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RESEARCH ARTICLE

Growth Performance and Nutrient Digestibility of Broiler Chickens Fed Diet with Graded Levels of Local Processed Groundnut Cake Meal as Replacement for Soybean Meal

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ABSTRACT

One hundred and twenty day old Arbor acre strain chicks were fed graded levels of local processed groundnut cake meal (LGNCM) diets to determine their response on growth performance and nutrient digestibility. The study consisted of five treatments replicated thrice with 8 birds per replicate in a complete randomized design using 0, 25, 50, 75 and 100% levels of LGNCM. The experiment lasted for 56 days with feed and water provided *ad libitum* throughout this period. The results showed that the mean final body weight, weight gain and feed conversion ratio (FCR) were all significantly ($P<0.05$) influenced by the dietary treatment. Birds on 0 and 25% LGNCM inclusion levels recorded the highest value on final body weight and weight gain; moreover, also they recorded the best feed conversion ratio. Apparent nutrient digestibility results showed significant differences ($P<0.05$) in crude protein, crude fiber, ether extract and ash digestibility among the dietary treatments. No significant dietary treatment effect ($P>0.05$) on the nutrient digestibility of dry matter, nitrogen free extract and energy were obtained. Growth performance and nutrient digestibility parameters investigated were optimized by birds up to 50% LGNCM inclusion level. However, to obtain maximum growth performance and also better digestibility of nutrients, 25% LGNCM inclusion level seems ideal to be recommended.

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INTRODUCTION

Broiler production is unique in that it offers the highest turnover rate and quicker returns to investment outlay. Funds invested in poultry especially in broiler production are recovered faster than in any other poultry or livestock agri-business (Onwumere *et al*., 2011). The high cost of feed and feed ingredient, particularly the protein concentrates has been a major problem of poultry production in development countries today apart from incidence of disease (Adeniyi and Balogun, 2002; Amaefule *et al.,* 2004) .The ultimate goal of livestock production is the attainment of sustainable production with minimum cost of production and maximum returns. This has however been unachievable due to the prohibitive cost of feed ingredients. the search for alternative protein sources of feed ingredients as a partial or complete substitute to a conventional costly ingredient in poultry ration has been long (Robinson and Singh, 2001; Nwambe *et al*., 2011). The urgent need to arrest the high cost of feed ingredient has prompted nutritionists, farmer and other players in the industry to shift research focus to alternative feedstuff, which are locally available, cheap and within the reach of farmers. One of such ingredients is locally processed groundnut cake, which is a good sources of protein, with a crude protein content of about 40% (Warnick, 1996), which make it good protein concentrate in poultry ration. Groundnut (*Arachis hypogeal*) is widely cultivated in Nigeria due to its high level of acceptance for oil among local consumer. It is known however that processing techniques like fermentation, roasting, and autoclaving can improve nutritional quality and bioavailabilty of nutrients present in legumes (Oloyede *et al*., 2010). Like soyabean (Glycine max), groundnut (*Arachis hypogeal*) is an industrial crop used mainly as a source of oil (Elegbede, 1998). Groundnut cake obtained after frying the cake in oil and which the Hausa people of Nigeria call Kulikuli is used as a delicious snack for humans and can be used as supplement in other dishes, and as a food, groundnut is

very high in energy due to its high fat and protein content (Elegbede, 1998; Oloyede *et al.*, 2010). The cake or residue obtained after the oil is extracted has been reported to be high in protein and used as supplement in animal feed (Akano and Atanda, 1990; Kwanashie *et al.*, 1992). Therefore, this study was carried out to determine the growth performance and nutrient digestibility of broiler chickens fed graded levels of local processed groundnut cake meal.

MATERIALS AND METHODS

Experimental location

The experiment was conducted in the Poultry Unit of Teaching and Research Farm of the Department of Animal Production Technology of Federal College of Wildlife Management New-Bussa, Niger State, Nigeria.

Test ingredient preparation

The groundnut seeds were procured, clean of dirt, de-hulled, and toasted over fire using open frying pan; milled in a milling machine and the oils were extracted. Later, they were fried slightly and molded into lumps, soaked in water for few minutes to remove the leftover oil. The lumps were finally sun-dried and ground into meal.

