20^1E with a relative humidity between 60 - 90%. It is in the tropical rainforest zone of Nigeria (SLUSK –AK, 1989).

Experimental Animals and Management: Eighteen (18) West African dwarf bucks aged 6-9 months were sourced from Abak local Government Area and used for the study. These animals were quarantined for two weeks to allow them adjust to the new environment. The animals were identified with plastic neck tags and housed singly in their individual pen. The three stated forages were cut, weighed (2kg each) and offered to the animals in addition to fresh drinking water. The animals were randomly allotted to three treatments, with 6 bucks per treatment after balancing for weight. At the end of the experiment that lasted for 56 days, a total of nine bucks with3 bucks per treatment were fasted for 24 hours, weighed before slaughtering for carcass evaluation.

Experimental Design and Data Collection: Completely randomized design was used with three treatments. Each forage represented a treatment as follows: (T_1) *Alchornea cordifolia* (T_2) *Aspilia africana* (T_3) *Andropogon tectorum*. Four bucks were assigned to each of the treatments. Data were collected on the weight of bucks before slaughtering, and on the carcass, weight using hanging weighing scale while electronic scale was used to weigh the internal organs.

Data analysis: Data generated from the experiment was analyzed using ANOVA and significant differences were separated using New Duncan Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The results of the carcass characteristics of bucks fed three (sole) forages is presented in Table 2. The live weights of the bucks did not differ ($P>0.05$) significantly among the treatment group but the highest mean value was recorded in T_2 followed by bucks in T_3, while those fed *Alchornia cordifolia* had the least. Carcass weight and dressing percentages showed significant ($P<0.05$) differences between treatment groups. Both parameters followed similar trend. The dressing percentages obtained in the study were in line with the ranges of 49-54%, 40.39-53.40% and 47-50.29% reported by Anya (2001), Udo, (2009) and Eyoh *et al*. (2018) for West African dwarf goats respectively. This implies that these forages even though fed sole, were nutritionally suitable for goats feeding. The organ weights were not significantly ($P>0.05$) different among the treatments.

However, the weights of liver and kidney were numerically higher in bucks fed *Aspilia africana* (T_2) followed by bucks in (T_3) *Andropogon tectorum*. *Aspilia africana* is known to produce useful agent in the management of non- responsive anemia in humans and animals. Foley (2008) reported that increase weight of kidney may result in better homeostasis as well as production of erythropoietin and also red blood cell are regulated by erythropoietin. This could explain the reason for variation of the organs in this experiment.

CONCLUSION

The West African dwarf bucks compared favourable in all the parameters tested; with bucks on (T_2) fed *Aspilia africana* showing significant differences in almost all the parameters. It is suggested that if fed in combination with other forages may improve overall performance of the animals.

Table1: Proximate composition of experimental forages

	T_I ***Alchornea cordifolia***	**T_2** ***Aspilia africana***	**T_3** ***Andropogon tectorum***
Dry matter	90.04	89.63	79.00
Crude protein	17.93	12.51	14.32
Ether extract	1.13	1.94	1.81
Crude fibre	16.84	1.28	1.71
Ash	11.38	1.79	7.52
Energy(kcal)kg	3.37	3.89	5.38

Table 2: Carcass Characteristics of WAD bucks in the different treatments.

Parameters	T_1 (AC)	T_2 (AA)	T_3 (AT)	SEM
Live weight (kg)	8.35	8.77	8.75	0.59
Carcass weight (kg)	3.42[b]	4.39[a]	4.24[a]	0.41
Dressing percentage (%)	40.59[b]	50.05[a]	48.45[a]	2.05
Organ weights (g)				
Liver	107.51	221.101	210.81	17.31
Kidney	42.29	58.10	51.22	2.08

[a, b] means in the same row with different superscripts are significantly ($P<0.05$) different. T_1 (AC) = ***Alchornea cordifolia*** T_2 (AA) = ***Aspilia Africana*** T_3 (AT) = ***Andropogon tectorum***

