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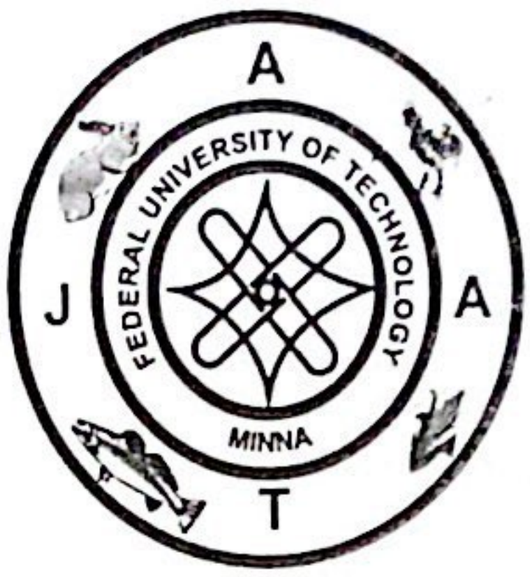

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GROWTH PERFORMANCE, CARCASS AND ECONOMIC CHARACTERISTICS OF WEANER RABBITS FED VARYING LEVELS OF PELLETED BOILED NEGRO COFFEE (*SENNA OCCIDENTALIS*) SEED MEAL

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ABSTRACT

The growth performance, carcass and economic characteristics of weaner rabbits fed diets containing graded levels of pelleted boiled Senna occidentalis seed meal were studied. Forty five (45) mixed breeds and sexes' weaner rabbits were used for the experiment. The rabbits were randomly assigned to five (5) dietary treatments containing boiled Senna occidentalis *seed meal (BSOSM) at 0.0 %, 2.50 %, 5.00 %, 7.50 % and 10.00 % inclusion levels. The experimental design was a completely randomized design. The data collected included body weight and feed intake, while the body weight gain, feed conversion ratio (FCR), protein efficiency ratio (PER), energy efficiency (EE), cost of feed per kg body weight gain and nutrient digestibility were calculated. The data collected were subjected to analysis of variance. The results revealed that there were significant ($P < 0.05$) differences in all parameters measured and rabbits fed 7.5 % BSOSM had the best performance in terms of growth rate, Protein efficiency ratio and energy efficiency (EE). They also had the lowest cost of feed per Kg body weight gain. The result of the carcass characteristics measured showed that these characteristics were significantly ($P < 0.05$) affected by the levels of inclusion of BSOSM. It can be inferred that BSOSM is of good nutritional quality if the anti-nutritional factors are eliminated. It was therefore concluded that up to 7.5 % of boiled* Senna occidentalis *seed meal could be used in formulating diets for rabbits with no deleterious effect on growth performance and carcass characteristics.*

KEYWORDS: Weaner rabbits, *Senna occidentalis* seed meal, feed cost/body weight, growth rate, boiling.

INTRODUCTION

There is need to increase the production of protein of animal source in Nigeria. This is due to the fact that the large quantities of proteins consumed in Nigeria are of plant source and this sources lack one or more essential amino acids, whereas proteins of animal sources are balanced in amino acids (Aduku, 2004). The contributions of traditional livestock (cattle, sheep, goat and pig)

to this national problem has been indeed marginal, providing help to only few Nigerians who mostly are urban dwellers (Ahamefule *et al.*, 2000).

In order to meet up with the animal protein requirements of Nigerian population, increased production of monogastric animals like rabbit is necessary because of their high productive potential and short generation interval (Ayanwale, 2006). With the increasing awareness of the great potentials of the domestic rabbit (*Oryctolagus cuniculus*) in the tropics as pet, meat producer, research animal and veritable sources of income; notable efforts are now being directed towards the full exploitation of these desirable potentials even under the harsh tropical intensive husbandry.

