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Growth performance and nutrient digestibility of broiler chickens fed diets containing varying inclusion levels of dried watermelon rind at the starter phase

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Abstract

Watermelon rind is one of the several unwanted by-products generated by restaurants, fruit juice producers and food industries in Nigeria that can be gotten rid of by using it as an energy source in broiler production. The growth performance and apparent nutrient digestibility of broilers fed diets containing varying inclusion levels of dried watermelon rind (DWMR) in replacement for wheat offal as source of energy and fibre at starter phase was evaluated. The dried watermelon rind was prepared by sun-drying fresh watermelon for three days and oven-dried at 50 ºC for 2 hours. The birds were randomly allocated to five (5) treatments ($T_1 – T_5$), each treatment had three replicates with ten (10) birds per replicate. The birds were fed varied levels of DWMR at 0 %, 25 %, 50 %, 75 % and 100 % in replacement of wheat offal to obtain five diets. Feed and water were provided ad-libitum throughout the 28 days study duration. Body weight, Body weight gain, Feed intake, Feed conversion ratio and apparent nutrient digestibility were measured. The results obtained on the growth performance shows no significant (P>0.05) difference of the growth parameters across treatments. However, there was significant (P<0.05) difference in the digestibility of Crude fibre, Ether extract, Ash, Nitrogen free extract and Total digestible nutrient across treatments. There was no obvious variation in dry matter and crude protein digestibility. The result of the total digestible nutrient was significantly (P<0.05) higher in T_2 (92.90 %) than the T_1 (84.99 %) which was the control diet. The crude fibre digestibility recorded in T_2 (63.48 %) and T_1 (61.09 %) is higher than T_5 (43.00 %), the ether extract digestibility of T_1 (96.42 %) is higher than the other groups with the lowest in T_4 (95.25 %). There was depress ash digestibility in T_5 (68.30 %), lower than the other groups with the highest in T_1 (82.59 %). The study therefore concluded that farmers can replace wheat offal with 25 % watermelon rind in broiler starter diet without any deleterious effect in the growth performance and nutrient digestibility.

Keywords: Broilers, Starter, Growth, Digestibility, Watermelon, Rind

La Performance de croissance et digestibilité des éléments nutritifs des poulets de gril nourris avec des régimes alimentaires contenant différents niveaux d'inclusion de croûte de pastèque séchée à la phase de démarrage

Résumé

La croûte de pastèque est l'un des nombreux sous-produits indésirables produits par les restaurants, les producteurs de jus de fruits et les industries alimentaires au Nigéria qui peuvent être débarrassés en l'utilisant comme source d'énergie dans la production de poulets à griller. La performance de croissance et la digestibilité apparente des éléments nutritifs des poulets de grillage nourris selon des régimes alimentaires contenant différents niveaux d'inclusion de la croûte de pastèque séchée (DWMR) en remplacement des aals de blé comme source d'énergie et de fibres à la phase de démarrage ont été évaluées. La croûte de pastèque séchée a été préparée par pastèque fraîche séchée pendant trois jours et séchée au four à 50

°C pendant 2 heures. Les oiseaux ont été attribués au hasard à cinq (5) traitements (T1 - T5), chaque traitement avait trois répliques avec dix (10) oiseaux par réplique. Les oiseaux ont été nourris à des niveaux variés de DWMR à 0 %, 25 %, 50 %, 75 % et 100 % en remplacement des aals de blé pour obtenir cinq régimes alimentaires. L'alimentation et l'eau ont été fournies ad-libitum tout au long de la durée de l'étude de 28 jours. Le poids corporel, le gain de poids corporel, l'apport alimentaire, le rapport de conversion des aliments pour animaux et la digestibilité apparente des nutriments ont été mesurés. Les résultats obtenus sur la performance de croissance ne montrent aucune différence significative (P>0,05) des paramètres de croissance entre les traitements. Cependant, il y avait une différence significative (P<0,05) dans la digestibilité des fibres brutes, extrait d'éther, cendres, extrait sans azote et nutriment digestible total entre les traitements. Il n'y avait aucune variation évidente dans la matière sèche et la digestibilité brute de protéine. Le résultat du nutriment digestible total a été significativement (P<0,05) plus élevé en T2 (92,90 %) que le T1 (84,99 %) qui était le régime de contrôle. La digestibilité des fibres brutes enregistrée en T2 (63,48 %) et T1 (61,09 %) est plus élevé que T5 (43,00 %), la digestibilité de l'extrait d'éther de T1 (96,42 %) est plus élevé que les autres groupes ayant le plus faible taux de T4 (95,25 %). Il y avait une digestibilité déprimante des cendres en T5 (68,30 %), inférieure à celle des autres groupes ayant le taux le plus élevé en T1 (82,59 %). L'étude a donc conclu que les agriculteurs peuvent remplacer les aals de blé par 25 % de croûte de pastèque dans le régime de démarrage des poulets à griller sans aucun effet délétère dans la performance de croissance et la digestibilité des nutriments.