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Performance characteristics and nitrogen metabolism of West African dwarf sheep fed diets containing *Garcinia kola* (bitter kola) seed meal

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Abstract
Garcinia kola like other medicinal plants contains some secondary metabolites that can be used to improve rumen microbial efficiency leading to better feed conversion. Therefore, this study was carried out to investigate the performance characteristics in terms of feed intake, growth rate, feed conversion efficiency and nitrogen utilization of West African dwarf sheep fed diets containing *Garcinia kola* seed meal (GKSM). Sixteen West African dwarf Sheep weighing 12.00 $^{\pm}$ 0.5kg were randomly allotted to four treatments in a completely randomised design. The levels of inclusion are 0%GSKM, 2.5%GSKM, 5.0%GSKM and 7.5%GSKM as diets 1,2,3 and 4 respectively. The experiment lasted for sixteen weeks in which feed intake, daily weight gain was determined and nitrogen metabolism was assessed using metabolic cages. The results obtained showed that the dry matter intake ranged from 530.25g/day to 581.04g/day which were significantly different ($P< 0.05$) between T1 and T2,T1 and T4. The best total weight gain was exhibited by control diets with 0% GSKM. Though treatment T3 had the best nitrogen retention of 52.86% but T1 had highest nitrogen balance of 3.93 with no significant difference ($P> 0.05$) from other treatments. Treatment 1 had better feed conversion ratio compared to other treatments of 18.39 feed/g gain. In all parameters considered, the control group with 0% GSKM exhibited the best performance. However, other physiological mode of action of *Garcinia kola* other than performance characteristics can be explored.
Keywords: Growth, utilization, intake and kola.

INTRODUCTION

Nutrition has been identified as one of the major factors responsible for poor performance of the indigenous breeds (1). The animals are exposed to severe nutritional stress especially during the dry season when forages are scarce and low quality. This leads to weight loss, mortality, decreased reproductive performance and kid mortality (2). Small ruminant feed requirements in the tropics are aggravated by high cost conventional feeds and lack of alternative sources of feeds particularly during the dry season when forages are not readily available (3). This has necessitated the need to search for alternative sources that are cheaper and readily available. *Garcinia kola* seeds containing phytochemicals such as kolavirons, alkanoids, saponins, tanins and flavonoids which have various biological and pharmalogical properties. These phytochemicals compounds are known to have antimicrobial activities which can be used to modulate rumen environments as well as other physiological activities.

MATERIALS AND METHOD

The experiment was carried out at the Institute of Agricultural Research and Training (IAR&T), Moor Plantation, Ibadan. It lasted for sixteen (16) weeks. The milling of the dried pieces of *Garcinia kola* into fine powder and later incorporated into the diet of the experimental animals. Sixteen West African dwarf rams weighing 12.00±0.05kg were used. Animals were housed individually in a well-ventilated pen. The experimental design used was completely Randomized Design (C.R.D). At the onset of the experiment, initial body weight of the animals was measured and recorded weekly. The animals were fed 5% based on their body weight. The data collected were feed intake, weight gain and feed conversion ratio. At the end of the feeding trials, the animals were allotted to individual metabolic cages designed for separate collection of faeces and urine. Nitrogen metabolism by the rams was calculated as the difference between Nitrogen intake and nitrogen excreted from faeces and urine while percentage nitrogen retention was computed from nitrogen balance expressed as a percentage of nitrogen intake.

Chemical Analysis: All samples of feeds and faeces were analysed for proximate compositions using the procedures described by (4). The fibre fractions were determined according to (5).

