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Full Length Research

Growth performance, nutrient digestibility and cost benefit analysis of broiler birds fed lizard meal as a replacement for fishmeal

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ABSTRACT: Two hundred and twenty-five day-old broiler chicks of "Anak 2000" strain were used to determine the effect of partially and completely replacing fishmeal (Fm) with lizard meal (Lm) in broiler birds. The objectives were targeted at the growth performance, nutrient digestibility and the cost benefit analysis of the birds from day old to the eight weeks of research. A week was carved out for the brooding of the birds. The birds were distributed into five treatment groups of forty-five birds, replicated three times with fifteen birds each per replicate in a completely randomized design (CRD). The processed lizard meal was included in the diet at levels of 0, 25, 50, 75 and 100% corresponding to treatments 1, 2, 3, 4 and 5. Feed and water were given *ad-libitum* throughout the experiment. Proximate analysis of lizard meal and the experimental diets were equally carried out according to laid down standards. Results obtained showed that growth performance parameters differed significantly ($p<0.05$) across the treatment groups with treatment 4 (75% Lm) possessing a superior ($p<0.05$) value of 2987.33 g, 53.66 g and 2.28 in terms of final body weight (FBW), average daily weight gain (ADWG) and feed conversion ratio (FCR), which was closely followed by birds in treatment 5 (100%) with 2870 g, 51.23 g and 2.40 for FBW, ADWG and FCR. The least performance was obtained in treatment 3 (50%) with 2431.33 g, 42.27 g and 2.93 for FBW, ADWG and FCR respectively. Nutrient digestibility results showed higher values of dry matter, crude protein and ether extract in treatment 4 (81.24%, 63.82% and 52.78%) which also has the least value for crude fiber (44.05%). Cost benefit analysis was best in treatments 4, with profit and cost benefit ratio of ₦1098.97 and 1.58. Thus, from the overall results obtained in the present research work, it can be deduced that replacement levels at 75% performed best, though replacement level up to 100% is viable without any detrimental effect on the performance and cost implication in the short and long run.

Keywords: Broiler birds, cost benefit analysis, fishmeal, growth performance, lizard meal, nutrient digestibility.

INTRODUCTION

Broiler production is carried out in all parts of the country with no known religious, social or cultural inhibitions associated with their consumption. Specifically, investment in broiler enterprises is attractive because the production cost per unit is low relative to other types of livestock and poultry meat is tender and broiler enterprises have short production cycles (Olabode *et al*., 2020). Thus, the success of exotic breeds and the ease of mastering the techniques of poultry production among other factors have made it develop to the status of agribusiness in Nigeria as distinct from subsistence production. According to Olabode *et al.* (2017), broiler marketing is a very challenging task for any sizeable broiler production in Nigeria that no farmer should invest in it unless he has a fair knowledge of market outlets and the size of their demand. Chicken constitutes of the most common sources

of animal protein in developed countries, but this is not the case in developing countries mostly due to the cost which is beyond the reach of the common man, of which daily intake of animal protein precept falls far below the normal intake as recommended by FAO (2010).

However, feed cost is presently very high and makes up 70-80% (Oluyemi and Robert, 2007) of the total cost of production in Nigeria. The ultimate aim of broiler nutrition is to increase the production efficiency of the poultry. The economic importance of poultry feeding has become apparent when it is realised that feed is the highest single cost factor and constitutes about two-third of the total production cost. Thus, many cases of broiler business failures can be traced to poor or improper feeding of the birds. Therefore, it is pertinent that the right nutrients in adequate quantity and quality be supplied to the birds. There is therefore the need to continue to source for alternative sources of protein and energy that are not in stiff competition with humans. Such feedstuff should not be the ideal food for man and should also have limited or no industrial usage.