The potential of livestock in extenuating the problem of protein insufficiencies in human nutrition in developing countries is becoming less accomplishable (Ari, 2006). This has been attributed to inadequate supply and high cost of some conventional feed ingredients such as soybean, groundnut, maize and wheat in addition to animal protein sources such as fish meal and blood meal. The prices of these conventional feed ingredients have been increasing continuously in recent times; at the same time, availability is often fickle. The problem has been worsened due to the increasing competition between humans and livestock for these conventional feed ingredients (Odunsi, 2003). Feed forms a very important component in livestock production and if not available, livestock will not exist. The search for novel high quality but cheap sources of protein and energy are major sources of concern to nutritionists and bodies charged with the responsibility for food in many parts of the developing world (Kudu *et al.*, 2010). This high cost of conventional feed ingredients has necessitated the research into alternative feed ingredients that have high nutritive value, readily available, less expensive and of no use for human consumption, such as senna coffee seeds (*Senna occidentalis*). The utilization of senna coffee seeds (*Senna occidentalis)* in livestock feed is not popular because of lack of information about its nutritional qualities and the presence of anti-nutritional factors such as polyphenols, toxalbumin, cyanide, phytates, anthroquinones and triterpenoids (Abdullahi *et al.*, 2003). Boiling is one of the methods which had been used to eliminate the anti-nutritional factors of non-conventional feedstuffs (Yahaya, 2014). Most of the methods used in processing feedstuffs do not completely remove the anti-nutritional factors but only lower the levels of their concentrations to tolerable limits (Akinmutimti, 2004). This particular research work is aimed at exploring the potentials of *Senna*

occidentalis seeds on the performance of weaner rabbits. It is expected that from this research, useful suggestions would be made that could be favourable to both small and large scale farmers.

MATERIALS AND METHODS

Experimental Site: This experiment was carried out at the Rabbit Unit of the Department of Animal Production Teaching and Research Farm situated at the Main Campus, Gidan Kwano, Federal University of Technology, Minna, Niger State. Minna is located within latitude 09^0 30' and 09^0 45' north and longitude 06^0 30 and 06^0 45'East of the equator. It falls within the Southern Guinean Savannah Agro-Ecological Zone of Nigeria. The mean annual rainfall varies from 1100 - 1600 mm, it has a mean temperature of between 21^0C and 36.5^0C (Federal Metrological Station, Minna, 2015).

Source of Experimental Materials: Forty five mixed breed weaner rabbits of five weeks old with an average body weight of 546.67g were purchased from the Ministry of Livestock and Fisheries Development, Minna, Niger State: while the *Senna* coffee seed pods were harvested from the matured stands along road sides in Bida, Niger state, at the beginning of dry season (October to November). The pods were properly dried and threshed to obtain the seeds. The seeds were cleaned through winnowing, and undesirable particles like sand, undersized seeds, stem and leaves were removed. The quantities required for this experiment were collected.

Processing of *Senna occidentalis* Seeds: All the sorted seeds were boiled. The method of Omoikhoje *et al.* (2009) adopted by Yahaya (2014) was used. The method involved putting the cleaned seeds into heated water at 100^0 C for 60 minutes. At this temperature, majority of the hard cotyledons of the seeds were expected to be softened. After which the boiled seeds were removed, put into a sieve to drain the water and later sun dried. After the cooked seeds have dried considerably (hard to break with hand).they were milled into fine particles by using grinding engine equipped with 600µm mesh screen size. They were thereafter allowed to cool and then stored in air tight containers and labelled boiled *Senna occidentalis* meal (BSOM). The BSOM was analysed for phytic acid, tannin, cyanide and trypsin inhibitor at the Biochemistry Laboratory at the National Cereals Research Institute Baddegi, Niger State,using the methods described by Onwuka (2012).

Experimental design and Management of the Experimental Animals: Forty five mixed breeds of weaned rabbits were randomly divided into five treatment groups. Each group comprised of nine rabbits, which was

further sub-divided into three, such that each replicate groups of three rabbits were obtained for each sub-group with three rabbits per replicate. The rabbits were housed in cages and the floor of the cage were covered with wire mesh for faeces and urine to drop, thus, preventing the rabbits from coming in contact with them. The cages were enclosed in a house under intensive management system, where the floor was cemented. The walls were netted to the roof to prevent entry of foreign bodies and this enhanced cross ventilation. Before the commencement of the experiment, the rabbits were acclimatized for the period of five days, during this period, they were fed control diets. The rabbits were also treated against endo and ecto-parasites using sodex^{R} (deformer) and Ivomectin^{R} respectively. Further medications were administered where necessary. The experiment lasted for the period of twelve weeks.

