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Assessment of Some Serum Metabolites and Enzymes of Broiler-Chickens Fed Raw and Processed Bambara Groundnut

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Abstract: Sixty day-old broiler chicks were used in a 4-weeks feed trial to determine the status of raw, roasted and fermented bambara groundnut. The raw and processed bambara groundnuts were used as the sole source of protein in a basal broiler chick starter diet. 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. Application of roasting and fermentation techniques were able to reduce the levels of some antinutrients in the bambara groundnut except for oxalate that increased significantly for the fermented sample. The results showed that the serum parameters like total protein, uric acid and creatinine levels indicated that both roasted and fermented based diet fed to the birds were unable to efficiently make available the nutrients in the diets to the birds. Serum transaminases (GOT and GPT) and serum alkaline phosphatase (ALP) showed significant ($p<0.05$) increase in the activity of the serum of birds fed on roasted and fermented bamabara groundnut based diet. It is therefore concluded that the quality of the protein of the raw and processed bambara groundnut based diet demonstrated inferiority relative to the soybean based diet.

Key words: Bambara groundnut, transaminases, antinutrient, phophatase

Introduction

The rapid increase in the world population and acute protein shortage particularly, in developing countries has necessitated the urgent need for a means of increasing food production especially cheap and good sources of protein. Rich sources of quality protein for the body are mainly animal sources such as poultry. The major hindrance however, to commercial poultry production is the high cost and unavailability of the standard commercial feeding stuffs. 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 convectional ones. A very good class of plants that can be exploited for this purpose are the legumes.

Legumes are very important sources of protein and lipid as well as minerals and vitamins required for the proper growth of chicks (Balogun and Fetuga, 1986). However, their use is limited by the presence of antinutritional factors (Nwokolo and Sim, 1987). The presence of antinutritional factors such as trypsin and chymotrypsin in inhibitors in legumes lower digestibility of legume protein (Elegbede, 1998). 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. Processing techniques are effective ways of achieving desirable changes, removal of un-desirable components and effective utilization of the full potential of legumes as feed stuff (Gloria *et al*., 1995). Bambara groundnut is a protein-rich legume crop (Obizoba, 1998). It is cheap and readily available; indicating that it may reduce feed cost and make poultry production more profitable if found suitable for poultry.

The present study was designed to evaluate the status of some serum parameters of broiler chicks fed on raw and processed bambara groundnut based diets.

Materials and Methods

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

Feed Ingredients: 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.

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

Experimental birds: A total of 60 day-old broiler chicks (average weight 38.48±0.43g) were purchased from Dimeji farms, Geri Alimi, Ilorin, Nigeria.

Table 1: Percentage Composition of Experimental Diets

Ingredients	SM	RBM	ROBM	FBM
Maize	47.00	47.00	47.00	47.00
Soyabeans	35.00			
Bambara groundnut	-	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	0.01	0.01	0.01

Methionine was added to the soybean meal diet and bambara groundnut meal diet because it is a limiting amino acid in them and its absence in the diet has been shown to cause carbitne deficiency

Table 2: Proximate Composition of Different Bambara Groundnut Samples (%)

Constituent	RBS	ROBS	FBS
Crude Protein	24.88±0.04	24.81±0.06	29.25±0.05
Ether Extract	4.80±0.00	6.60±0.13	7.00±0.01
Crude Fibre	2.02±0.02	2.00±0.03	2.04±0.03
Ash content	5.70±0.09	6.98±0.01	7.00±0.11
Nitrogen Free Extract	62.60±0.02	60.11±0.01	51.45±0.66

Determination was on dry matter basis. Each value is a mean of triplicate determinations (±SEM) RBS-Raw Bambara Groundnut sample, ROBS-Roasted Bambara Groundnut sample, FBS-Fermented Bambara Groundnut sample

Table 3: Proximate Composition of Experimental Diets (%)