Agama agama is a specie of lizard from the *Agamidae*, mostly found in the sub-Saharan Africa region. They are usually distinguished from amphibians by their dry, scaly skin that limits water loss, more powerful jaws, internally fertilize and advanced circulatory, respiratory, excretory, and nervous systems and considerable behavioural control over their body temperature (Olabode *et al*., 2017). *Agama* lizards are of different types and occur in different sizes. They usually live in groups or colonies. The lizard has a head and a trunk that is joined by a definite neck with a long tapering tail. They live on walls and ceilings of buildings and feed on small insects by picking them on the tips of their sticky tongues. Its size varies from 13 to 30 cm in total length. *Agama agama* is well suited to arid conditions. They remain active throughout the day except for the hottest hour when even shady spots can reach 38°C. *Agamas* are primarily insectivores, but they have been known to eat small mammals, reptiles and vegetation. *Agama agama* tends to reproduce during the wet season, but can also reproduce in areas that receive constant rainfall (Olabode *et al*., 2020). This research work is therefore geared towards the replacement of fishmeal with lizard meal in the diet of broiler birds to determine their growth performance, nutrient digestibility and cost benefit analysis.

MATERIALS AND METHODS

The experiment was carried out at the poultry section of the Federal College of Agriculture, Ishiagu, Ebonyi State, Nigeria. Matured *Agama agama* lizards of both sexes were used. The lizards were caught within the college environment with the catapult. Care was observed so as not to cause much damage to the carcass of the lizard. The lizards were slaughtered and the internal organs removed. The carcass was boiled at 100^{o}C for five minutes and thereafter sundried to appreciable moisture content for easy grinding to meal, which was later incorporated into the diets of the birds at different levels. Five experimental diets were compounded and the lizard meal was added at inclusion levels of 25, 50, 75 and 100% to replace fishmeal in treatments 2, 3, 4 and 5 respectively, while treatment 1 served as the control with a 0% level of lizard meal (Tables 1 and 2). A completely randomized design (CRD) was used. A total of two hundred and twenty-five (225) unsexed Anak “2000” were used for the research work with each treatment comprising forty-five birds with three replicates of fifteen birds each. Feed and water were given ad-libitum and vaccinations were administered according to laid down standards.

Proximate analysis of the lizard meal and the experimental diets were carried out using the procedure of AOAC (2015). Data were collected for growth performance, nutrient digestibility and cost benefit analysis. The initial weight of the birds was obtained at the beginning of the research using a 30 kg sensitive scale and then subsequently on a weekly basis. Feed intake was also recorded as the difference between the quantity of feed given the previous day and the quantity that was left the next day. The feed conversion ratio was obtained as the ratio of feed intake divided by the body weight gain. Nutrient digestibility was calculated using the formula;

$$\mathrm{ND} = \frac{\mathrm{AN\ Feed} - \mathrm{AN\ Faeces}}{\mathrm{AN\ Feed}} x\ 100$$

Where: ND = Nutrient digestibility, AN Feed = Amount of nutrient in the feed, AN Faeces = Amount of nutrient in the faeces

While the cost benefit analysis was computed using the procedure;

Cost of bird = Amount expended or spent on the purchase of bird.

Cost per kg of feed = Cost of feed/25kg.

Cost of feed consumed = Total feed intake x cost per kg of feed/1000.

Other costs = These include transportation, vaccine, drugs, litter materials etc.

Total cost of production = Cost of bird + Cost of feed consumed + Other cost.

Revenue = Average final Weight of birds x cost per kg of the current market price of 1kg meat of broiler/1000.

Table 1. Composition of starter broiler diet fed lizard meal as a replacement for fishmeal.

Ingredients	Treatments				
	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%)	T5 (100%)
Fishmeal	3.50	2.63	1.75	0.87	0.00
Lizard meal	0.00	0.87	1.75	2.63	3.50
Total	100	100	100	100	100

Other feed ingredients had the same value across treatment group: Maize-54.00; Wheat offal-5.00; Soybean meal-5.40; Groundnut cake-25.00; Bloodmeal-2.00; Bonemeal-2.50; Limestone-1.50; Salt-0.25; Starter premix-0.35; Lysine-0.15; Methionine-0.35.

Table 2. Composition of finisher broiler diet fed lizard meal as a replacement for fishmeal.

Ingredients	Treatments				
	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%)	T5 (100%)
Fishmeal	1.00	0.75	0.50	0.25	0.00
Lizard meal	0.00	0.25	0.50	0.75	1.00
Total	100	100	100	100	100

Other feed ingredients had the same value across treatment group: Maize-54.00; Wheat offal-7.00; Soybean meal-3.05; Full fat soya-3.00; Groundnut cake-16.80; Palm kernel cake-7.55; Bloodmeal-2.50; Bonemeal-2.50; Limestone-1.50; Salt-0.25; Starter premix-0.35; Lysine-0.15; Methionine-0.35.