Experimental Diets: The ground boiled *Senna occidentalis* Seed Meal (BSOSM) was mixed into rabbit's rations at 0.00, 2.50, 5.00, 7.50 and 10.00 % inclusion levels designated as T_1, T_2, T_3, T_4 and T_5 respectively.The compositon of the experimental diets is shown inTable1. Diet T_1, which contained 0.00 % BSOSM, was served as the control diet. The diets were pelleted by a using pelleting machine equipped with 4 mm screen size. The rabbits were fed with the respective ration *ad-libitum* from 6:00 am – 6:00 pm and was supplemented with water spinach (*Ipomoea aquatica*) from 6.00 pm - 6.00 am. Water was also made available to all the rabbits *ad-libitum*. The left over feed was collected and weighed on daily basis in order to know the feed intake. The feeders were cleaned every morning before the provision of fresh feed, and the drinkers were washed and rinsed with clean water every morning and evening.

Data Collection: The records of weekly body weight, weight gain and feed intake were kept while the feed conversion efficiency, protein efficiency and energy efficiency were calculated.

Economic benefit analysis: The method adopted by Yahaya (2014) was used. In this method, the following parameters were determined.

Feed cost / kg weight gain =FCR x cost / kg feed. ; Where FCR= Feed Conversion Ratio

Statistical Analysis: The performance records of the animals were subjected to one-way analysis of variance based on the completely randomized design (CRD) model (SAS, 2008 version 9.2). Duncan multiple range test (Duncan, (1955) was used to separate the means where significant at 5 % level of significance.

RESULTS AND DISCUSSION

Anti-nutritional factors of raw and boiled *Senna occidentalis* seeds: The results of the effects of boiling process on the anti-nutritional factors of *Senna occidentalis* seed are presented in Table2. The results showed that the percentages of cyanide, phytate, tannin, saponin and trypsin inhibitors in the raw Senna occidentalis seeds were reduced significantly (P<0.05) by the boiling process. The reduction observed in the content of cyanide, phytate, tannin, saponin and trypsin inhibitor are in line with the report of Yahaya (2014) who reported that boiling and malting are effective processes of removing anti-nutritional factors in *Senna occidentalis* seeds and also agreed with the findings of Omoikhoje *et al.* (2009) who observed higher percentage of reduction in ANFs of cooked Bambara nut and attributed it to broken down of intermolecular forces that bind the anti-nutritional factors together in Bambara nut.

Proximate composition of raw and boiled *Senna occidentalis* seeds: The proximate composition of raw and boiled *Senna occidentalis* seeds meal is presented in Table 3. The results show that boiling increased significantly (P<0.05) some nutrients present in *Senna occidentalis* seed used in this experiment. The level of crude protein, crude fibre, ether extract and dry matter content were increased significantly (P<0.05) in boiled *Senna occidentalis* seed meal; this is in line with the finding of Obun *et al.* (2011) who reported that boiling of leguminous seed concentrate the nitrogenous compounds by reducing the water molecules thereby improving the dry matter, crude protein and ether extract content. The NFE (nitrogen free extract), was increased significantly (P<0.05) in the boiled *Senna occidentalis* seed meals, which agreed with the finding of Yahaya (2014) who reported that boiling reduced the moisture and energy content of *Senna occidentalis* seed. The dry matter content of both raw and boiled *Senna occidentalis* seeds was moderately high. This indicated that the seeds whether raw or boiled could be stored for long period of time without spoilage, as the dry matter content values were within 85 to 100 % required for safe storage of foodstuff of plant origin (Anhwange *et al.*, 2004).