Diet	SM	RBM	ROBM	FBM
Crude Protein	33.34±0.02	32.90±0.39	32.98±0.15	33.09±0.02
Ether Extract	3.25±0.02	2.80±0.00	3.00±0.05	2.75±0.01
Crude Fibre	5.60±0.05	5.25±0.01	4.90±0.00	5.10±0.01
Ash content	7.56±0.00	6.47±0.01	6.39±0.01	7.49±0.01
Nitrogen Free Extract	50.10±0.02	52.58±0.01	52.48±0.05	51.57±0.05

Determination was on dry matter basis. Each value is a mean of triplicate determinations (±SEM). SM-Soybean Meal, RBS-Raw Bambara Groundnut sample, ROBS-Roasted Bambara Groundnut sample, FBS-Fermented Bambara Groundnut sample

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

Preparation of Raw and Processed Bambara Groundnut Seeds:

(i) Raw bambara groundnut seeds were milled using a local grinder and thereafter sieved so as to remove the seed coat leaving behind the smooth seed samples.

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

(iii) 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 hours.

Management of experimental birds: The metabolic cage and its environment were washed and thoroughly disinfected three days before the arrival of the chicks. The electrical appliance that supplied heat was properly checked and was switched on few hours before the arrival of the birds. The day-old broiler chicks were acclimatized for one week and were randomly allocated to four experimental starter diets after weighing (Table 1). Each diet was replicated three times with five birds in each treatment. The control diet was the commercial soybean meal based diet. Feed and water were administered *ad Libitum*. The birds were maintained on the experimental diets for 28 days Vaccinations and medication were administered as and when due.

Serum analysis: Three hours to the close of the feeding trial, the birds were starved. Thereafter, the birds were weighed and sacrificed by severing the jugular veins with a sharp blade. The blood was then allowed to flow freely into labelled sample bottles Serum creatinine was determined using the alkaline picrate method (Scott, 1965), serum uric acid was determined by the method of caraway; while total protein content was determined by the Biuret method (Bassey *et al.*, 1946). Glutamate pyruvate. Transaminase (GPT), Glutamate Oxaloacetate Transanmase (GOT) and Alkaline phosphatase activities were determined by the methods of Reitman and Frankel (1957), Schmidt and Schmidt (1963) and Bassey *et al.* (1946) respectively.

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 4 shows the effect of the experimental diets on the serum total protein, uric acid and creatinine. The values of total protein for birds on raw, roasted and fermented bambara groundnut based diets are 24.50 g L^{-1}, 15.75 g L^{-1} and 23.00 g L^{-1} respectively. These values are significantly lower ($p<0.05$) than that of the birds fed soybean based diet which is 30.50 g L^{-1}. This could be as a result of poor protein utilization from the diet. The nutritional status with respect to protein has a profound effect on the synthesis of plasma protein both directly in the provision of raw materials for synthesis and indirectly due to protein deprivation on the liver (Liener, 1975). The lowest value observed in roasted bambara groundnut based diet might be as a result of denaturation during

Table 4: Serum Total Protein, Uric Acid and Creatinine Levels of Birds Fed on the Experimental Diets

Parameters	SM	RBM	ROBM	FBM
Total Protein (g L^{-1})	30.50±1.55^{a}	24.50±1.50^{b}	15.75±1.32^{c}	23.00±1.23^{b}
Uric Acid (nmol L^{-1})	0.23±0.01^{a}	0.26±0.02^{b}	0.30±0.01^{c}	0.27±0.01^{b}
Creatinine (nmol L^{-1})	89.50±0.91^{a}	58.50±1.23^{b}	44.00±6.32^{c}	48.75±2.14^{c}

Each value is a means of triplicate determinations (± SEM). Values along the same row with different superscript are significantly different ($p<0.05$). SM - Soybean Meal, RBM - Raw Bambara groundnut Meal, ROBM - Roasted Bambara Groundnut Meal, FBM - Fermented Bamabra Groundnut Meal

