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Performance and digestibility of nutrients by broiler finishers fed graded levels of *Mucuna pruriens* seed meal

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ABSTRACT

High demand and expensive nature of conventional basal feed stuffs (such as soybean and groundnuts) used in poultry diets as protein source has led to search for non-conventional and cheaper basal feed sources which could be used as alternative protein feedstuffs. *Mucuna pruriens* seed is one of the alternative feed ingredients identified. A four week feeding trial was conducted to evaluate the effect of boiled Mucuna seed meal (BMSM) on the growth performance and the digestibility of nutrients by four week-old broiler finisher chicks. Three hundred and fifteen (315) broiler chicks were randomly allocated to five experimental treatment diets in a completely randomized design (CRD). Each treatment was replicated thrice having twenty-one (21) birds per pen. BMSM was prepared and fed in graded levels of 10.0, 20.0, 30.0, and 40.0% alongside control diet of 0.0 BMSM. Feed and water were given to the birds *ad libitum*. The parameters measured and calculated include final body weight, weight gain, feed intake, feed to gain ratio and feed cost per kilogram gain. Digestibility of dry matter, crude protein, crude fibre, ether extract, ash and nitrogen free extract were also calculated. Haematological samples were collected into a sterile, universal bottles containing Ethylene diamine tetraacetic acid (EDTA) and assayed. The data collected were subjected to analysis of variance (ANOVA) at 0.05 level of probability. The results showed that the final body weight of birds at 0% (2528.03^{a}), 10% (2500.00^{a}), and 20% (2500.67^{a}); the weight gain at 0% (1434.03^{a}), 10% (1405.00^{a}) and 20% (1405.67^{a}); feed intake at 0% (3270.63^{a}), 10% (3280.91^{a}) and 20% (3280.42^{a}) as well as feed to gain ratio at 0% (2.28^{a}), 10% (2.30^{a}) and 20% (2.33^{a}) levels of inclusion of BMSM were statistically (P>0.05) similar. They were however, significantly (p<0.05) higher than those from 30% and 40% levels of inclusion. Feed cost per kilogram weight gain and feed cost per bird were lower for all BMSB diets when compared to the control diet. Digestibility of nutrients (DM, CP, CF, EE, Ash and NFE) was similar and better for the birds fed the control, 10.0 and 20.0% BMSM based diets than those on 30 and 40% BMSM based diets. There were no significant differences (P>0.05) between the treatment means for *packed* cell volume (PCV), heamoglobin (Hb) and Total protein (Tp). It was concluded that inclusion of BMSM in the diets of broiler finisher chicks up to 20% has beneficial effects.

Keywords: Broiler chicks, *Mucuna pruriens*, Digestibility, Graded levels

Introduction

The global demand for livestock products will require increasing amounts of feed protein supplies and sources which usually come with its attendant high cost Akinola *et al*., (2020). In Nigeria, the Livestock industry has not been able to supply sufficiently the much

needed animal protein by the populace. Poultry production, especially the broiler chickens remains one of the dynamic ways of attaining sustainable and rapid production of high quality protein to meet the increasing demand of the Nigeria teeming populace (Apata and Ojo, 2002), due to short generation interval of 6-8 weeks of broiler chickens (Akinmutimi, 2004), but one of the main challenges in poultry enterprise is high cost of feed which is estimated to be about 78.8% of the total cost of production (Akure *et al.*, 2020). This high cost has been attributed to the over-dependence on the expensive conventional feed stuffs such as soybean and groundnut cake which is mainly used in poultry feed formulation (Emenalon and Udedibie, 1998). A high demand for these feed ingredients has resulted in an increase in their prices and consequently, cost of poultry feeds and its products (Akinmutimi and Okwu, 2006). This necessitates research into non-conventional feedstuffs (NCF) that are readily available, cheap and nutritionally safe.

One of these NCF is *Mucuna pruriens* seeds (Akure, 2013) which is a widely available leguminous seed found in the forest, it thrives well where others fail due to excellent adaptability to extreme climatic conditions. It yields about three to four tonnes of seed per hectare. It is a potential source of protein because it is very high in crude protein. It has a crude protein of about 29.89% (Akure, 2013).This research aims at evaluating the effect of feeding Boiled *Mucuna* seed meals on the growth performance and nutrient digestibility when included at different levels in the diet of broiler finishers.

Materials and Methods

Experimental site:

The experiment was conducted at the poultry section, Department of Livestock, Ministry of Agriculture, Mariri, in Kumbotso Local Government Area of Kano State. The area lies between latitude 11^{o}55'N and longitude 8^{o}36'E at an altitude of 460m above sea level with an average annual rainfall of 600-1000mm, mean temperatures of 21.21^{o}C and humidity of 52.81 %. (KNARDA, 2011).

