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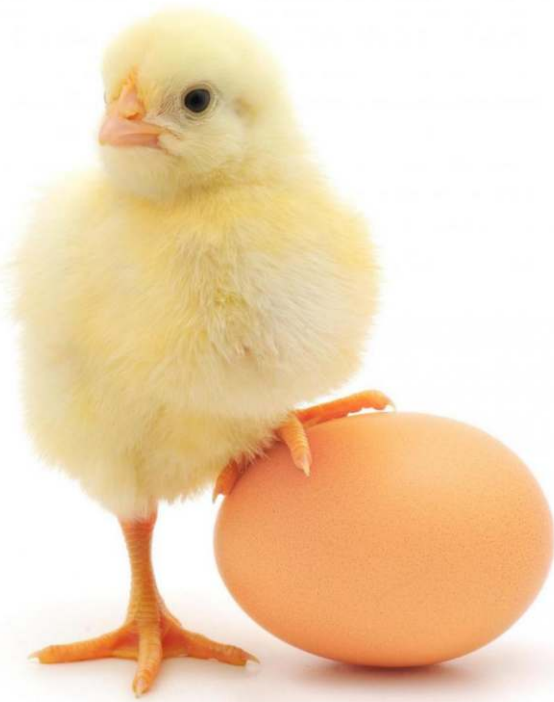

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Performance of Broilers Fed Raw Bambarra Groundnut [*Vigna subterranean* (L.) *Verdc*] Offal Diets Supplemented with Lysine and or Methionine

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Abstract: One hundred and twenty 3-week old Anak broilers were used to evaluate the performance, feed cost and apparent nutrient digestibility coefficients of raw Bambarra Groundnut Offal (BGO) diets supplemented with lysine and or methionine. The experimental design was Completely Randomized Design (CRD) with each treatment replicated three times. Five treatment diets were formulated to be isoenergetic and isonitrogenous. The inclusion level of the bambarra groundnut offal in diets 2, 3, 4 and 5 was 20%. Diet 1 (control) had no BGO, lysine or methionine supplementation while diets 2, 3, 4 and 5 were supplemented with lysine, methionine, lysine + methionine and no supplementation, respectively. Parameters measured were final live weight, daily weight gain, feed intake, Feed Conversion Ratio (FCR), Protein Efficiency Ratio (PER), feed cost and apparent nutrient digestibility coefficients. Results showed that broilers fed diet 4 supplemented with lysine+methionine had improved FCR (2.05) and PER (2.37) than broilers fed other diets and was consistently similar to the control diet in all parameters measured. There were no significant ($P>0.05$) differences among the broilers fed the various diets in feed cost indices measured, except cost per kg feed. Broilers fed diet 4 supplemented with lysine and methionine had the highest apparent digestibility coefficient of protein (59.39%) while broilers fed diet 5 without amino acid supplementation had the lowest (52.78%). The conclusion was that raw bambarra groundnut offal should be supplemented with lysine and methionine to improve broiler FCR, PER, digestibility coefficient of CP and reduce feed cost.

Key words: Bambarra groundnut offal, broilers, performance, lysine, methionine

INTRODUCTION

The cost of conventional feedstuffs, which are major sources of energy and protein in poultry diets, has continued to increase (Onu and Mdubuike, 2006; Defang *et al*., 2008) due to their short supply. There is also stiff competition between human consumers, industrial processors and other users for conventional feedstuffs like maize, sorghum, soybean and fish meal (Agbede *et al*., 2002). This has resulted in high cost broiler feed, causing economic losses in broiler production in Nigeria (Aderolu *et al*., 2007). There is, therefore, the need to continue to source for alternative sources of energy and protein that are not likely to face such competition and demand as the conventional feedstuffs. Such a feedstuff should not be food for man and should also have very limited or no industrial use. Bambarra groundnut offal a by-product of Bambarra groundnut processing, which is a non-conventional feedstuff, may fit into this class.