Experimental Animal, Design and Diet

A total of one hundred and twenty (120) Arboracre of day old broiler chickens were used in the experiment. They were randomly allocated to the 5 isonitrogenous and isocaloric dietary treatment diets in a completely randomized design (CRD). Each treatment consists of three (3) replicates with eight (8) chicks each. The dietary treatments contained 0 (T1), 25 (T2), 50 (T3), 75 (T4) and 100% (T5) levels of inclusion of local processed groundnut cake meal (LGNCM) as shown in Table 1.

Management practices

Experimental diets and water were provided and made available for the birds' *ad-libitum* throughout the experimental period of 56 days. Deep litter system was used with wood shaving serving as the litter material. Vaccination and medication programs were carried out as at when due. All other management practices were put in place accordingly.

Performance indices

The birds were weighed initially at the start of the experiment and subsequently on weekly basis to determine their weight gain. Weighed quantities of feed were provided to the birds and left over of the feeds were also weighed and the difference between the two was calculated to determine their weekly feed intake. Feed conversion ratio and protein efficiency ratio were also estimated.

Nutrient digestibility (metabolic cage) trial

At the end of 56 days, 2 birds per replicates closest to the mean weight of the birds in each treatment group were randomly selected and placed in clean, disinfected and individual metabolic cages for nutrient digestibility study. Two days acclimatization period prior to the commencement of three days metabolic trial were allowed while a given quantity of feed was offered daily to the selected birds. Daily excreta voided per replicate were collected and dried in the drying chamber for 12 hours at 60^{o}C. Dried excreta voided per replicate for the period of the trial were pooled together and representative samples used to determine the proximate composition (AOAC, 1990).

Statistical Analysis

All data collected were subjected to one way analysis of variance appropriately (ANOVA) using SAS (2001) and significant differences were separated using Duncan's multiple range test (Duncan, 1995).

RESULTS

The proximate composition of the LGNCM meal and experimental diets are presented in Table 2. The result showed that LGNCM contained 88.02% DM, 40% crude protein, 15% ether extract, 7% crude fiber, 5% ash, and Nitrogen Free Extract of 33%. The proximate composition of the experimental diets showed that T_1 diet contained the highest value of crude protein and T_5 had the lowest value. Crude fiber content of the diets was highest in T^5 and lowest in T_1 whereas the energy level of the diets fall within the same range with T_1 diet having the highest value and T_2 had the least value. The results of the effect of treatments on the performance of broilers are presented in Table 3. These result showed that the final body

Table 1: Gross ingredient composition of experimental diets

Ingredient	Starter phase					Finisher phase				
	0%	25%	50%	75%	100%	0%	25%	50%	75%	100%
Maize	51.00	51.00	51.00	51.00	51.00	59.00	58.75	58.55	58.25	58.40
LPGNC	-	7.00	17.50	28.00	35.00	-	6.50	13.0	19.50	26.00
Soya beans	35.00	28.00	17.50	7.00	-	26.00	19.50	13.00	6.50	-
Fish meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Wheat offal	7.00	7.00	7.00	7.00	7.00	8.10	8.00	8.00	8.00	7.50
Oyster shell	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
*Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.14	0.50	0.74	1.00	1.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100	100	100	100	100
Calculated composition										
C P %	23.13	23.17	23.31	23.41	23.43	20.06	20.10	20.10	20.02	20.10
ME(Kcal/kg)	2814.0	2829.4	2852.5	2875.5	2891.0	3098.0	3100.0	3102.0	3106.0	3129.5