Statistical Analysis: Data collected were subjected to analysis of variance (ANOVA). Separation of mean was done using Duncan multiple range test (6)**.**

Table 1. Gross composition of experimental diets (g/100g)

Ingredients	T 1	T 2	T 3	T 4
Dried cassava peel	40.00	37.50	35.00	32.50
Palm kernel cake	10.00	10.00	10.00	10.00
Brewer dried grains	10.00	10.00	10.00	10.00
Groundnut haulms	20.00	20.00	20.00	20.00
Cowpea husk	15.00	15.00	15.00	15.00
Garcinia kola seed meal	0.00	2.50	5.00	7.50
Dicalcium phosphate	2.00	2.00	2.00	2.00
Urea	1.00	1.00	1.00	1.00
Premix	1.00	1.00	1.00	1.00
Salt	1.00	1.00	1.00	1.00
Total	100	100	100	100

Treatment 1:- 100% control diets
Treatment 2:- 97.5% control diets + 2.5% *Garcinia kola* seed meal.
Treatment 3:- 95% control + 5% *Garcinia kola* seed meal.
Treatment 4:- 92.5% control + 7.5%*Garcinia kola* seed meal.

Table 3:Nitrogen Metabolism (g/day) of West Africa Dwarf Sheep Fed diets containing *Garcinia kola* seed meal

Parameter (g/day)	T_1	T_2	T_3	T_4	SEM (±)
Nitrogen Intake	8.93^a	3.79^b	3.93^b	3.82^b	0.89
Faecal Nitrogen output	1.29^a	0.32^b	0.28^b	0.50^b	0.13
Urinary Nitrogen output	3.71^a	1.59^b	1.56^b	1.58^b	0.35
Nitrogen Balance	3.93	1.89	2.09	1.73	0.43
Nitrogen Retention (%)	40.89	49.19	52.86	43.33	2.17

^{ab} means in the same row with different superscripts are significantly different (P< 0.05)

Table 4: Performance characteristics of West Africa Dwarf Sheep Fed diets containing *Garcinia kola* seed meal

Parameter (g/day)	T_1	T_2	T_3	T_4	SEM (±)
Dry matter Intake (g/d)	581.04^a	530.23^b	580.40^a	555.68^b	8.00
Initial Weight (kg)	13.17	13.00	13.50	13.33	0.35
Final Weight (kg)	15.38	14.78	14.95	14.65	0.35
Weight Gain (kg)	2.21	1.78	1.45	1.32	0.19
Average daily gain (g/day)	31.60	25.43	20.71	18.86	7.98
Feed conversion ratio	18.39^b	20.85^b	28.03^a	29.46^a	3.56

^{ab} means in the same row with different superscripts are significantly different (P< 0.05)

RESULT AND DISCUSSION

The results of effect of *Garcinia kola* seed meal inclusion at different levels 0%, 2.5%, 5.0% and 7.5% on dry matter intake, weight gain and feed conversion ratio were presented in Table 4. The dry matter intake ranged from 530.23g/day to 581.04g/day. The decrease in the total body weight gain in this study 31.60 g/d to 18.86 g/d was in line with the report given by (7) who administered oral suspension of dried bitter kola to rabbit at 1200, 1500 and 1800 mg/kg body weight observed significantly (P<0.05) lower body weights from rabbits administered 1500 and 1800mg/kg body weight. The best feed conversion efficiency was exhibited by the animals on control diets compared with other treatments, this is in contrary to the trials performed by (8) that reported enhanced growth performance when bitter kola was fed to poultry. Nitrogen metabolism of rams fed diets containing GKSM is presented in Table 3. Nitrogen intake for sheep on diet 1 (8.93g/day) was higher and differed significantly from other treatments. This could be probably due to the higher crude protein in the diet 1. This is in line with (9) who reported that crude protein combination in a diet has a significant effect on the nitrogen intake of sheep.