Bambarra groundnut (*Vigna subterranean* (L.) *Verdc*) is a legume grown mainly in the Middle Belt region and Enugu State of Nigeria (Doku and Karikari, 1971). Bambarra groundnut seed has been reported to contain 14-24% CP (Rachie and Roberts, 1974; Evans *et al*., 1975; Temple and Aliyu, 1994; Olomu, 1995). The protein of the nut is of high biological value (FAO, 1982; Olomu, 1995), with a high amount of lysine (6.60%) and 1.30% methionine (Poulter, 1981; Temple and Aliyu, 1994). According to Ezuoke (2003), bambarra groundnut is not an oily seed since it contains only about 6% of ether extract.

Bambarra groundnut contains moderate amounts of calcium and iron, though poor in phosphorus and with fairly high contents of thiamine, riboflavin, niacin and carotene, but very low in ascorbic acid (Oyenuga, 1968). Bambarra groundnut contains minimum amount of trypsin and chymotrypsin inhibitors (Doku and Karikari, 1971).

The seeds are normally milled and sieved several times to obtain the flour locally called *Okpa* that is a nutritive human food. The offal, which is available throughout the year and cheap, has no industrial or other uses as at now. The offal contains about 17.90-21.16% CP (Ezuoke, 2003; Amaefule and Iroanya, 2004; Amaefule and Osuagwu, 2005), 5.29% CF and 12.44 MJ/kg gross energy (Ezuoke, 2003; Amaefule and Iroanya, 2004). The feeding of toasted bambarra groundnut offal diets to pullets has been evaluated by Onyimonyi and Onukwufor (2003). Amaefule and Iroanya (2004) replaced soybean meal and maize with bambarra groundnut offal in broiler diets and reported that bambarra groundnut offal could replace the 2 feedstuffs up to 10% in the diets without adverse effect on broiler performance. Also, Amaefule and Osuagwu (2005) studied the performance of pullet chicks fed graded levels of raw bambarra groundnut offal diets as replacement for soybean meal and maize and concluded that BGO could be a valuable feedstuff in pullet chick diets which could be included up to 5% of the pullet diet.

The development of the offal as an alternative energy and protein source could solve the problem of high broiler feed cost for small scale farmers and also provide avenue for a better disposal of the waste (offal), which could constitute an environmental problem. The objective of this study was to determine the performance, cost and apparent nutrient digestibility of broilers fed raw bambarra groundnut offal diets supplemented with lysine and or methionine.

MATERIALS AND METHODS

The study was carried out at the Poultry Unit of Teaching and Research Farm of Abia State University, Umuahia Campus, Abia State. The place is situated in the South East Zone of Nigeria, with an average environmental temperature of about 27°C and annual rainfall of 2000-2484 mm. Day-old broilers, feedstuffs and drugs were procured from local dealers in Umuahia.

Experimental diets: Five isoenergetic and isonitrogenous broiler diets were formulated in such a way that Diet 1 (control) had no raw bambarra groundnut offal (BGO) and no amino acid supplementation. Diets 2, 3, 4 and 5 each had 20% BGO supplemented with 0.20% lysine, 0.20% methionine, 0.20% lysine+0.20% methionine and no (0%) amino acid supplementation, respectively. The percentage composition of the experimental diets is shown in Table 1.

Experimental birds and their management: One hundred and twenty, 3 week-old Anak broilers were used for the experiment. The chicks were procured from Obasanjo Farms, Ottah, Ogun State. The day-old broilers were brooded using kerosene stoves under metal hovers and electric bulbs as source of light in a deep-litter house. The house was a tropical type with dwarf walls. Both sides were open and covered with wire gauze. The birds were randomly allotted to five treatment diets after brooding for three weeks. There were 24 birds in each treatment and 8 broilers per replicate. Feed and water were provided *ad libitum*.

Health management practices included the administration of I/o at day-old, infectious bursa disease (*Gumboro*) vaccine at 7th, 21st and 35th day, Newcastle disease vaccine (*Lasota*) at 14th and 42nd day. Coccidiostat were administered to the broilers at 2nd, 5th and 7th weeks. Anti-stress, antibiotics and vitamin mineral supplements were administered during the periods of brooding and rearing.

Experimental design and data collection: The experimental design for the experiment was Completely Randomized Design (CRD) with statistical model:

$$Y_{ijk} = \mu + T_i + e_{ijk}$$

where:

Y_{ijk} = Single observation on the broiler characteristics.

μ = Overall mean.

T_i = Effect of treatment diets.

e_{ijk} = Experimental error.