weight, weight gain and feed conversion ratio were significantly affected (P<0.05) by dietary treatments. Birds on T_1 and T_2 had significantly higher (P<0.05) final body weight and weight gain which differed from values of obtained for T_3, T_4, and T_5. There was no significant differences (P>0.05) observed in the mean feed intake across the dietary treatments. The mean feed intake is also highest for the birds fed T_1 (control diet), closely followed by those on T_2 (25% LGNCM) and lowest for birds fed T_5 (100% LGNCM). Birds fed control diet and 25% LGNCM gave the best feed conversion ratio while those fed T_5 (100% LGNCM) and T_4 (75% LGNCM) recorded a poorer feed conversion ratio. The protein efficiency ratio (PER) was also significantly (P<0.05) affected by the dietary treatments. The apparent nutrient digestibility of the dietary treatments is presented in Table 4, that indicated significant differences (P<0.05) in crude protein (CP), crude fiber (CF), ether extract and ash digestibility values among treatments. The crude protein, crude fiber and ash digestibility were maximized in birds fed control diet compared with those fed 25% LGNCM while the lowest value was obtained from the birds fed diet substituted with 100% LGNCM. There were no significant (P>0.05) dietary treatments effect on the nutrient digestibility of dry matter (DM), nitrogen free extract (NFE), and energy values among various treatment groups. NFE and energy digestibility were observed to follow the same pattern across the various dietary treatments where the highest value was obtained from birds fed control diets and lowest value observed from birds fed 50% LGNCM.

DISCUSSION

The proximate composition of the experimental diets were adequate in nutrient content as recommended for broiler birds in tropics (Olomu, 1995); also the crude protein of the LGNCM has shown to be relatively comparable to that of soybean as reported by NRC (1994); this implies that the LGNCM and SBM are comparable in their ability to supply protein for cockerel birds. The crude protein content of LGNCM obtained in the study was slightly different from some previously documented reports (Aguihe *et al.*, 2010), which may be due to component variations associated with location, method of sample collection and processing and analytical procedure used. The downward decrease in the final body weight of the birds was observed as the graded levels of LGNCM in the diets increased. Feed intake was inversely related to the increasing levels of LGNCM across the treatments; observation at 25% LGNCM tended to suggest that lower levels only may be beneficial to broilers. The high fat content in the LGNCM may have increased the energy density of the feed and consequently increased feed intake depression (Elegbede, 1998, Adeniji, 2008). Also, The reduction in feed intake for broilers birds on LGNCM diets may suggest that the level of residue oil in the LGNCM based diets is higher than what is achieved in the soybean meal control diet and this implies higher energy content of GNC and consequently lower feed intake for the birds on the diets with LGNCM (Adeniji, 2008). Birds have been known to eat in order to satisfy energy requirement [NRC, 2004]. Moreover, the energy content of all the diets are similar but the higher fiber content might had induced low feed intake in the treatments as the levels of LGNCM inclusion increased. The weight gain followed a similar trend to feed intake. The weight gain decreased across the treatment with birds on T_1 having the highest weight gain and those on T_5 lowest weight gain which implied that there was decrease in weight gain as the inclusion level of LGNCM increases. This could be due to decreased feed intake across the treatments. The

Table 2: Proximate composition of Local Groundnut Cake Meal (LGNCM) and Experimental diets (g/100g)

Parameters	LGNCM	T_1	T_2	T_3	T_4	T_5
Dry matter	98.02	97.28	95.98	96.45	94.96	96.55
Crude protein	40.08	20.25	19.25	19.50	20.20	18.35
Crude fiber	7.00	8.00	7.00	9.00	9.00	10.00
Ether extract	15.00	10.00	11.00	10.00	9.00	9.00
Ash	5	11	10	6	8	10
NFE	32	50.75	52.75	54.50	54.00	53.65
ME(Kcal/kg)	3878.62	3331.88	3481.66	3471.25	3356.50	3420.23

Table 3: Growth performance of broiler chickens fed graded levels of Local Processed Groundnut Cake Meal

Parameter	$T_{1\ (0\%)}$	$T_{2\ (25\%)}$	$T_{3\ (50\%)}$	$T_{4\ (75\%)}$	$T_{5\ (100\%)}$	SEM
Final Weight (g/b)	2383.30^{a}	2253.30^{ab}	2100.33^{bc}	1960.27^{c}	1900.09^{c}	7.77
Weight gain (g/b)	2295.30^{a}	2165.30^{ab}	2012.33^{bc}	1872.27^{c}	1812.10^{c}	4.23
Weight gain (g/b/d)	40.99^{a}	38.67^{ab}	35.93^{bc}	33.43^{c}	32.36^{c}	1.47
Feed intake (g/b)	6103.33	6090.00	5989.97	5883.33	5866.67	130.40
Feed intake (g/b/d)	91.13	90.89	89.11	87.20	86.90	1.67
FCR	2.65^{a}	2.81^{a}	2.97^{a}	3.14^{b}	3.23^{b}	0.08
PER	1.20^{a}	1.13^{a}	1.08^{ab}	1.02^{b}	0.99^{c}	0.02