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Performance of West African Dwarf Goats Fed an Ensiled Mixture of Some Non-Conventional Feedstuffs

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Abstract: A study was carried out to determine the performance of West African Dwarf (WAD) goats fed an ensiled mixture of some non-conventional feedstuffs. Cassava peels, *burukutu* waste, bambaranut waste, maize offal and rice milling waste (CBBMR) were mixed together with addition of 150mls of water per 0.5kg of the mixed feed. The CBBMR-mixtures were ensiled in polythene bags for 7 and 14 days for T_2 and T_3 respectively, while the control (T_1) was un-ensiled. Twelve (12) male WAD goats with an average live weight of 5.5kg were randomly allotted to 3 treatments of 4 replicates each. Samples of both un-ensiled and ensiled (7 and 14 days) mixture of CBBMR were taken to the central laboratory unit of the National Animal Production Research Institute (NAPRI) Zaria for proximate analysis. Results showed that the colors obtained in the study were close to the original color (brown) of the initial materials ensiled and the smell was generally alcoholic. The pH value ranged from 4.6 in T_1 to 5.0 in T_3. The sample had no fungal growth and had a firm texture. Result on proximate analysis showed that values for the ensiled diets (T_2 and T_3) were higher than those un-ensiled (T_1). None of the performance and economic parameters were significantly affected (P> 0.05) by the experimental diets. The overall result showed that there was no adverse effect on the animals. It is recommended that non-convectional feedstuff be ensiled as a way of increasing and preserving the nutritive value of feedstuffs.

Keywords: Performance, Ensiled, un-ensiled, Goats and Economic Parameters

DESCRIPTION OF PROBLEM

Feed shortage poses a major constraint to goat production in Nigeria (Ahamaefule and Elendu, 2010). Even where fodder resources abound, seasonal fluctuations in nutritive value make sustainable gains in production from good management unrealistic (Alli-Balogun *et al.,* 2003). Nigeria's feed resources have been in the decline in recent years; because it increasingly relies on imports to meet the needs of an expanding livestock industry (FAO, 2008). The persistent feed shortage represents a major limitation to animal production in many developing countries, including Nigeria. Ruminant animal production in the tropics is faced with seasonal fluctuations in feed material especially in dry season (Oluwatobi, 2010). The ever-increasing livestock population in Nigeria calls for an alternative sources of feed material to boost livestock production in Nigeria and developing countries. During this period of feed scarcity (especially during the dry season), it is advisable to source for and utilize alternate low-cost feed for ruminants. These supplements should be cheap, readily available and mostly of little or no importance to man (Ahamaefule, 2002). Some of this non-convectional feedstuff that hold promise in ruminant nutrition are cassava peels, rice milling waste, bambaranut waste, brewer's dried grain, maize offal etc.

MATERIALS AND METHODS

Sources and preparation of samples/experimental diets: The cassava peels, *burukutu* waste, bambaranut waste, maize offal and rice milling waste (CBBMR) were mixed together with addition of 150ml of water per 0.5kg of the mixed feed. The CBBMR mixtures were ensiled in polythene bags for 7 days and14 days as T_2 and T_3respectively, while the control (T_1) was un-ensiled.

Management of experimental goats: Twelve (12) male West African Dwarf goats with an average live weight of 5.5kg were purchased and randomly allotted to 3 treatments of 4 replicates each. The goats were reared in partitioned pens. Prophylactic treatments such as Ivomectin injection against ecto and endo parasite, *Peste de petite* (PPR) vaccine and Iron Injection were administered. Ivax was administered orally as drug to combat diarrhea. Leftover feeds were daily weighed to obtain the feed consumed and weight gain analysis. The experiment lasted for 54 day with a 14 days adjustment period inclusive.

Proximate assay: Samples of both un-ensiled and ensiled mixture of CBBMR were taken to the central laboratory unit of the National Animal Production Research Institute (NAPRI) Zaria for proximate analysis. Sample of ensiled mixture of CBBMR were subjected to assay according to standard procedure (AOAC, 1999).