Table 1: Composition of the experimental diets

Parameters	T1(0.00)	T2 (2.50)	T3 (5.00)	T4 (7.50)	T5 (10.00)
Maize	36.00	36.50	37.00	37.00	37.50
Soybean	27.00	25.00	24.00	24.00	20.00
Blood meal	2.45	2.45	2.45	2.50	2.00
BSOSM	0.00	2.50	5.00	7.50	10.00
Rice offal	18.00	17.00	18.00	16.45	17.95
Maize offal	13.00	13.00	10.00	9.00	9.00
Bone meal	2.50	2.50	2.50	2.50	2.50
*Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.40	0.40	0.40	0.40	0.40
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20
Total	100	100	100	100	100
Calculated Nutrients					
Crude protein	18.05	18.02	18.03	18.05	18.00
Met. Energy (kcal/kg)	2999.26	3000.05	3003.63	3002.78	3004.11
Crude fibre	11.43	11.27	11.24	10.97	11.12
Calcium	1.01	1.02	1.03	1.03	1.02
Phosphorus	0.62	0.60	0.61	0.62	0.59

*To provide the following per 100 kg of the diet: 440 mg riboflavin, 720 mg calcium, 2 g pantothenate, 2 g niacin, 2.2 g chloride, 15 mg folic acid, 1 mg vitamin B_{12}, 15 mgretinol, 165g vitamin D_2, 1000 mg DL-tocopherol acetate, 1700 mg copper, 200 mg iodide, 3000 mg manganese, 5000 mg zinc,10,000 mg iron. 0.00: 0 % boiled *Senna occidentalis* Seed Meal 7.50: 7.5 % boiled *Senna occidentalis* Seed Meal 2.50: 2.5 % boiled *Senna occidentalis* Seed Meal 10.00: 10 % boiled *Senna occidentalis* Seed Meal. 5.00: 5 % boiled *Senna occidentalis* Seed Meal Met. = Metabolizable

Table 2: Anti-nutritional factors of both raw and boiled *Senna occidentalis* seed meals

Anti-nutritional factors	Raw	Boiled	% Reduction
Phytic acid(mg/100g)	503.10	356.38	29.16
Tannin(g/kg)	25.64	17.83	71.22
Cyanide(mg/100g)	18.07	6.49	64.08
Trypsin inhibitor(g/kg)	36.85	16.80	54.41

Table 3 Proximate composition of the experimental diets (%)

Parameters	T1 (0.00)	T2 (2.50)	T3 (5.00)	T4 (7.50)	T5 (10.00)
Dry matter	89.21	90.21	90.13	90.47	90.29
Crude protein	18.13	18.04	17.94	18.06	17.92
Ether extract	3.54	3.69	3.98	3.72	4.17
Crude fibre	11.02	10.86	10.74	10.68	10.55
Ash	8.72	8.86	9.23	9.08	9
NFE	47.8	48.76	48.24	48.93	48.65
Total	100	100	100	100	100

*NFE: Nitrogen Free Extract; Diet 1(T1) = 0% SOSM; Diet 2(T2) =2.5% SOSM Diet 3(T3) =5.0% SOSM; Diet 4(T4) =7.5% SOSM; Diet 5(T5) =10.0) % SOSM

Table 4: Growth performance of weaner rabbits fed graded levels of pelleted boiled *Senna occidentalis* seed meal

Parameters	T1 (0.00)	T2 (2.50)	T3 (5.00)	T4 (7.50)	T5 (10.00)	SEM	LS
Initial body weight (g)	546.67^{a}	548.33^{a}	548.33^{a}	548.33^{a}	546.67^{a}	20.35	NS
Final body weight (g)	1175.00^{bc}	1200.00^{bc}	1410.00^{ab}	1550.00^{a}	1053.30^{c}	119.42	**
Av.d.body wt gain (g)	7.48^{bc}	7.66^{bc}	10.26^{ab}	11.94^{a}	6.03^{c}	1.40	**
Av.d. feed intake (g)	56.50^{a}	53.34^{b}	45.51^{c}	43.93^{c}	40.48^{d}	0.97	**
FCR	7.88^{c}	6.96^{bc}	4.47^{ab}	3.78^{a}	7.20^{c}	1.16	**
PER	1.43^{c}	1.25^{bc}	0.81^{ab}	0.68^{a}	1.30^{c}	0.21	**
EER	2.36^{c}	2.08^{bc}	1.34^{ab}	1.14^{a}	2.17^{c}	0.30	**

Av.d =Average daily, FCR=Feed conversion ratio, EE=Energy efficiency, PER=Protein Efficiency ratio, SEM = Standard error of the mean, LS = Level of significance.