Benefit/Profit = Revenue – Cost of production.

Cost benefit ratio = Cost of production/Benefit.

Data collected were subjected to analysis of variance and significant difference means were separated according to the method of the Duncan multiple range test as outlined by Obi (2002).

RESULTS AND DISCUSSION

Table 3 revealed the proximate composition of lizard meals in relation to that of fish meals. From Table 3, it can be deduced that lizard meal had a high level of crude protein content of 54.8%, moderate crude fibre level of 11.32%, ether extract content of 4.84%, ash content of 10.16%, nitrogen free extract level of 13.98% and a low moisture content of 4.90%. These values obtained for lizard meal were closely related to the values obtained for fishmeal which had 60.04% crude protein, moderate crude fibre of 7.63%, ash content of 10.26%, 9.80% ether extract, nitrogen free extract of 9.01% and a moisture content of 3.26% respectively. Thus, the result obtained for lizard meal was in consonance with those reported by Abulude *et al.* (2007) and Tiamiyu (2014) where they observed a range value of 54.05-57.69% content of crude protein, 2.56-3.01% value for ether extract, ash content of 1.11-3.18%, nitrogen free extract of 21.38-21.94% and a moisture content of 3.85-4.18% respectively. They suggested that the differences obtained in the proximate composition could be due to differences in the method of processing, the type and feed consumed by the lizard itself and the climatic condition of the geographical location where the lizard was obtained. Results of the proximate composition of the lizard meal showed that the lizard meal is superior to other unconventional animal protein sources such as locust meal, grasshopper meal, maggot meal etc (Ogunji 2004; Abulude *et al*., 2007).

The growth performance and nutrient digestibility of broiler birds fed lizard meal as a replacement for fishmeal are shown in Table 4. Results obtained revealed that the average daily feed intake (ADFI) value was superior ($p<0.05$) in treatment 2 (129.40 g) which differ from those of ADFI for birds in treatments 1, 3, 4 and 5 with values of 123.89, 123.85, 122.08 and 122.85 g respectively. This work agrees with the report of Ojewole and Annah (2005) who observed a similar trend while working with three animal protein sources in broiler birds. Dietary effect on average daily weight gain showed that birds in treatment 4 had the highest ($p<0.05$) value of 53.66 g which was similar ($p>0.05$) to those in treatment 5 (51.23 g) but different ($p<0.05$) from those of birds in treatment 1, 2 and 3 with values of 48.95, 46.07 and 42.27 g respectively. The high level of average body weight gain observed in treatments 4 and 5 could be due to the ability of the birds to extract the protein in the lizard meal for growth at that level of inclusion. Also, various authors had suggested the absence of anti-nutritional factors in the lizard meal as reasons for making the protein nutrient bioavailable for the development of muscles and growth of the birds **(**Agu et al., 2021; Ojewola and Annah, 2006). This research work agrees with those reported by Ijaiya and Eko (2009) who obtained significantly better effects than the control when

Table 3. Proximate composition of lizard meal in relation to fishmeal

Parameters	Lizard meal	Fishmeal
Dry matter	95.10	96.74
Moisture content	4.90	3.26
Crude protein	54.80	60.04
Crude fiber	11.32	7.63
Ash	10.16	10.26
Ether extract	4.84	9.80
Nitrogen free extract	13.98	9.01
Metabolizable energy (Kcal/kg)	3369.50	3065.35

Table 4. Growth performance and nutrient digestibility of broiler birds fed lizard meal as a replacement for fishmeal.

Parameters	Treatments					SEM
	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%)	T5 (100%)	
IBW (g)	357.00	362.00	360.00	358.00	360.00	-
FBW (g)	2755.67^{b}	2619.34^{c}	2431.33^{d}	2987.33^{a}	2870.00^{a}	67.01
ADFI (g)	123.89^{b}	129.40^{a}	123.85^{b}	122.08^{b}	122.85^{b}	31.28
ADWG (g)	48.95^{b}	46.07^{c}	42.27^{d}	53.66^{a}	51.23^{a}	5.61
FCR	2.53^{b}	2.81^{a}	2.93^{a}	2.28^{c}	2.40^{b}	0.14
DM (%)	78.60^{b}	78.10^{b}	77.90^{c}	81.24^{a}	80.66^{a}	10.55
CP (%)	62.16^{a}	60.71^{b}	60.09^{b}	63.82^{a}	62.41^{a}	9.14
CF (%)	44.65^{b}	46.37^{a}	45.79^{a}	44.05^{b}	44.10^{c}	0.19
EE (%)	50.45^{c}	51.60^{b}	51.55^{b}	52.78^{a}	51.95^{b}	1.39