Preparation of experimental Diets:

Five experimental diets were formulated. The inclusion levels of processed Mucuna seed meal were as follows T1- 0% BMSM, T2-10.0% BMSM, T3-20.0% BMSM, T4 -30.0% BMSM, T5 -40% BMSM, The feed composition for the broiler finisher is shown in Table 1.

Table: 1 Gross composition of experimental diet (Broiler finisher) % containing Boiled *Mucuna* seed meal (BMSM)

Ingredients (%)	Levels of BMSM, %				
	0	10.00	20.00	30.00	40.00
Maize	55.05	51.80	46.95	39.00	32.25
Groundnut cake	25.00	18.25	13.10	11.05	7.80
Mucuna seed meal	0.00	10.00	20.00	30.00	40.0
Soybean meal	8.00	8.00	8.00	8.00	8.00
Maize offal	5.00	5.00	5.00	5.00	5.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	1.00	1.00	1.00	1.00	1.00

Common salt	0.30	0.30	0.30	0.30	0.30
Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.10	0.10	0.10	0.10	0.10
*Vitamin/trace min.premix	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**
Calculated Analysis (%)					
ME (Kcal/kg)	3001	3000	3112	3020	3025
Crude Protein	20.00	20.00	20.00	20.00	20.00
Crude fibre	4.35	4.78	6.46	7.85	7.95.
Ether Extract	7.80	7.92	7.45	7.00	6.95
Ash	6.40	6.45	6.40	6.42	6.35
Calcium	1.25	1.29	1.27	1.28	1.29
Available Phosphorus	0.78	0.79	0.70	0.74	0.74
Lysine	1.20	1.22	1.24	1.20	1.22
Methionine	0.57	0.59	0.51	0.57	0.58
Methionine + Cystine	0.75	0.72	0.70	0.72	0.70
Cost/kg diet (₦)	171.15	168.22	167.45	163.75	160.50

*Biomix Premix supplied per kg of diet: Vit. A, 10000 I.U; Vit.D_3, 2000 I.U; Vit.E, 23mg; Vit.K, 2mg; Vit.B1 (Thiamine), 1.8mg; Vit.B2 (Riboflavin), 5.5mg; Vit. B6 (Pyridoxine), 3.0mg; Vit B12, 0.015mg; Pantothenic acid, 7.5mg; Folic acid, 0.75mg; Niacin, 27.5mg; Biotin, 0.06mg; Choline chloride, 300mg; Cobalt, 0.2mg; Copper, 3mg; Iodine, 1mg; Iron, 20mg; Manganese, 40mg; Selenium, 0.2mg ; Zinc, 30mg; Antioxidant, 1.25mg; I.U; International unit; M.E., Metabolisable Energy.

Management of experimental birds

A total of three hundred and fifteen (315) four-week old chicks were used for this study. The birds were randomly assigned to pens in a completely randomized design (CRD). There were five treatments and each treatment was replicated three times with 21 birds per pen which constituted sixty three birds per treatment. The routine management such as cleaning of in and out of the poultry house was carried out, The management of the birds was carried out according to the standard procedures for brooding, vaccination and medication (NRC, 1994). Birds were supplied with experimental diets and fresh water *ad libitum* throughout the trial period.

Performance study

The performance characteristics were measured in terms of weight gain, feed intake, and feed to gain ratio. The birds were weighed at the beginning of the experiment and allotted into pens in a completely randomized design (CRD). The birds and feed were weighed weekly to calculate the feed intake and the weight gain. The average final weights of the birds were also calculated at the end of the experiment.

Digestibility study

At the end of the experiment the birds were weighed and after the final weighing, one bird per pen (3 per treatment that is a total of 15 per study) were selected and housed individually, in cages for faecal collection. The birds were allowed to acclimatize for

seven days in the cages and also fed common diets for the seven days. After the seven days the birds were fasted of feed for twenty four hours during which is expected that feaces from previous feeding would be voided out by the bird, after that the experimental diets were introduced, 100g of feed was supplied daily and water given *ad libitum.* Faecal droppings per bird were collected daily. At the end of collection period (7 days) the faeces for each bird were bulked, thawed, weighed and oven dried at 60^0C for seventy two (72) hours and subjected to proximate analysis.

$$\% \text{ Nutrients Digestibility} = \frac{\text{Nutrient intake - Nutrient voided}}{100} \times 100$$

The faecal samples collected during the digestibility studies were subjected to proximate analysis (AOAC, 1990). Values obtained were then used to calculate the apparent nutrient digestibility

Haematological study

At the end of the experiment, 2ml of blood samples, obtained through the wing vein was taken from one bird per pen (3 birds per treatment) into a sterile, universal bottles containing Ethylene diamine tetraacetic acid (EDTA), an anticoagulant. The blood samples were analysed and the heamatological parameters measured were packed cell volume (PCV), heamoglobin (Hb) and Total protein (Tp).