Determination of economics of feeding ensiled CBBMR to West African Dwarf goats: The economics indices of the supplemental diets were calculated using the market price of the feedstuff as at the time of executing the experiment, the following were calculated: Revenue (selling price) = Gross margin + Total variable cost of production, Cost benefit ratio = Total Revenue÷ variable cost of production, Total variable cost of production = Cost of goat + Cost of other variable input, Total feed Cost = Total feed intake x Cost of feed per kg, Feed cost per kg gain ratio = Feed conversion ratio x Feed cost per kg, Benefit / live weight gain = Total weight gain x Cost of a kg of goat meat, Gross margin = Selling Price (revenue) - total variable cost of production, Feed Conversion Ratio = Total feed consume ÷ Body weight gain.

Silage quality determination: Samples were collected and used for quality assessment; colour assessment was done with visual observation and colour charts. The pH of each treatment sample was determined using a pH meter.

Statistical analysis: Completely Randomized design was used. Data collected were subjected to Analysis of variance (ANOVA) and means that are significantly different were separated using least significantly different (LSD), with complete software known as statistical package for social science (SPSS) 16th version.

Table 1: Composition of the experimental diets

Ingredients	T_1 (un-ensiled)	T_2 (7 days ensiled)	T_3 (14 days ensiled)
Burukutu dried grain	27	27	27
Bambaranut Waste	43	43	43
Cassava Peals	5	5	5
Maize offal	20	20	20
Rice Milling Waste	2	2	2
Salt	1	1	1
Bone Meal	2	2	2
Total	**100**	**100**	**100**

Table 2: Quality of ensiled and un-ensiled mixture of CBBMR.

	Treatments		
Parameters	**T_1(un-ensiled)**	**T_2 (7 days ensiled)**	**T_3(14days ensiled)**
Colour	brown	golden brown	golden brown
Smell	Nil	Alcoholic	Alcoholic
Texture	Gritty	Firm	Firm
pH	5.6	4.6	5.0

Table 3: Proximate composition (%), metabolizable energy (Kcal/Kg) of ensiled and un-ensiled mixtures of CBBMR

	Treatments			
Parameters	**T_1 (un-ensiled)**	**T_2 (7days ensiled)**	**T_3 (14days ensiled)**	**Gamba Grass**
Dry matter (%)	92.23	95.88	95.99	74.60
CP (%)	18.48	21.19	19.74	8.50
Crude Fibre (%)	25.49	26.27	23.65	17.00
NFE (%)	39.47	37.02	40.02	58.23
Ether Extract (%)	7.65	8.02	7.96	5.40
Ash (%)	8.25	7.50	8.39	10.82
Energy (Kcal/kg)	2664.80	2713.00	2753.01	2781.10

Key – Dm = Dry matter, Cp = Crude protein, NFE = Nitrogen Free Extract

Table 4: Performance and economics of feeding ensiled mixture of CBBMR to West African Dwarf goats.

	Treatments			
Parameter	T_1(control)	T_2 (7days ensiled)	T_3 (14 days ensiled)	SEM
TSI (g)	10991	10171	10991	10.59^{NS}
DSI (g)	274.78	254.28	274.78	10.44^{NS}
TGI (g)	13216.00	13220.00	15116.00	487.05^{NS}
DGI (g)	330.40	330.50	377.90	12.18^{NS}
TFI (g)	24207	23391	26107	787.25^{NS}
TWI (ml)	8642.0	6540.0	6476.7	513.49^{NS}
DWI (ml)	216.05	163.50	161.92	12.83^{NS}
IW (g)	6166.70	5800.00	6266.70	323.08^{NS}
FW (g)	7633.30	6906.70	7566.70	394.78^{NS}
TWG (g)	1466.7	1106.70	1300.00	154.09^{NS}
DWG (g)	36.67	27.67	32.50	3.85^{NS}
FCR (g)	16.50	21.14	20.08	3.65^{NS}
FC/kg (N)	25.10	27.61	27.61	0.42^{NS}
FC/kg gain (N)	414.15	583.68	554.41	103.36^{NS}
CBR	1.40	1.42	1.42	0.01^{NS}
TFC (N)	15.10	16.10	18.00	0.64^{NS}
TVCP (N)	2398.2	2398.2	2398.2	18.64^{NS}
GM (N)	968.50	1018.50	1001.80	25.00^{NS}
R (N)	3366.70	3416.70	3400.00	39479.20^{NS}

