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Evaluation of Growth Characteristics and Haematological Indices of Broiler-chicks Fed Raw and Processed Bambara Groundnut Seed as a Component of Poultry Feed

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Abstract: Sixty broiler chicks (day-old) were used in a 4-week feeding experiment to assess the growth response and heamatological variables of broilers-chicks fed raw, roasted and fermented bambara groundnut as a sole source of protein. Soybean based diet served as the control. There were four (4) experimental groups, each made up of five birds in three replicates, allocated to the experimental diets. The results showed that the average final live weight, average weekly weight gain and average feed intake of birds fed fermented bambara groundnut performed better than birds fed roasted bambara groundnut but demonstrated inferiority when compared to the control. Among other organs measured the relative weight of gizzard were significantly ($p<0.05$) influenced by the dietary treatment. Protein quality as revealed by the haematological parameters, like Haemoglobin (Hb), Packed Cell Volume (PCV) and Red Blood Cell (RBC) levels indicated that fermented based diet fed to the birds performed better than but demonstrated inferiority when compare with the soybean based diet. However, the results showed that raw bambara groundnut based diet has a high protein quality when compared with the control diet. The use of bambara groundnut therefore in the feeding of broilers in the developing countries if properly harnessed and processed can make poultry production affordable.

Key words: Bambara groundnut, protein quality, haematological indices

INTRODUCTION

The high cost of poultry feed in the third world countries has been one of the major hindrance to commercial poultry production. This arises from the competition between man and animals for the available grains. It has been established that proteins are essential components of cells and tissues and as such are highly needed for normal functioning of the body. Rich sources of quality protein for the body are mainly animal sources such as poultry. Miles and Featherson (1976) have also earlier reported that chicks fed with diet supplemented with protein grew more rapidly and effectively. A need therefore arises for the search into the possible ways of obtaining maximum production in poultry with minimum expenditure, so that the products can be sold at relatively low prices with similar or even better nutritional quality than conventional ones. One of a very good class of plants that can be exploited for this purpose is the legumes. Legumes are very important sources of protein, lipid and other nutrients like minerals and vitamins required for the proper growth. However the quality of leguminous plants is influenced by the antinutritional factors present in them which make them unsuitable for consumption in their native form (Nwokolo and Sim, 1987). It is known however that processing techniques like fermentation, roasting, germination and autoclaving can improve nutritional quality and bioavailability of nutrients present in legumes such as bambara groundnut.

Bambara groundnut is a protein rich seed. It is a cheap and readily available legume which may reduce feed cost and make poultry production more profitable. The role of grain legumes in the diets of animal and man in developing countries has been earlier reported (Agbede, 2000).

Bambara groundnut is one of the few indigenous tropical African legume crops mostly found in Nsukka zone of Enugu State and Nothern Nigeria. Bambara groundnut is economically important because it is an inexpensive source of high quality protein. It is highly valued among the Eastern and Northern states of Nigeria. Bambara groundnut is processed into consumable food and taken in various forms as source of protein to Nigerians. The commercial utilization of this seed is gradually increasing in Africa. Despite this, its use is still limited. Bambara nut is a protein rich seed. The potential which attaches to this foodstuff both economically and nutritionally makes it imperative that studies be made on the legume.

The present study therefore investigates growth performance and some haematological indices of broilers chicks fed on raw and processed bambara groundnut.

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MATERIALS AND METHODS

Bambara groundnut: Bambara groundnut seeds were purchased at the Emir's market, Ilorin, Nigeria.

Feed Ingredients: The feed ingredients such as maize bran, wheat offal, bone meal, oyster shell, soybean, vitamin-mineral mixture and all vaccines used for the birds were purchased at Oluwagbemisola Livestock Feeds and Health Consult (Nig) Limited, Ajasse Ipo Road, Offa Garage, Ilorin.

Experimental birds: A total of 60 day old broiler chicks weighing an average of 38.49±0.43 g were purchased from Dimeji Farms, Geri Alimi, Ilorin, Nigeria.

Fermenting organism: The fungus, Aspergillus niger, used for fermentation was obtained from Department of Crop Production, University of Ilorin, Ilorin, Nigeria.

Chemicals and reagents: All chemicals and reagents used were of analytical grade.

Preparation of raw and processed bambara groundnut seeds: Raw bambara groundnut seeds were milled using a local grinder and thereafter sieved so as to remove the seed coat.

Roasted bambara groundnut seeds was prepared by roasting in fire sand using a local heating system of coal. The seeds were continually stirred until a characteristic brownish coloured seed which indicated roasting was obtained. The seeds were then milled and sieved to remove the seed coat.

Fermented bambara groundnut. The fermentation of the milled seeds was carried out using *Aspergillus niger*. The inoculated samples were wrapped with aluminum foil and kept at ambient temperature. In 14 days, the fungi covered the surface of the samples and its growth was terminated by oven drying at 60°C for 24 h.