Mots-clés: Poulets à griller, Démarreur, Croissance, Digestibilité, Pastèque, Rind

Introduction

The search for alternative feed ingredients is an on-going struggle, aimed at using available local feed resources, crop residues and agro byproducts, to feed livestock as to ensure sufficient animal protein intake and food security for the Nigerian state. These fight has been intensified of recent on account of the skyrocketing prices of conventional feed ingredients such as maize, wheat bran, groundnut cake soya beans and fish meal (Okai *et al*., 2010). Feed accounts for70-80 % of the total cost in broiler production (Saina, 2003). Conventional feed ingredients such as broiler energy and protein concentrates used in the formulation of broiler diets are predicted to be in short supply in a few years to come due to high demand (Farrel, 1997). Robinson and Singh *et al.* (2001) suggested that the major factor that will contribute to this shortage is competition with human requirements and expanding intensive livestock production. Crop residues and agro byproducts undoubtedly possesses immense potentials as feed ingredients for livestock in general and poultry in particular. Prominent among these crop residues and agro byproducts is watermelon rind. Nigeria is one of the leading producers of watermelon in Africa, and the largest production of the crop comes from the Northern part of country, where the suitable agro ecology is found (Bosede *et al*., 2012). Watermelon rind is one of the several unwanted by-products generated by restaurants, fruit juice producers and food industries in Nigeria. A great quantity of this waste is got rid of indiscriminately into the environment thereby causing pollution one way or the other. Alagbe (2018) and Okia *et al.* (2010) had reported the potentials of dry watermelon rind as an energy source in rabbit's nutrition. This paper therefore investigated the growth performance and nutrients digestibility of broilers fed diets containing varying inclusion levels of dried watermelon rind at starter phase.

Materials and methods

Experimental location

The experiment was conducted at the poultry unit of the Teaching and Research Farm, Federal University of Technology, Minna, Niger State. Minna is within latitude 09° 36' 50" N and longitude 06° 33' 25" E (Minna Niger Geography, 2004 - 2017) with an altitude of 700, 000 metres above sea level, day light temperature fluctuates to 38 ºC at the onset of wet season to 28 ºC at the middle of wet season and average annual rainfall is 1209.7 mm (Federal University of Technology, Minna, Students Handbook, 2017).