KEY: R = Revenue, GM = Gross Margin, TVCP = Total Variable Cost of Production, TFC = Total Fixed Cost, CBR = Cost Benefit Ratio, FCR = Fixed Conversion Ratio, TSI = Total Silage Intake, DSI = Daily Silage Intake, TWI = Total Water Intake, DWI = Daily Water Intake, IW = Initial Weight, FW = Final Weight, TFI = Total Feed Intake, TGI = Total Grass Intake, TWG = Total Weight Gain, DWG = Daily Weight Gain, FC = Feed Cost, NS = Not Significant, SEM = Standard Error of Mean.

RESULTS AND DISCUSSION

The quality of the ensiled feedstuff is presented in Table 2. The colors obtained in the present study were close to the original color of the initial materials ensiled and thus is in line with the findings of Asaolu (2000) who

reported the colour observed from cassava peel silage to be light brown in colour. The pH value ranged from 4.6 in T_1 to 5.0 in T_3 which is within the range of 4.5 to 5.3 as reported by Meneses *et al.* (2007).

The proximate composition and metabolizable energy (Kcal/kg) presented in Table 3, showed that they all increased after ensiling. This increase may be attributed to the activities of micro organism which agreed with the findings of (Ubalua, 2007) who reported that solid fermentation of a mixture of cassava peels and waste water from fermented cassava resulted in a product with higher protein content. Couch (1978) reported that the ensiling of brewer' dried grain resulted in a product with higher protein content. This result also indicates that the more the ensiling period, the more the dry matter and metabolizable energy.

None of the performance and economics of feeding parameters were significant as presented in Table 4. Numerically however, it appears that the goats on the control diet performed better than those fed the T_2 and T_3. were also a little more expensive when compared to the control diet because of the cost of the polythene used for the ensiling.

CONCLUSION AND RECOMMENDATIONS

The result obtained indicates that ensiling with the aid of polythene bags is a simple and appropriate method of conservation of non-convectional feedstuff. Ensiling also helps to improve the keeping quality and nutritive value of non-convectional feed materials which would have been left to waste.

Based on the results obtained from this study, it is recommended that ensiling of non-convectional feedstuff be encouraged as a way of preserving the nutritive value of feedstuff. Research efforts should be geared towards feeding of ensiled non-conventional feedstuff to ruminants especially during the dry season. More research should be carried out with longer period of ensiling such that will last for about 21 days.

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Growth Performance and Meat Quality Evaluation of Goats Fed Urea-Treated Sugarcane Waste and Kolanut Husk Supplemented Diets

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Abstract: This study was conducted to determine growth performance and meat quality evaluation of goats fed urea-treated sugarcane waste and kolanut husk supplemented diets. Twenty-four West African dwarf goats aged between 5 and 6 months old with an average body weight of 5.00 ± 0.58kg were assigned to four treatment diets with six goats per treatment in a completely randomized design. The treatment diets prepared were: D_1 (100% guinea grass), D_2 (50% guinea grass and 50% urea treated sugarcane waste), D_3 (50% guinea grass and 50% urea treated kolanut husk), and D_4 (50% guinea grass and urea treated 25% sugarcane waste with 25% kolanut husk). At the end of 84days feeding trial and weight measurement of goats, they were slaughtered for meat quality evaluation. The results showed that final body weight (8.37kg) was significantly ($P < 0.05$) higher in diet D_2 than other treatment diets. Total weight gain and average daily weight gain (3.01kg and 35.83g), appearance (7.16), flavour (7.00) and tenderness (7.02) were significantly higher in D_4 compared with D_1, D_2 and D_3. Initial body weight and juiciness were not significantly ($P > 0.05$) affected by treatment diets. It can be concluded that 50% guinea grass and urea treated 25% sugarcane waste with 25% kolanut husk (D_4) has the potential to improve growth performance and enhance meat quality of goats.