Table 4: Nutrient digestibility of broilers fed experimental diets

Parameter	$T_{1\ (0\%)}$	$T_{2\ (25\%)}$	$T_{3\ (50\%)}$	$T_{4\ (75\%)}$	$T_{5\ (100\%)}$	SEM
Dry matter %	91.60	90.43	91.30	89.83	88.40	1.20
Crude protein%	91.67^{a}	89.27^{a}	81.13^{b}	80.60^{b}	76.77^{b}	2.73
Crude fiber %	83.80^{a}	82.10^{b}	75.40^{b}	75.37^{a}	57.83^{c}	3.50
Ether extract %	94.60^{a}	94.30^{a}	85.87^{b}	92.60^{ab}	89.50^{ab}	1.22
Ash %	85.80^{a}	84.77^{a}	71.77^{b}	71.40^{b}	70.07^{b}	2.16
Nitrogen Free Extract %	86.23	86.10	85.70	85.13	84.57	0.36
Energy(Kcal/kg)	94.47	93.00	89.37	92.53	91.30	0.87

[ab] Means with the same superscripts are not significantly (P>0.05) different.

higher weight gain observed in birds fed control diet followed by 25% LGNCM diet suggests a positively higher bioavailability and utilization of amino acids (Aziz *et al.* 2001). The lower weight gain recorded in birds on T5 (100% LGNCM) could be due to presence of high crude fiber content and groundnut cake meal as sole protein source at higher level of inclusion was not efficient for good body weight gain. These findings are in close agreement with the report of Ghadge *et al* (2009) and Aguihe *et al*. (2010). Feed conversion ratio (FCR) is a direct indication of how best the feed given to birds was turned to meat. The values obtained for FCR were significantly affected (P>0.05) by dietary treatments and it increases as the levels of LGNCM in the diets increased. Birds on T_1 had the lowest value compared with birds on T_2 while those on T_4 andT_5 had the highest value. The lower the feed conversion ratio, the better the quality of the feed, hence, the birds on control and 25% LGNCM level had the lowest FCR thus making them more efficient feed converters. The PER showed a decreasing pattern as the replacement level of soybean meal with LGNCM increased. Hence, the decreasing value of the PER with increasing level of LGNCM are indication that LGNCM protein quality is lower than the soybean meal. This may have accounted in part for the observed decrease in weight gain when soybean substitution exceeded 50% level of LGNCM.

Crude protein, crude fiber, ether extract and ash digestibility were significantly (P<0.05) affected by inclusion levels of LGNCM in the diets. The nutrient digestibility of CP, CF and ash decreased as the level of inclusion of LGNCM in the diets increased. The crude protein, crude fibre and ash utilization were optimized in birds fed control diet followed by diet substituted with 25% LGNCM and the lowest value was obtained in birds fed 100% LGNCM. The Ash and energy utilization took the same trend in that they were maximized in birds fed control diet followed by 25% LGNCM, while 50% LGNCM gave the lowest value. The generally high digestibility of nutrients shown by birds fed control diet as compared with those fed 25% LGNCM could be as a result of high amount of available and digestible protein and lower level of crude fiber in the diets which are adequately known to enhance nutrient digestibility. Hence, the digestibility of these nutrients in the diets decreased at higher inclusion level of LGNCM (Adeniji, 2008).

Conclusion

The findings of this study showcased LGNCM as having the potential of replacing soybean meal to the tune of 25% in the diet of broiler chickens which gave the optimum performance and nutrient utilization. At higher level of inclusion (beyond 50%), performance was impaired with less nutrient digestibility.

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