IBW-Initial body weight; FBW-Final body weight; ADFI-Average daily feed intake; ADWG-Average daily weight gain; FCR-Feed conversion ratio; DM-Dry matter; CP-Crude protein; CF-Crude fibre; EE-Ether extract.

Table 5. Cost benefit analysis of broiler birds fed lizard meal as a replacement for fishmeal.

Parameters	Treatments					SEM
	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%)	T5 (100%)	
FBW (g)	2755.67^{b}	2619.34^{c}	2431.33^{d}	2987.33^{a}	2870.00^{a}	67.01
CDC (₦)	420.00	420.00	420.00	420.00	420.00	-
CKgF (₦)	167.50^{a}	160.09^{a}	152.68^{b}	145.27^{c}	137.86^{d}	11.90
CFC (₦)	1016.83^{a}	1015.07^{a}	926.56^{b}	868.99^{c}	829.87^{c}	32.17
OE (₦)	450.00	450.00	450.00	450.00	450.00	-
TCP (₦)	1886.83^{a}	1885.07^{a}	1796.56^{b}	1738.99^{c}	1699.87^{d}	19.24
RV (₦)	2617.87^{c}	2488.37^{d}	2309.76^{e}	2837.96^{a}	2726.50^{b}	44.81
B/P (₦)	731.04^{b}	603.30^{c}	513.20^{d}	1098.97^{a}	1026.63^{a}	37.04
CBR	2.58^{b}	3.13^{a}	3.50^{a}	1.58^{c}	1.66^{c}	0.03

FBW-Final body weight; CDC-Cost of day-old chick; CKgF-Cost per kg of feed; CFC-Cost of feed consumed; OE-Other expenses; TCP-Total cost of production; RV-Revenue; B/P-Benefit/profit; CBR-Cost benefit ratio. **Note: A kg of broiler cost ₦950.00.**

silkworm caterpillar meal was used to replace fishmeal in the diets of broiler birds. The feed conversion ratio was highest ($p<0.05$) for birds in treatment 3 (2.93), which was similar ($p>0.05$) to those in treatment 2 (2.81). While treatment 4 had the least (2.28) corresponding to the most efficient treatment, which also differs from those in treatment 1 (2.53) and 5 (2.40) respectively.

Higher dry matter of 81.24% was observed in treatment 4, which was followed closely by those in treatment 5 (80.66%), while 77.90% was least in treatment 3. The superior ($p<0.05$) level of crude protein was reported in treatment 4 (63.82%) which was closely followed by

62.41% obtained in treatment 5, which was also similar (p>0.05) to 62.16% obtained in treatment 1. The least value of 60.09% was observed in treatment 3. The high level of crude protein in treatments 4 and 5 suggest the reason behind the superior final body weight and average daily body weight gain observed in the treatments. This connotes that a high percentage of crude protein in these treatments was duly utilized to gain weight in the birds. Crude fibre value was lowest in treatments 4 and 5 with values of 44.05% and 44.10%, while the highest value of crude fibre was obtained in treatments 2 (46.37%) and 3 (45.79%) respectively. This is in agreement with the report of Oluyemi and Robert (2007) who said, birds eat more when the level of fibre in the diet is high. This can be observed in the values of the average daily feed intake of the birds. Cost benefit analysis showed that a better profit and cost benefit ratio was observed in treatments 4 and 5 with values of ₦1098.97 and ₦1026.63 for profit and 1.58 and 1.66 for cost benefit ratio respectively (Table 5).

Conclusion

It can be deduced from the research work that lizard meal up to the level of 100% can be used conveniently to replace fishmeal in the diet of broiler birds, without any negative impact on the performance of the birds and also more and better profit can be generated from such research work, especially at 75% and 100% levels of replacement.

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