Management of experimental birds: Sixty day-old broiler chicks of mixed sexes were used for the experiment. The environment where the birds were kept was cleaned and disinfected three days before the arrival of the chicks. The feeders and drinkers were also washed and disinfected. The electrical appliance that supplies heat was properly checked and was switched on few hours before the arrival of the birds. All the cages were covered with white polythene to provide warmth. On arrival of the birds, they were randomly distributed into four dietary treatment groups. Each treatment had three replicate groups with five birds per replicate. The birds were supplied with feed and water *ad-libitum*. They were acclimatized to their new environment for one week. The individual weights of the birds were taken prior to the commencement of the experiment and this was done thereafter on a weekly basis. The feeding troughs and drinkers were washed daily and replaced with new feeds and drinks respectively. The litters were also emptied on a daily basis. Vaccinations and medications were administered as, and when due. The experiment lasted for four weeks.

Proximate composition and feed formulation: The proximate and percentage composition of the experimental diets are shown in Table 1 and 2 respectively.

Table 1: Percentage composition of formulated diets

Ingredients	Diet A (%)	Diet B (%)	Diet C (%)	Diet D (%)
Maize	47.00	47.00	47.00	47.00
Soybeans	35.00	-	-	-
Bambara groundnut based diet	-	35.00	35.00	35.00
Maize bran	6.00	6.00	6.00	6.00
Wheat offal	8.00	8.00	8.00	8.00
Bone meal	2.54	2.54	2.54	2.54
Oyster shell	1.00	1.00	1.00	1.00
Salt	0.20	0.20	0.20	0.20
Vit/mineral premix	0.25	0.25	0.25	0.25
DL-Methionine	0.01	-	-	-

*Vitamin/Mineral premix contained: 800 I.U. Vit A, 1200 I.U Vit D_3, 13 I.U. Vit E, 2 mg Vit K_3, 2 mg riboflavin, 10 mg nicotinic acid, 7 mg panthothic acid, 900 mg choline, 0.08 mg biotin, 1.5 mg folic acid, 0.2 mg Co, 80 mg Mn, 50 mg Zn, 2 mg Cu, 0.1 mg Se

Table 2: Proximate composition of experimental diets

Parameters	SM	RBM	ROBM	FBM
Crude protein (%)	35.34±0.02^a	34.90±0.39^a	34.98±0.15^a	35.09±0.02^a
Ether extract (%)	3.25±0.02^a	2.80±0.00^b	3.00±0.05^c	2.75±0.01^b
Crude fibre (%)	5.60±0.05^a	5.25±0.01^b	4.90±0.00^c	5.10±0.01^b
Ash content (%)	7.56±0.00^a	6.47±0.01^b	6.39±0.01^c	7.49±0.01^d
Nitrogen free extract (%)	48.56±0.02^a	50.58±0.01^b	50.48±0.05^b	49.57±0.05^a

Determination was on dry matter basis. Each value is a mean of three determinations ± SEM. Values along the same row with different superscripts are significantly different ($p<0.05$). SM = Soybean Meal; RBM = Raw Bambara Groundnut Meal; ROBM = Roasted Bambara Groundnut Meal; FBM = Fermented Bambara Groundnut Meal

The growth parameters: The birds were placed on the experimental diets for a period of four weeks during which feed intake, body weight gain, feed conversion ratio and percentage mortality were determined as described by Otunola *et al.* (2002).

Relative organ measurement: The liver, kidney, heart, lungs and gizzard were dissected out from the experimental birds. The organs were blotted clean with tissue paper, weighed and the weight expressed in % organ to body weight.

Hematological analysis: At the end of 28 days, blood was sampled from three birds per treatment by sacrificing the birds. Samples for haematological analysis were collected after severing the jugular vein of the birds, in EDTA treated sample bottles to prevent coagulation;. Packed Cell Volume (PCV), Red Blood Cell (RBC), White Blood Cell (WBC) and Hemoglobin (Hb) were determined using the wintrobes Microhematocrit centrifuge, Neubaer haematocytometer and sahli`s methods respectively. The differential white blood cell counts were obtained by making a differential count with Wright`s Stain (Tietz *et al.*, 1995).

Statistical analysis: All data were subjected to Analysis of Variance (ANOVA) (Steel and Torrie, 1960) and the significant difference between the treatments and control were determined using the Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Table 3 and 4 indicate the performance and the organ to body weight ratio of the birds fed on the experimental diets respectively.

The average final live weight, average weekly weight gain and average weekly feed intake of the control diet (Table 3) were higher ($p<0.05$) than those fed on the experimental diets. It was observed to be lowest in birds fed on roasted bambara groundnut based diet (R_oBM). This observation might be as a result of nutrient inactivation due to prolong heating during roasting (Anita, 1996). Also the low values shown in Table 3 of average final live weight, average weekly weight gain and average weekly feed intake of birds fed fermented bambara groundnut based diet could be as a result of the presence of antinutrients which the processing technique were unable to sufficiently reduce hence causing retarded growth (Martinez *et al.*, 1995) and low digestibility (Pusztai *et al.*, 1995).