Keywords: Growth, Meat, Agro-By-Products, Urea, Goats

INTRODUCTION

Adequate feeding of ruminant livestock in quantity and quality, most especially during the dry season has been the major constraint threatening goat productivity in the tropics, this is because during this period forages are dried up with low nutritive values for goat consumption. The concentrate feed ingredients that would have countered this incessant problem of poor quality forages are also scarce and erratic in supply, hence feeds shortage have been recognized as a limiting factor to a successful goat production enterprise in Nigeria (Okoruwa and Bamgboye,2017). In response to these challenges, the usual practice has been to supplement forages in goat diets with agro-by-products. The problem of high fibre with low protein content of most of these agro- by- products reduced live weight of goats and quality of their products (Okoruwa and Bamgboye, 2017). Thus, the need to treat some of these underutilized agro- by- products is necessary in order to improve nutrient values of these feeds for better performance with improve goat products.

Sugarcane and kolanut are mostly harvested in the dry season, which is a period of the year when there is lack of forages for goats' consumption. After the extraction of sugarcane and kolanut main products, their wastes which are mainly fibrous materials constitute nuisance to the environment (Odebumi *et al*.,2009; Akinbode *et al.,* 2018). Some authors (Okoruwa and Bamgboye, 2017; Akinbode *et al.,* 2018) reported that when high fiber agro- by- products undergo some treatment they can be potentially valuable sources of nutrient for ruminants. However, information on urea treatment of sugarcane waste and kolanut husk or their combination as supplement to goats feeding on poor quality forages is scarce. Hence, the objective of the study was to determine growth performance and meat quality evaluation of goats fed urea treated sugarcane waste and kolanut husk supplemented diets.

MATERIALS AND METHODS

The study was conducted at the Ruminant Unit of the Teaching and Research Farm, Ambrose Alli University, Ekpoma. Harvested matured poor-quality Guinea grass with urea treated sugarcane waste and kolanut husk were used for the preparation of the experimental diets. The four diets prepared were D_1 (100% Guinea grass) , D_2 (50% Guinea grass and 50% urea treated sugarcane waste) ,D_3 (50% Guinea grass and 50% urea treated kolanut husk), and D_4 (50% Guinea grass and urea treated 25% sugarcane waste with 25% kolanut husk).

Twenty four West African dwarf female goats of about 5 – 6 months old with an average body weight of 5.00 ± 0.58kg were sourced from Ekpoma livestock market for the study. They were randomly allotted to the four dietary treatments with six goats per treatment in a completely randomized design. Treatment diets were given to goats at 5% dry matter body weight twice daily at about 8:00am and 5:00pm. They also had free access to clean water and management practices were carried out. Goats were weighed at the commencement of the study to determine the initial body weight. Subsequently, they were weighed weekly to determine live weight changes. At the end of 84days feeding trial, two goats from each treatment group were selected at random, fasted for 16hours before slaughtered and cut into parts. Thereafter, cooked meat from loin chops were served in plates to a 12 member taste panel drawn from the staff and students population of the department to adjudge the test for sensory evaluation as reported by Oniolorunda *et al.* (2010). However, the urea treated test ingredients and experimental diets were analysed for proximate composition using the procedures of (AOAC, 2005).

Data collected for growth performance and sensory evaluation were subjected to analysis of variance and where significant difference occurred means were separated using Duncan's multiple range tests (SAS, 2009).