The broilers were weighed at the beginning of the experiment and subsequently on a weekly basis. Subtracting initial live weight from final live weight gave weight gain. Feed offered to broilers were weighed daily and leftover (feed not consumed) were also weighed. Feed intake was determined by subtracting leftover feed from feed offered to the birds. The weighing of birds and feed was done using a top loading weighing scale. Weighing of birds took place in the morning hours (7.00-8.00 am local time) each week. Feed conversion ratio was determined by dividing feed intake with weight gain, protein efficiency ratio was calculated as weight gain divided by protein intake, while cost per kg weight gain was calculated as FCR x cost per kg feed.

Chemical and data analyses: Experimental diets and faecal samples were analyzed for proximate composition according to methods of AOAC (1990). Data collected were subjected to Analysis of Variance (ANOVA) while differences among treatment means were separated using Duncan's Multiple Range Test (Duncan, 1955). Data in percentages were subjected to Arcsine transformation before ANOVA.

RESULTS AND DISCUSSION

The proximate composition of Bambarra Groundnut Offal (BGO) and bambarra groundnut offal diets fed to broilers is presented in Table 2. Bambarra groundnut offal had a crude protein content of 19.78%, which agreed with the value reported by Amaefule and Iroanya (2004) but higher than the value of 17.90% reported by Amaefule and Osuagwu (2005). The crude fibre of 6.43% obtained for raw BGO in this study is also closer with 5.40% reported by Amaefule and Iroanya (2004) but lower than 11.30% obtained by Amaefule and Osuagwu (2005).

Table 1: Percentage composition of raw bambarra groundnut offal diets supplemented with Lysine and or methionine

Feedstuffs	Diets 1	2	3	4	5
Bambarra groundnut offal	0.00	20.00	20.00	20.00	20.00
Maize Offal	44.64	28.36	28.36	28.36	28.36
Wheat Offal	11.16	11.16	11.16	11.16	11.16
Palm Kernel Cake	18.60	18.60	18.60	18.60	18.60
Fish meal	4.42	4.42	4.42	4.42	4.42
Groundnut cake	17.68	13.76	13.76	13.76	13.76
Bone meal	3.00	3.00	3.00	3.00	3.00
Premix*	0.25	0.25	0.25	0.25	0.25
NaCl	0.25	0.25	0.25	0.25	0.25
Total (%)	100	100	100	100	100
L-Lysine (%)	-	0.20	-	0.20	-
D-L Methionine (%)	-	-	0.20	0.20	-
Calculated composition					
C P (%)	20.64	20.64	20.64	20.64	20.64
ME (MJ/kg)	10.32	10.45	10.45	10.45	10.45
Crude fibre (%)	9.02	8.72	8.72	8.72	8.72
Lysine (%)	1.04	1.09	0.89	1.09	0.89
Methionine (%)	0.37	0.31	0.51	0.51	0.31
Arginine (%)	2.02	1.83	1.83	1.83	1.83
ME: CP ratio	119.51	121.03	121.03	121.03	121.03

*Premix supplied Vitamin A 200000 IU, Vit. D_3 400000 IU, Vit. E 8.00 g, Vit. K_3 0.40 g, Vit. B_{12} 0.32 g, Vit. B_2 0.96 g, Vit B_6 0.56 g, Vit. C 2400 mg, Vit. B_{12} 400 mg, Folic acid 0.16 g, Biotin 8.00 mg, Choline 48.00 g, Ca Pantothionate 1.60 g, Mn 16.00 mg, Fe 8.00 mg, Zinc 7.20 g, Copper 0.32 g, Iodine 0.25 mg, Cobalt 36.00 mg, Selenium 16.00 mg, BHT 32.00 g

Table 2: Proximate composition of bambarra groundnut offal diets supplemented with lysine and or methionine and that of raw Bambarra groundnut offal (DM Basis)

Nutrient	Diets 1	2	3	4	5	BGO
Dry matter (%)	87.89	86.38	86.92	87.75	86.94	87.35
Crude protein (%)	20.93	21.14	21.05	21.32	21.01	19.78
Ether extract (%)	3.00	3.11	3.43	3.28	3.14	2.19
Crude fibre (%)	9.00	10.64	10.41	10.78	10.55	6.43
Crude ash (%)	7.80	7.70	6.89	7.34	7.65	3.20
Nitrogen free extract (%)	47.16	43.79	45.14	45.03	44.59	55.75

BGO = Bambarra Groundnut Offal

Bambarra groundnut offal (BGO) is produced by manual sieving of milled bambarra groundnuts to obtain flour for human consumption. The amount of residual flour, particle size and the expertise of the miller affect the quality and proximate composition of the BGO. This could lead to variations among BGO obtained over a period.