Table 5 Percentage carcass cuts relative to dressed weight of rabbits fed graded levels of pelleted boiled *Senna occidentalis* seed meal

Parameters	T1 (0.00)	T2 (2.50)	T3 (5.00)	T4 (7.50)	T5 (10.00)	SEM	LS
Hind leg	21.62^{a}	22.23^{a}	21.45^{a}	19.86^{ab}	18.40^{b}	1.20	**
Fore leg	23.02^{a}	12.35^{b}	12.75^{b}	12.61^{b}	21.42^{a}	0.73	**
Loin	23.77^{ab}	21.67^{ab}	23.14^{ab}	24.76^{a}	20.66^{b}	1.71	**
Rib	16.97^{bc}	16.01^{c}	19.35^{a}	17.83^{b}	16.17^{c}	0.72	**

^{a,b,c} Means in the same row with different superscripts are significantly ($P < 0.05$) different, LS: Level of significance, **: Significant, SEM : Standard Error of the Mean.

0.00: 0 % boiled *Senna occidentalis* Seed Meal ;2.50: 2.5 % boiled *Senna occidentalis* Seed Meal;5.00: 5 % boiled *Senna occidentalis* Seed Meal;7.50: 7.5 % boiled *Senna occidentalis* Seed Meal;10.00: 10 % boiled *Senna occidentalis* Seed Meal

Table 6: Organ percentages relatives to dressed weight of weaner rabbits fed graded levels of pelleted boiled *Senna occidentalis* seed meal

Parameters	T1 (0.00)	T2 (2.50)	T3 (5.00)	T4 (7.50)	T5 (10.00)	SEM	LS
Liver	6.57^{a}	4.17^{b}	3.90^{b}	3.94^{b}	3.77^{b}	0.42	**
Lung	2.28^{a}	1.87^{b}	1.32^{c}	1.08^{d}	1.23^{cd}	0.07	**
Kidney	1.72^{a}	1.59^{ab}	1.50^{b}	1.29^{c}	1.25^{c}	0.09	**
Heart	0.62^{a}	0.46^{c}	0.55^{b}	0.38^{d}	0.63^{a}	0.03	**
Spleen	0.26^{a}	0.19^{b}	0.16^{b}	0.16^{b}	0.14^{b}	0.03	**

SEM = Standard error of the mean, LS = Level of significance.

Table 7: Economic characteristics of rabbits fed graded levels of pelleted boiled *Senna occidentalis* seed meal

Parameters	T1 (0.00)	T2 (2.50)	T3 (5.00)	T4 (7.50)	T5 (10.00)	SEM	LS
Feed intake(g)	4746.00^{a}	4480.56^{b}	3822.84^{c}	3690.12^{c}	3400.39^{d}	81.91	**
Cost of feed (₦/kg)	155.30^{a}	152.70^{b}	151.40^{c}	150,00^{d}	148.10^{e}	0.00	**
Total cost of feed (₦)	736.82^{a}	684.05^{b}	578.76^{c}	533.52^{c}	503.52^{d}	12.23	**
Weight gain (g)	628.30^{bc}	651.70^{bc}	868.30^{ab}	1003.30^{a}	506.70^{c}	117.85	**
Cost/kg wt gain (₦)	1224.20^{a}	1062.50^{ab}	676.30^{bc}	563.20^{c}	1066.20^{ab}	176.14	**

SEM = Standard error of the mean, LS = Level of significance.

Growth performance of weaner rabbits fed graded levels of pelleted boiled *Senna occidentalis* seed meal: The results of the effect of graded levels of pelleted boiled *Senna occidentalis* seed meal on growth performance of weaner rabbits are presented in Table 4.. The best performance in final body weight, average daily body weight gain, feed conversion ratio, protein efficiency ratio and energy efficiency recorded in those rabbits fed 7.5 % BSOSM might be attributed to nutritional quality of boiled *Senna occidentalis* seed meal. This is in agreement with the findings of Augustine *et al.* (2010) who reported that feeding of processed *Cassia obtusifolia* to broiler chickens increased weight gains and reduce feed conversion ratio. The average daily feed intake was gradually reduced as the levels of BSOSM increased in the diet which agreed with the findings of Yahaya (2014) who reported that the feed intake of guinea fowls decreased progressively as the levels of boiled *Senna occidentalis* seed meal increased in the diet. The lowest final bodyweight obtained in rabbits fed 10 % BSOSM could be as a result of lower feed intake which might be attributed to higher levels of anti-nutritional factors in *Senna occidentalis* seed meal contained in the diet as reported by Midala *et al.* (2013). This is an evidence that boiling did not completely remove the anti-nutritional factors in the feedstuff (Yahaya, 2014).