The feed conversion ratio of birds fed fermented bambara groundnut based diet were lower than birds fed roasted bambara groundnut. It was however observed that the feed conversion ratio of birds fed on the different experimental bambara groundnut based diets were significantly different ($p<0.05$) when compared to birds fed on the control diet with the feed conversion ratio being lower in birds fed on the control diet (Table 3). This could be as a result of inefficient nutrient utilization by birds fed on the different bambara groundnut based diets. Nwokolo (1986) reported similar significant differences in the feed conversion ratio of birds fed control and test diets with pigeon pea, thevetia and toasted/untoasted melon seeds respectively. This was attributed to the presence of antinutrients and inefficient utilization of nutrient.

Percentage organ to body weight ratio of the birds is shown in Table 4. There was no significant difference ($p>0.05$) between organs of birds fed control diet and experimental diet except for the gizzard. It was observed that the percentage organ to body weight ratio of gizzard of birds fed raw and roasted bambara groundnut based diet was higher than the birds fed control diet. This suggests development of muscularized gizzard in order to handle some extraneous component of the diet (Agbede, 2000).

Table 3: Performance of broiler chicks fed on experimental diet over a period of 28 days

Parameters	SM	RBM	ROBM	FBM
Average initial live weight (g)	39.43±0.56^a	38.97±2.39^a	39.08±0.71^a	39.17±0.10^a
Average final live weight (g)	170.50±8.66^a	160.00±0.01^b	107.50±8.77^c	121.88±8.65^d
Average weekly weight gain (g/chick/wk)	33.27±2.04^a	30.71±0.88^b	12.86±2.44^c	20.60±2.22^b
Average feed intake (g/chick/wk)	37.79±0.89^a	34.74±0.37^b	23.02±0.42^c	28.75±0.01^d
Feed efficiency ratio	1.14±0.04^a	1.06±0.02^a	1.79±0.01^b	1.40±0.04^c
Mortality	-	-	-	-

Each value is a mean of three determinations ± SEM. Values along the same row with different superscripts are significantly different ($p<0.05$)

Table 4: Percentage organ to body weight of broiler chicks fed on experimental diet over a period of 28 days

	SM	RBM	ROBM	FBM
Liver (%)	2.99±0.07^a	2.90±0.11^a	1.96±0.36^b	2.76±0.11^a
Kidney (%)	0.13±0.01^a	0.11±0.03^a	0.10±0.05^b	0.14±0.02^a
Heart (%)	0.61±0.04^a	0.67±0.05^a	0.71±0.17^a	0.68±0.06^a
Lungs (%)	0.55±0.03^a	0.54±0.04^a	0.54±0.05^a	0.53±0.15^a
Gizzard (%)	5.02±0.27^a	7.24±0.29^b	5.13±0.13^a	7.74±0.22^b

Each value is a mean of three determinations ± SEM. Values along the same row with different superscripts are significantly different ($p<0.05$)

Table 5: Haematological indices of broiler chicks fed on the experimental diets over a period of 28 days

Parameters	SM	RBM	ROBM	FBM
Hb (%)	14.28±0.13^a	12.68±0.32^b	13.35±0.16^c	9.65±0.52^d
PCV (%)	43.00±0.41^a	36.00±0.41^b	38.00±0.42^c	31.50±0.29^d
RBC (x 10^{12}/L)	3.17±0.04^a	2.69±0.05^b	2.96±0.01^c	2.35±0.08^d
WBC (x 10^9/L)	277.30±0.37^a	295.80±3.95^b	267.78±0.94^c	285.25±2.63^d
MCHC (g/dL)	34.00±0.00^a	33.50±0.29^a	34.10±0.00^a	34.15±0.25^a
MCH (pg)	43.20±0.41^a	43.25±0.75^a	43.10±0.82^a	43.25±0.85^a
MCV (μm^3)	132.00±0.70^a	133.00±1.08^a	135.50±0.29^a	135.00±1.16^a

Each value is a mean of three determinations ± SEM. Values along the same row with different superscripts are significantly different ($p<0.05$). PCV = Packed Cell Volume; Hb = Hemoglobin Concentration; RBC = Red Blood Cell, WBC = White Blood Cell; MCHC = Mean Cell Hemoglobin Concentration; MCH = Mean Cell Hemoglobin; MCV = Mean Cell Volume

Table 5 shows the haematological indices of birds fed on the various experimental diets. It was observed that the PCV, haemoglobin, RBC values for the birds placed on the raw and fermented bambara groundnut based diet were found to decrease significantly ($p<0.05$) in comparison with those on soybean based diet. This might indicate an immunological response to the presence of antinutritional factors present in the feeds and poor protein utilization (Apata, 1990). The WBC values for birds on raw and fermented bambara groundnut were observed to be high when compared with the control diet. This might be attributed to the immune system of the birds attempting to detoxify the antinutritional factors present in the feed which also supports earlier report.

Conclusion: The present study investigates various growth characteristics and haematological indices in broilers chicks. From the result obtained, it can be deduced that although broiler-chicks fed fermented bambara groundnut performed better than broiler-chicks fed roasted bambara groundnut, it still demonstrates inferiority when compared with soybean based diet. It is therefore concluded that some antinutrients are present in the bambara groundnut which cannot be completely removed by roasting and fermentation. Further work is therefore suggested be done to examine other processing techniques that may reduce or eliminate the levels of antinutrients in bambara groundnut seed.

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