Statistical Analysis

Data obtained from the performance and digestibility evaluation were subjected to analysis of variance (ANOVA) using procedure of SAS (2002), significant levels of differences among treatment means were determined using the Duncan's multiple range test.

Results and Discussions

Table 2 shows the performance of broiler finisher fed *Mucuna* seed meal. The final weight, weight gain, feed intake and feed to gain ratio, of birds fed 0 and 10.0 and 20.0% boiled *Mucuma* seed meal (BMSM) were similar, higher and better than those on other treatments, this could be an indication that chicks were able to efficiently utilize BMSM at 10.0 and 20% better than other levels. The better feed to gain ratio observed for birds fed 10.0 and 20.0% BMSM could also be as a result of sufficient digestible nutrients that were better utilized. The reduced feed intake at 30 and 40% levels of inclusion from this study agrees with the findings of Akinmutimi and Okwu, (2006) who reported reduced feed intake as the dietary levels of inclusion of cooked *Mucuna* seed meal increased in the diets of broiler chickens. This could be attributed to the effect of residual anti-nutritional factors which became pronounced as the dietary levels of BMSM increased. The reduced weight gain observed as the dietary level of inclusion increased from 30 to 40% BMSM also could be attributed to the reduced feed intake and poor efficiency of feed utilization which limited the availability of digestible nutrients. These findings are in consonance with the report of Dada *et al.* (2000) who observed that weight gain in broiler was directly related to feed intake, quality of feed as well as efficiency of feed utilization.There was significant ($P<0.05$) decrease among treatment means for feed cost per bird and cost per kilogram gain, which decreased as the dietary levels of BMSM increased. The feed cost per bird and per kilogram gain were significantly ($P<0.05$) better for all the BMSM diets compared to the control diet. This was because *Mucuna* seeds were cheaper and readily available without much competition from humans as they are not cherished as human food.

Table 2: Effects of feeding diets containing boiled *Mucuna* seed meal on performance of Broiler finishers.

			Levels of BMSM (%)			
Measurements	0.0	10.0	20.0	30.0	40.0	SEM
Initial weight (g/b)	1094.00	1095.00	1095.00	1095.00	1095.00	0.00
Final weight (g/bird)	2528.03^{a}	2500.00^{a}	2500.67^{a}	2154.73^{b}	2145.93^{c}	7.01
Weight gain (g/bird)	1434.03^{a}	1405.00^{a}	1405.67^{a}	1090.73^{b}	1050.93^{c}	12.44
Feed intake (g/bird)	3270.63^{a}	3280.91^{a}	3280.42^{a}	3166.88^{b}	3167.77^{b}	40.38
Feed toGain Ratio	2.28^{a}	2.30^{a}	2.33^{a}	2.90^{b}	3.00^{c}	0.02
Feed cost/kg weight gain (₦)	162.57^{e}	150.22^{d}	144.58^{c}	143.41^{b}	135.23^{a}	1.04
Feed cost/bird (₦)	490.44^{d}	477.58^{c}	475.24^{bc}	472.48^{b}	466.32^{a}	0.47

^{abcd}Means within the same row with different superscripts differ significantly (P<0.05) SEM = standard error of means

Table 3 and Table 4 show the result of the analysed proximate composition of boiled *Mucuna* seed meal diets and the nutrient digestibility by broilers fed diets containing graded levels of BMSM respectively. There were significant (P<0.05) differences among the treatment means for the digestibility of dry matter (DM), crude fibre (CF), ether extract (EE), ash, nitrogen free extract (NFE) and crude protein (CP) retention. The digestibility of all the nutrients were similar for birds fed control and those fed 10.0 and 20% BMSM diets but decreased significantly(P<0.05) as the level of inclusion of boiled *Mucuna* seed meal increased from 30 to 40% levels. The highest digestibility of CP, CF, EE, Ash and NFE were observed in birds fed 10.0 and 20% BMSM diets which were similar to those of birds fed the control diet. This could be due to the fact that the birds digested and utilized the diets containing 10.0 and 20% BMSM efficiently as evidenced by better gain on those diets. Dietary nutrient intake in the diet containing 10.0 and 20% BMSM was higher than those of birds fed 30.0 and 40.0% of BMSM. Hence, the significantly higher weight gain of the birds fed 0, 10 and 20.0% BMSM diets compared to other levels might have resulted from high nutrient intake and efficient nutrient digestion, absorption and utilization in the diets. The presence of highly digestible carbohydrate may be responsible for the high nutrient intake which resulted in high NFE digestibility in BMSM diets at 0, 10 and 20.0%BMSM.The significant (P<0.05) decrease in nutrient digestion as the dietary inclusion level of BMSM increased could be attributed to low digestible carbohydrate and high residual effect of anti-nutritional factors at high levels of BMSM hence low feed intake recorded. Akure, (2013) reported that residual MSM has negative effects on digestion absorption and utilization of nutrients. The adverse effect of residual tannin and hydrocyanic could also reduce digestive efficiency, and cause serious impairment in the absorption of nutrients across the intestinal wall, since tannins are known to complex with dietary proteins and bind dietary nutrients thereby reducing efficient digestion of nutrients. They are also known to lower the activity of several digestive enzymes such as trypsin and chymotrypsin.