There were no wide variations in the proximate composition of the experimental BGO diets as they were formulated to be isoenergetic and isonitrogenous. The Crude Fibre (CF) content of the diets were higher than the value of 5.50% recommended by Obioha (1992) due to the high inclusion levels of palm kernel meal (21% CF) and wheat offal in the diets. These, plus the absence of maize in the diets resulted in lower ME content of the diets. However, the diets were adequate in Crude Protein (CP), lysine, methionine and Arginine contents.

Performance: Supplementation of raw bambarra groundnut offal diets with lysine and or methionine did not significantly (P>0.05) affect the final live weight, daily weight gain, daily feed intake, daily protein intake and mortality of the broiler birds. But Feed Conversion Ratio (FCR) and Protein Efficiency Ratio (PER) were significantly (P<0.05) affected (Table 3).

Raw BGO diet supplemented with lysine and methionine significantly (P<0.05) reduced the feed conversion ratio (2.05) of the broilers more than lysine or methionine supplemented diets did. While there was no significant (P>0.05) difference among broilers fed control and lysine+methionine supplemented diets in FCR, broilers fed diet 5 (BGO + no amino acid supplement) had the highest FCR of 2.57. This could be due to the presence of Antinutrtional Factors (ANFs) in the raw BGO diet without amino acid supplementation and the amelioration of the effect of ANFs by amino acids, especially methionine, in the supplemented diets (D'Mello, 1995). Also, the supplementation with lysine + methionine resulted in the diet having the same lysine level with the control diet (Table 1), thereby meeting the NRC (1994) lysine requirement of the broilers. Protein

Table 3: Performance of broilers fed bambarra groundnut offal diets supplemented with lysine and or methionine

	Diets					
Parameter	1	2	3	4	5	SEM
Initial live weight (g)	429.17	433.33	447.92	435.42	429.17	11.71
Final live weight (g)	1600.00	1587.08	1638.99	1688.11	1525.00	76.50
Daily weight gain (g)	34.49	33.94	35.03	36.84	32.23	2.21
Daily feed intake (g)	75.30	85.49	84.95	75.38	82.68	5.70
FCR	2.18[bc]	2.53[ab]	2.43[ab]	2.05[c]	2.57[a]	0.11
Daily protein intake (g)	15.54	17.64	17.53	15.56	17.06	1.18
PER	2.24[ab]	1.93[bc]	2.01[bc]	2.37[a]	1.89[c]	0.10
Mortality (%)	8.33	0.00	8.33	8.33	4.17	3.73

[a, b]Means in a row with different superscripts are significantly different (P<0.05). SEM = Standard Error of Mean.
PER = Protein Efficiency Ratio; FCR = Feed Conversion Ratio

Table 4: Cost of feeding bambarra groundnut offal diets supplemented with lysine and or methionine to broilers

	Diets					
Cost	1	2	3	4	5	SEM
Feed cost per kg (₦)	34.49[a]	31.84[c]	31.84[c]	33.34[b]	30.34[d]	0.01
Total feed intake (g)	2.56	2.91	2.89	2.56	2.81	0.19
Total feed cost (₦)	88.30	92.55	91.96	85.45	85.29	6.46
Daily feed cost (₦)	2.60	2.76	2.70	2.52	2.51	0.19
Total weight gain (g)	1171.52	1153.75	1191.07	1252.69	1095.83	75.25
Feed cost per kg weight gain (₦)	75.19	80.45	77.27	68.24	77.97	3.67

[a, b]Means in a row with different superscripts are significantly different (P<0.05). SEM = Standard Error of Mean. ₦ 116 = $1.00

Efficiency Ratio (PER) followed the same trend with FCR. Broilers fed BGO diet supplemented with lysine + methionine had a significantly (P<0.05) higher PER than those fed lysine, methionine supplemented or non-supplemented BGO diets. The significantly (P<0.05) higher PER of broilers fed lysine+methionine supplemented BGO diet could be attributed to significantly (P<0.05) higher apparent digestibility of Crude Protein (CP) as shown in Table 5.