Carcass cuts percentages relative to dressed weight of rabbits fed graded levels of pelleted *Senna occidentalis* seed meal: The carcass cut up - parts as percentage of dressed weight of rabbits fed graded levels of pelleted boiled *Senna occidentalis* seed meal are presented in Table5. The rabbits fed 10 % BSOSM had lower hind leg, loin and ribs as percentage of dressed weight except forelegs that are lower in those rabbits fed 2.5 % BSOSM which could be attributed to lower feed intake as this agreed with the finding of Amaefule (2001), who reported that rabbits might have been surviving on less feed due to high level of anti-nutritional factors. The hind legs weight recorded in this experiment was lower; but the fore legs, loin and ribs as percentage of dressed weight were higher than the values reported by Jiya (2012). The difference observed in this study may be as a result of different protein quality used in the diets.

The weight of the internal organs as percentage relative to dressed weight of rabbits fed graded levels of pelleted boiled *Senna occidentalis* seed meal are presented in Table 6. The results showed significant differences ($P<0.05$) in all the parameters measured. Similar pattern of percentage was observed in the liver,

lung, kidney, heart and spleen which decreased progressively as the inclusion levels of BSOSM increased in the diets. This agreed with the finding of Yahaya (2014) who reported that the heart and lung of guinea fowls were reduced as inclusion levels of BSOSM increased in the diet of guinea fowls and attributed it to the negative impact of anti-nutritional factors in *Senna occidentalis* seed. Also, Tasaka *et al.* (2000) reported cardiomyopathy. in group of rabbits fed 4 % raw *Senna occidentalis* seed meal and concluded that the liver and heart were the most affected organs.

Economic characteristics of rabbits fed graded levels of pelleted boiled *Senna occidentalis* seed meal: The results of the economic characteristics of rabbits fed graded levels of pelleted boiled *Senna occidentalis* seed meal are presented in Table 7. The levels of inclusion of BSOSM had effect in all parameters measured. The feed intake decreased as the inclusion levels of BSOSM increased in the diet. This result agreed with the findings of Yahaya (2004) who reported that the feed intake of guinea fowls decreased as the inclusion levels of processed *Senna occidentalis* increased in the diets .The cost of producing 1 kg diets varied from ₦155:30 to ₦148:10. The lowest cost of producing 1 kg diets recorded by those rabbits fed 10 % BSOSM was due to cheap cost of *Senna occidentalis* seed. The highest weight gain recorded by those rabbits fed 7.5 % was in agreement with findings of Yahaya (2014) who reported that feeding boiled *Senna occidentalis* seed meal diet to guinea fowls increased weight gain and was equally cost effective. The cheapest cost of feed per kg weight gain of ₦563:20 was recorded in rabbits fed 7.5 % BSOSM. This might be attributed to nutritional quality of boiled *Senna occidentalis* seed which is in agreement with finding of Augustine *et al.* (2010) who reported that feeding of processed *Cassia obtusifolia* to broiler chickens increase weight gain and reduced cost of production.

CONCLUSION AND RECOMMENDATION

This study show that pelleted *Senna occidentalis* seed meal could be of good nutritional quality if the anti-nutritional factors are removed; the highest body weight gain and the cheapest cost of feed per kg body weight gain were recorded at 7.5 % dietary inclusion level of boiled *Senna occidentalis* seed meal.This level could be tolerated by the rabbits, and is also cost effective. It could then be recommended that up to 7.5 % boiled *Senna occidentalis* seed meal can be included in the diets of weaner rabbits. Further researches should be carried out to explore other processing methods on *Senna occidentalis* seed

with aim of making it more available in the livestock industry.

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