The decrease in crude fibre digestibility by the broiler chickens as the level of BMSM increased in this study agreed with the findings of Adegbola and Okonkwo, (2002), Agunbiade *et al.*, (2002) and Ani, (2009) who reported significant decrease in crude fibre digestibility with increasing level of fibre in diets. The significantly reduced (p<0.05) ash digestibility by broiler chickens at high levels of BMSM diets could be due to the residual tannin content of the *Mucuna* seed meal, because tannin also complex with minerals especially iron and prevents its absorption. Tannin has been reported to be an important factor responsible for depressed feed intake and low absorption of minerals from food commonly consumed in India (Navasiringa and Prabhavathi, 1987).

Table 3: Proximate composition of Broiler finisher diets containing Boiled *Mucuna* seeds meal (BMSM)

Constituents (%)	Levels, BMSM, %				
	0.0	10.0	20.0	30.0	40.0
Dry matter	96.41	95.68	94.76	92.18	92.05
Crude Protein	19.95	19.86	19.68	19.60	19.50
Crude fibre	7.70	7.00	7.25	7.63	7.70.
Ether Extract	8.86	7.12	7.40	7.35	7.75
Ash	6.90	6.75	6.55	6.40	6.10
Nitrogen free extract	53.00	52.95	52.88	52.20	51.00

Table 4 Effects of boiled *Mucuna* seed meal based diets on nutrients digestibility by broiler finishers (%)

Constituents (%)	0.0	10.0	Levels of 20.0	BMSM, % 30.0	40.0	SEM
Dry matter	92.65[a]	92.30[a]	92.56[a]	90.76[b]	87.61[c]	0.02
Crude protein	87.87[a]	87.86[a]	87.83[a]	82.53[b]	80.79[c]	0.03
Crude fibre	62.04[a]	62.82[a]	62.26[a]	52.36[b]	49.36[c]	0.01
Ether extract	85.77[a]	85.75[a]	85.50[a]	79.79[b]	71.17[c]	0.03
Ash	72.30[a]	72.33[a]	72.34[a]	55.87[b]	50.20[c]	0.04
NFE	91.67[a]	91.47[a]	91.02[a]	85.63[b]	80.80[c]	0.22

[abcd]Means within the same row with different superscripts differ significantly (P<0.05 SEM = standard error of means NFE=

Table 5 shows the result of the effect of BMSM in broiler diets on some haematological parameters of broiler finisher. There were no significant differences (P>0.05) between the treatment means for Packed cell volume (PCV), haemoglobin (Hb) and total protein (Tp).The non-significant (P>0.05) difference shown in the PCV, Hb and Tp showed that any of the diets was good enough to supply sufficient nutrients for birds, and safe for human consumption. This agreed with the findings of Tuleun *et al.*, 2009 who reported a non–significant (P>0.05) difference in PCV, and Hb values of broiler finisher fed 20% boiled *Mucuna* seed meal and those fed the control diet.

Table 5: Effects of boiled *Mucuna* seed meal based diets on some blood parameters of broiler finishers

Levels of BMSM, %

parameters	0.0	10.0	20.0	30.0	40.0	SEM
PCV (%)	29.55	29.50	29.52	29.53	29.50	0.07
Hb (g/d1)	9.63	9.60	9.64	9.62	9.63	0.04

TP (g/d1)	8.40	8.42	8.44	8.39	8.38	0.03

PCV= packed cell volume Hb= haemoglobin Tp= Total protein SEM = standard error of means

Conclusion

BMSM improved performance of broiler finishers. However, performance and digestibility of dry matter, crude protein, crude fibre, ether extract, ash and nitrogen free extract were better for birds on 10 and 20% BMSM diet. Therefore it is recommended that 20% BMSM can be included in the broiler finisher diet without any adverse effect on the performance and digestibility of nutrients. Its incorporation in broiler diets as a feed ingredient especially for large scale operations would result in substantial feed cost savings.

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