Experimental animals, treatments and design

One hundred and Fifty, one day-old broiler (mixed sex/Ross 308 strain) chicks were purchased from Agritech Farm in Ibadan, Oyo-state. The watermelon rinds were variously sourced from fruit vendor stands in Minna. The fresh rind obtained were washed with clean water and cut into pieces and then sundried for 3 days before being oven dried for 2 hours at 50 ºC. Maize, Groundnut cake (GNC), Fish meal, Limestone, Bone meal, Salt, broiler premix, methionine and lysine used to compound the feed were sourced from Kure ultramodern market, Minna, Niger State. In a Completely Randomized Design (CRD), 30 chicks were allotted to five treatments and three replicates of 10 birds making a total of 150 broiler chickens. Treatment 1 which served as control contained 0 % DWMR replacement level of wheat offal while treatments 2, 3, 4 and 5 had 25 %, 50 %, 75 % and 100 % replacement levels, respectively (Table 1). **The ingredient composition of the f**ive experimental diet is as presented in Table 2. The nutrient composition of the diets was such that dietT_1 contained 22.48 % CP, diets T_2, T_3, T_4 and T_5 contained 22.48 %, 22.46 %, 22.45 % and 22.44 % CP, respectively. Also T_1 contained 2834.52 Kcal/ kg Metabolizable energy, diets T_2, T_3, T_4 and T_5 contained 2826.68 Kcal/ kg, 2800.48 Kcal/ kg, 2773.76 Kcal/ kg and 2747.45 Kcal/ kg ME, respectively. The experiment lasted for 28 days in an intensive management system. Two weeks to the arrival of the birds, the pen was washed, fumigated and disinfected with Izal® and allowed to dry. Coal lit stoves were used to provide heat for the birds during the brooding period. The chicks were vaccinated against Newcastle disease in the first week, Gumboro disease in second week, Lasota in third week, second dose of Gumboro disease in fourth week and anti-biotics, dewormers, coccidiostats and multivitamins were provided as required. Clean drinking water was offered *ad libitum* over the experimental period of 8 weeks. The birds in all treatments were kept under the same management system. Proximate analysis of feed was carried out using the procedure of AOAC (2012) while data on growth parameters and apparent nutrient digestibility were also obtained.

Statistical analysis

The data were subjected to one-way analysis of variance (ANOVA) in a completely randomized design arrangement using the Statistical Package for Social Scientists (SPSS, 2007). Where differences occurred; Duncan version 17.0 was used to separate means.

Table 1. Experimental diets and their inclusion levels

Diets	Inclusion levels
Diet 1:	0 % inclusion of sundried watermelon rind (as control)
Diet 2:	25 % inclusion of sundried watermelon rind
Diet 3:	50 % inclusion of sundried watermelon rind
Diet 4:	75 % inclusion of sundried watermelon rind
Diet 5:	100 % inclusion of sundried watermelon rind.

Table 2. Ingredients composition of experimental diets

Ingredient	0% DWMR	25% DWMR	50%DWMR	75% DWMR	100% DWMR
Maize	54.50	54.17	53.90	53.58	53.30
GNC	33.00	33.33	33.60	33.92	34.20
Wheat offal	5.00	3.75	2.50	1.25	0.00
Fishmeal	3.00	3.00	3.00	3.00	3.00
DWMP	0.00	1.25	2.50	3.75	5.00
Bonemeal	3.50	3.50	3.50	3.50	3.50
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Calculated value					
Crude protein	22.48	22.48	22.46	22.45	22.44
M.E (Kcal/kg)	2,834.52	2,826.68	2,800.48	2,773.76	2,747.45
Crude fibre	3.71	3.60	3.48	3.70	3.25
E.E	4.52	4.46	4.40	4.35	4.29
Calcium	1.12	1.12	1.12	1.12	1.12
Phosphorus	0.71	0.70	0.68	0.67	0.65

Key- DWMR: Dried Watermelon Rind ; GNC: Groundnut Cake; E.E: Ether Extract; M.E: Metabolizable Energy.

Results

Proximate analysis of dried watermelon rind

The results of the proximate analysis of the dried watermelon rind are shown in Table 3. The results shows that dried watermelon rind contains 92.00 % dry matter, 12.25 % crude protein, 8.64 % ether extract, 11.50 % ash, 15.50 % crude fibre and 44.11 % nitrogen free extract. The crude protein and ash values of the proximate analysis is closely related to that of Al-Sayed and Ahmed (2013), and the crude fibre, ether extract and NFE are in line with that of Feumba *et al*. (2016) and Alagbe (2018).

Proximate composition of the experimental starter diet (0 - 4 weeks)

The results of the proximate composition of the experimental diet at starter phase are shown in Table 4. The result obtained shows that the dry matter in the diets ranges from 90.40 – 91.00 % while crude protein, crude fibre, ash, ether extract and nitrogen free extracts ranges from 21.35 – 22.75 %; 2.50 – 3.00 %; 8.00 – 10.00 %; 10.00 – 17.00 % and 38.75 – 46.70 % respectively. Treatment 1 had the highest crude protein value (22.75%) while treatment 4 had the least crude protein value (21.35%). The dry matter was higher (91.00 %) in treatment 3 & 4 and least (90.40 %) in treatment 5.