Generally, the performance of these broilers fed amino acid supplemented BGO diets composed almost entirely of agro-industrial wastes confirms the report of Preston (1995) that locally available feed resources could be used in feeding monogastric (poultry) animals and that the diets should be supplemented with synthetic amino acids, especially lysine and methionine. The results obtained in this study also showed that broilers could be fed diets with Metabolizable Energy (ME) lower than NRC (1994) recommended ME levels to encourage feed intake but with slightly (5-10%) increased CP content (Olomu, 1995).

Cost: The cost of feeding raw bambarra groundnut offal diets supplemented with lysine and or methionine is presented in Table 4. The control diet (Diet 1), which had no BGO and no amino acid supplementation had the highest (P<0.05) cost per kg of the diet, followed by diet 4 (BGO with lysine + methionine). The diet with the lowest cost per kg feed was Diet 5, which was not supplemented with lysine or methionine. Although, there were no significant (P>0.05) differences among broilers fed the various diets in most cost indices, broilers fed diets 4 and 5 had the lowest (numerically) cost of total and daily feed consumed as shown in Table 4. Broilers fed Diet 4 had the lowest feed cost per kg live weight gain of ₦68.24 compared to ₦75.19, ₦77.27, ₦77.97 and ₦80.45 by broilers fed diets 1, 3, 5 and 2, respectively.

The reduction in cost of feeding the broilers due to BGO diets either supplemented or not supplemented with lysine or methionine could be attributed to the lower cost of BGO (₦15.00/kg) compared to maize offal (₦27.00/kg) and groundnut cake (₦59.00/kg). The implication of this reduced feed cost is that a broiler farmer could make more profit by feeding broilers with BGO diet supplemented with lysine and methionine.

Apparent nutrient digestibility: The apparent nutrient digestibility coefficient of broilers as affected by bambarra groundnut offal diets supplemented with lysine and or methionine is presented in Table 5. Apparent digestibility coefficient of Crude Protein (CP) of broilers fed diet 4 was similar to that of broilers fed diet 1 (Control), two of which were significantly (P<0.05) higher than those of broilers fed diets 2, 3 and 5. Broilers fed diet 5 (BGO without lysine or methionine supplementation) had the lowest CP digestibility coefficient of 52.78%.

There were no significant (P>0.05) differences among the broilers fed various treatment BGO and control diets in apparent digestibility coefficient of Dry Matter (DM), ether extract, crude fibre and nitrogen free extract. The results suggest that the broilers were able to digest and derive nutrients from the diets with the same level of

Table 5: Apparent nutrient digestibility coefficient of broilers fed Bambarra Groundnut offal diets supplemented with lysine and or methionine

	Diets					
Nutrient	1	2	3	4	5	SEM
Dry matter (%)	55.17	58.86	56.66	56.04	55.13	1.27
Crude protein (%)	59.12[a]	53.79[bc]	53.94[b]	59.39[a]	52.78[c]	0.34
Ether extract (%)	79.37	79.12	78.41	81.58	80.06	0.94
Crude fibre (%)	55.59	55.36	54.54	57.21	54.23	1.83
Nitrogen free extract (%)	64.57	66.26	64.31	63.91	63.82	1.36

[a, b]Means in a row with different superscripts are significantly different ($P<0.05$). SEM = Standard Error of Mean

efficiency, except CP digestibility. However, the high Crude Fibre (CF) content of the diets (Table 1) and lower ME: CP ratio than NRC (1994) recommended levels could have been responsible for the observed apparent digestibility coefficient of nutrients in this study.

Conclusion: It was concluded that raw bambarra groundnut offal could be a valuable energy and protein feedstuff for broilers that should be supplemented with lysine and methionine to improve feed conversion ratio and protein efficiency ratio. Bambarra Groundnut Offal (BGO) diets would reduce cost of feed and improve digestibility coefficient of crude protein of the broilers.

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