RESULTS AND DISCUSSION

Table 1: Proximate composition (DM %) of urea treated test ingredients and experimental diets

Parameters	Test ingredients		Experimental diets			
	SW	KH	D_1	D_2	D_3	D_4
Dry matter	92.82	87.43	97.02	93.42	90.73	92.08
Crude protein	10.06	12.49	7.89	13.02	15.24	13.63
Crude fibre	31.99	13.68	40.23	36.12	26.96	31.54
Ash	8.03	6.34	6.88	7.96	6.61	7.79
Ether extract	1.18	1.63	0.89	1.04	1.26	1.15
Nitrogen free extract	41.56	53.29	40.02	35.37	41.66	41.97

SW = sugarcane waste, KH = kolanut husk

Table 2 shows the growth performance and sensory evaluation of goats fed experimental diets. Final body weight was significantly ($P < 0.05$) higher in goats on test diets D_2 (8.37kg), D_3 (8.36kg) and D_4 (8.25kg) than those on control diet D_1 (7.90kg). This could be due to the levels of nutrient availability which positively contributed to the test diets utilization to enhance final body weight. Some authors (Okoruwa and Bamgboye, 2017; Akinbode *et al.*, 2018) clearly indicated that urea treatment plays an important role in nutrient availability, digestion and absorption of diet, which result to feed utilization and increase in growth rate of animals. Total and average daily weight gains were highest in goats placed on D_4 (3.01kg and 35.83g), followed by those on D_2 (2.89kg and 34.41g) with D_3 (2.68kg and 31.91g) before those on D_1 (1.98kg and 23.57g). This indicates the superiority of the diet D_4 over others in terms of live weight gain. These results were consistent with Edoror and Okoruwa (2017), who reported that a diet which contains a balance of nutrient is efficiently interacted in terms of utilization to give highest total weight gain.

Significant differences ($P < 0.05$) were observed in all parameters obtained in sensory evaluation except juiciness that was not significantly ($P > 0.05$) influenced by treatment diets. Appearance that is used by consumers in accepting or rejecting a meat product under examination was significant ($P < 0.05$) in D_4 (7.16) than those on diets D_3 (6.16), D_2 (6.82) and D_1 (5.21) . Flavour is an important meat quality index, as poor flavour will discharge consumes from accepting meat products, while tenderness is a yardstick that people use to know whether meat is tough and dry or not. Flavour and tenderness that were significantly ($P < 0.05$) highest in D_4 (7.00 and 7.02) and lowest in D_3 (5.99 and 5.83) followed the same trend as observed in appearance. These results were expected as colour and odour of meat ten to discharge consumers from accepting meat products. This finding agreed with the report of (4) who noted that colour serves as an important sensory attribute which correlate with changes in meat flovour.

Table 2: Growth performance and meat quality of goats fed experimental diets

Parameters	Experimental diets				± SEM
	D_1	D_2	D_3	D_4	

Initial body weight (kg)	5.92	5.48	5.68	5.24	0.02
Final body weight (kg)	7.90[b]	8.37[a]	8.36[a]	8.25[a]	0.12
Total weight gain (kg)	1.98[c]	2.89[b]	2.68[b]	3.01[a]	0.04
Average daily weight gain (g)	23.57[c]	34.41[b]	31.91[b]	35.83[a]	0.67
Sensory evaluation					
Appearance	5.21[c]	6.82[b]	6.54[b]	7.16[a]	0.21
Flavour	5.99[c]	6.38[b]	6.68[b]	7.00[a]	0.36
Tenderness	5.83[c]	6.24[b]	6.38[b]	7.02[a]	0.42
Juiciness	6.21	6.49	6.72	6.63	0.01

[a,b,c] Means in the same row with varying superscript differ significantly ($P < 0.05$)

CONCLUSION

From the results obtained in this study, it can therefore be concluded that 50% Guinea grass and urea treated 25% sugarcane waste with 25% kolanut husk improved growth performance and enhance meat quality of goats.

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