Growth performance of broiler fed diets containing various inclusion levels of dried watermelon rind at starter phase (0 - 4 weeks)

The results of growth performance of broiler chickens fed diets containing various inclusions of dried watermelon rind in replacement of wheat offal at the starter phase are presented in Table 5. The results obtained shows no significant ($P>0.05$) difference and no particular trend was noticed in any of the growth variables (final body weight of the birds, mean body weight, mean body weight gained, average feed intake, feed conversion ratio, protein efficiency and energy efficiency ratio of the birds) measured across the treatments.

Nutrient digestibility of broiler chicken with the inclusion of dried watermelon rind at starter phase (0 - 4 weeks)

The results of nutrient digestibility of broiler chickens fed diets containing various inclusions of dried watermelon rind in replacement of wheat offal at the starter phase are presented in Table 6. The results obtained shows that dry matter and crude protein were not significantly (P>0.05) affected by the replacement of dried watermelon rind. However, crude fibre, ether extract, ash and NFE were significantly (P<0.05) affected, although no particular trend was noticed in the apparent nutrient digestibility. Treatment 2 recorded highest crude fiber digestibility (63.48 %) while treatment 4 record the least (43.00 %). Treatment 1 had the highest ether extract digestibility (96.42 %) while treatment 4 recorded the least (95.25 %). Treatment 1 had highest ash digestibility (82.59 %) while treatment 5 recorded the least (68.30 %). Treatment 1 had highest nitrogen free extract digestibility (94.74 %) while treatment 3 recorded the least (91.47 %). The results of total digestible nutrient shows that treatment 2 (92.90 %) had significantly (P<0.05) different TDN compared to others with treatment 1 recording the lowest (84.99 %).

Table 3.Proximate analysis of dried watermelon rind

Items (g/100g)	Content in DWMR (%)
Dry matter (DM)	92.00
Crude Protein (CP)	12.25
Ether Extract (EE)	8.64
Ash	11.50
Crude Fibre (CF)	15.50
Nitrogen Free Extract (NFE)	44.11

Key- DWMR: Dried Watermelon Rind;

Table 4. Proximate composition of the experimental starter diets (0 - 4 weeks)

Proximate composition	0% DWMR	25% DWMR	50%DWMR	75% DWMR	100% DWMR
Moisture (%)	9.40	9.20	9.00	9.00	9.60
Crude Protein (%)	22.75	22.05	22.40	21.35	21.70
Ether Extract (%)	10.00	17.00	13.50	15.00	11.50
Crude Fibre (%)	2.50	3.00	3.00	2.50	2.50
Ash (%)	10.00	10.00	8.50	10.00	8.00
Nitrogen Free Extract (%)	45.35	38.75	43.60	42.15	46.70
Dry matter (%)	90.60	90.80	91.00	91.00	90.40

Key- DWMR: Dried Watermelon Rind

Table 5. Growth performance of broiler chickens with the inclusion of fed dried watermelon rind at starter phase (0 - 4 weeks)

Parameters	0% DWMR	25% DWMR	50%DWMR	75% DWMR	100% DWMR	SEM	LS
Initial weight (g)	47.57	47.30	46.97	47.20	47.30	0.21	NS
Final weight (g)	138.78	141.69	141.71	145.04	138.97	1.99	NS
Body weight gain (g)	178.30	174.54	181.63	187.09	177.19	4.22	NS
Weekly weight gain (g)	44.58	43.64	45.41	46.77	44.30	1.05	NS
Average feed intake (g)	106.46	109.09	114.89	111.72	105.24	1.82	NS
Feed conversion ratio	2.42	2.49	2.54	2.43	2.45	0.04	NS
Protein efficiency ratio	1.84	1.81	1.97	1.96	1.94	0.04	NS
Energy efficiency ratio	0.15	0.14	0.14	0.15	0.15	0.003	NS

Key- DWMR: Dried Watermelon Rind, SEM: Standard Error of Mean; LS: Level of significance; NS: No significant difference.