Table 5: Specific Activities of Some Enzymes in the Serum of Birds Fed on The Experimental Diets

Parameters	SM	RBM	ROBM	FBM
GPT (IU L^{-1})	33.00±1.35^{a}	40.50±0.65^{d}	34.25±1.44^{b}	36.50±0.50^{c}
GOT (IU L^{-1})	53.75±1.93^{a}	60.25±4.92^{c}	54.00±2.12^{b}	54.20±0.98^{b}
ALP (IU L^{-1})	75.60±1.23^{a}	123.6±5.81^{b}	64.00±1.49^{c}	115.73±7.40^{b}

Each value is a means of triplicate determinations ± SEM. Values along the same row with different superscript are significantly different ($p<0.08$). SM - Soybean Meal, RBM - Raw Bambara Groundnut Meal, ROBM - Roasted Bambara Groundnut Meal, FBM - Fermented Bambara Groundnut Meal

processing (Anita, 1996). Information regarding nutritional status and malnutrition is often obtained from the total protein (Allison, 1998).

Uric acid values was 0.26+0.02 nmol L^{-1}, 0.30+0.01 nmol L^{-1} and 0.27+0.01 nmol L^{-1} for birds fed on raw, roasted and fermented bambara groundnut based diets respectively. Higher values of serum uric acid observed in birds placed on raw and processed bambara groundnut based diets in comparison to the control diet (Table 4) might be as a result of poor dietary protein utilization (Akinola and Abiola, 1990).

Broilers fed RBM, ROBM and FBM based diets had slightly low values of creatinine; 58.50+1.23, nmol L^{-1} 44.00+6.32 nmol L^{-1} and 48.75+2.14 nmol L^{-1} respectively compared to that of control (SM) 89.50+0.91 nmol L^{-1}. This might be due to improper protein utilization (Eggum, 1976).

Table 5 shows the specific activities of some enzymes in the serum of birds fed on the different experimental diets. Transaminases are the most commonly used indicators of cellular necrosis and high levels in serum may indicate liver malfunctioning (Rosenthal, 1977). They occupy a central position in amino acid metabolism; increase in their activities in the serum as herein observed could have a consequential effect on the amino acid metabolism in these tissues. Furthermore, it may indicate some sort of injury to the organs. Such damage may cause the enzymes to leak from the injured organs to the blood stream.

In this study, the birds placed on raw, roasted and fermented bambara groundnut based diet showed significant increase in glutamate pyruvate transaminase activities when compared with the Soybean based diet. Although values of GPT of birds on test diets were higher when compared with the control diet they, however, still falls within the normal range in chicken which ranges from 1-37 IU L^{-1} (Ker *et al.*, 1982). Glutamate oxaloacetate transaminase is associated with the mitochondria and cytoplasm. Alteration in its activity could imply alteration in the cytosolic content. The mitochondria is regarded as the power house of the cell and exposure of this organelle to assault of any form could imply cell death. The activities of glutamate oxaloacetate transaminase was observed to be higher in birds fed various bambara groundnut based diet when compared with the birds fed on control diet. Similar trend was also observed for Alkaline phosphatase activity in the serum. It was observed to be highest in birds fed in raw bambara groundnut based diet. These observations could be as a result of the negative effect of antinutrients. Similar report had been made earlier by Alletor and Fetuga (1985) on the activities of these enzymes in blood of rats injected with legume antinutrients.

Conclusion: The present study investigates the effect of raw and processed bambara groundnut based diets on some serum metabolites and enzymes of broiler-chickens. From the result obtained, it can be seen that processing bambara groundnut by roasting before its inclusion into broiler diets was unable to improve the bioavailiability of nutrients in the diets to the birds. It could also be observed that some antinutrients are present in bambara groundnut which cannot be totally removed by the processing techniques applied like fermentation.

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