Table 6. Nutrient digestibility of broiler chicken with the inclusion of dried watermelon rind at starter phase (0 - 4 weeks)

Parameters	0% DWMR	25% DWMR	50% DWMR	75% DWMR	100% DWMR	SEM	LS
Dry matter (%)	86.62	88.55	86.40	86.99	87.55	1.91	NS
Crude Protein (%)	82.67	81.51	78.50	77.27	78.50	3.21	NS
Crude Fibre (%)	61.09^{a}	63.48^{a}	59.54^{a}	43.00^{b}	52.99^{ab}	9.18	*
Ether Extract (%)	96.42^{a}	95.59^{ab}	96.00^{ab}	95.25^{b}	95.70^{ab}	0.63	*
Ash (%)	82.59^{a}	78.09^{a}	75.41^{a}	79.27^{a}	68.30^{b}	5.91	*
Nitrogen Free Extract (%)	94.74^{a}	94.09^{a}	91.47^{b}	93.41^{a}	94.73^{a}	1.49	*
Total Digestible Nutrient (%)	84.99^{c}	92.90^{a}	88.41^{b}	89.09^{b}	87.44^{bc}	2.91	*

Key- abc, means in the same row with different superscript are significantly different (P>0.05); DWMR: Dried Watermelon Rind, SEM: standard error of mean; LS: Level of significance; NS : No significant difference; *: There is significant difference.

Discussion

There was no significant (P>0.05) difference in the growth performance of the birds on various parameters such as feed intake, final body weight, body weight gain and feed conversion ratio at starter phase. This observation is in line with the result obtained by Okai *et al.* (2010) who observed no significant difference on feed intake and body weight gain on albino rats fed varying levels of watermelon rind and also similar to the report of Alagbe (2018) on growth parameters were also not significant on supplementing watermelon rind on weaner rabbits.

The result obtained from the apparent nutrient digestibility indicated that there was no significant (P>0.05) difference in the dry matter and crude protein digestibility. This observation may be due to low feed intake and this compare favourably to the findings obtained by Machado *et al.* (2012) who reported that supplementing simplified diets can lead to lower feed intake which can result to corresponding decrease in dry matter and crude protein digestibility on rabbits. The crude fibre digestibility shows that T_2 (63.48 %) and T_1 (61.09 %) were significantly (P<0.05) higher than T_5 (43.00 %). This variation could be due to the higher watermelon inclusion (100 %) in the diet of T_5 and is in line with the work of Igoche (2015) on broilers that watermelon contains tannin which may render nutrients unavailable for proper digestion (Kumar, 2012). The ether extract (lipid) digestibility of T_1 (96.42 %) was significantly (P<0.05) higher than the other groups with the least in T_4 (95.25 %) which may be due to the lower lipid content in the treatment diet (10.0 %) compared to the other groups (17.0 %, 13.5 %, 15.0 % and 11.5 % in the diet of T_2, T_3, T_4 and T_5 respectively) and this relates to the result observed by Mukhtar *et al.* (2016) that over indulgence of lipid can result to hindrance in it digestibility. The depressed ash digestibility in T_5 (68.30 %) was significantly (P<0.05) lower compare to the other treatment groups with the highest in T_1 (82.59 %) which correlates with the work of Asar *et al.* (2010) on rabbits that fruit peels contain higher amount of anti-nutritional factors. This may be due to the phytic acid and oxalate content in the water melon rind, phytase bind minerals and inhibits their absorption in the intestine (Kolawole *et al.*, 2013).

The result of the total digestible nutrient was significantly (P<0.05) higher in T_2 (92.90 %) than in T_1 (84.99 %). This may be due to the citrulline and lycopene content of water melon as it was reported that citrulline and lycopene improve the gastro-intestinal tract and cures urinary tract infections of broilers and this is related to

the findings of Oluremi *et al*., (2007) on broilers, which reported that phytochemicals when present in adequate quantity can favourably improve nutrient digestibility of livestock.

Conclusion

The study showed that dried watermelon rind can be included up to 25 % in replacement of wheat offal as fibre and energy source without having any deleterious effect on the growth performance of broiler chickens at starter phase. Also the replacement at 25 % can effectively improve the crude fibre digestibility and total digestible nutrient for broilers at starter phase.

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