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Full Length Research

Replacement levels of feather meal to fishmeal in broiler birds (A case study in Ishiagu, Ivo Local Government Area of Ebonyi State)

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ABSTRACT: One hundred and forty-four (144) day old "Sayyed" broiler birds were used to determine the effect of replacing fishmeal with feather meal on the growth performance and cost benefit analysis of broiler birds. The birds were randomly selected and distributed into four treatment groups of thirty-six birds, each comprising three replicates per treatment with twelve birds per replicate, which was laid out in a completely randomized design (CRD) format. Isocaloric and isonitrogenous diets were formulated with the inclusion of the feather meal to replace fishmeal at the rate of 0, 25, 50 and 75% corresponding to T1, T2, T3 and T4 respectively. Feed and water were given *ad-libitum* and relevant drugs and vaccination were administered to the birds as when due. Proximate composition of feather meal and the experimental diet was also carried out according to laid out procedure and standard. There were significant ($p<0.05$) differences in the parameters obtained for growth performance and cost benefit analysis across the treatment groups. Growth performance was significantly ($p<0.05$) influenced across the treatments with treatment 2 having a superior ($p<0.05$) value for final body weight, average daily weight gain and feed conversion ratio with values of 2520.10 g, 46.72 g and 2.55, which was closely followed by treatment 2 (2490.74 g, 46.12 g and 2.57), while the least values were obtained in treatment 4 (2315.34 g, 42.56 g and 2.78) respectively. Cost benefit analysis showed that profit obtained and cost benefit ratio was superior in treatment 3 (50%) with values of ₦667.51 and 2.55, while the least was observed in treatment 1 (₦514.69 and 3.56) respectively. Thus, it can be concluded that inclusion of feather meal in the diet of broiler birds up to the level of 75% is possible without much impact on their performance.

Keywords: Broiler birds, cost benefit analysis, feather meal, fishmeal, growth performance.

INTRODUCTION

One of the greatest constraints to poultry production in Nigeria is the cost of feed, which accounts for about 60 to 80% of the recurrent expenditure in intensive poultry production (Oluyemi and Robert, 2007). This is due to the fact that feedstuffs used in formulating and compounding diets for poultry birds are in high demand for human consumption and industrial uses (Olabode *et al*., 2017) thus, alternative feeding stuff must be sourced. Protein for poultry is usually supplied from two major sources, i.e. animal and plant sources. Plant proteins are cheaper and therefore their use in large quantities ensures less expensive as compared to animal proteins. However, the use of some of the plant protein sources is limited due to their content of anti-nutritional factors. Such anti-nutritional factors include trypsin, chymotrypsin and amylase inhibitors, aflatoxins and polyphenolic compounds which tend to inhibit and obstruct the activity of digestive enzymes, thereby causing digestive losses (Agu *et al*., 2021).

Feather meal is a by-product of processing poultry; it is made from poultry feathers by partially grinding them under elevated heat and pressure and then drying. Although total nitrogen levels are fairly high (up to 12%), the bioavailability of this nitrogen may be low. Feather

meal is used in formulated animal feed and inorganic fertilizer (Crawshaw, 2019). Feather meal is made through a process called 'rendering'. Steam pressure cookers with temperatures over 140°C (284°F) are used to "cook" and sterilize the feathers. This partially hydrolyses the proteins, which denatures them. It is then dried, cooled and ground into a powder for use as a nitrogen source for animal feed (mostly ruminants) or as an organic soil amendment. Feathers represent 3-7% weight of the live bird, therefore producing a considerable mass of protein (Soni *et al*., 2019). Therefore, this research work is aimed at determining the replacement levels of feather meal to fish meal in broiler birds.

MATERIALS AND METHODS

The research was carried out at the poultry unit of the Animal Production Department, Federal College of Agriculture, Ishiagu, Ebonyi State. The feathers were sourced from Artisan market Enugu in Enugu state where there is a surplus heap of feathers lying as waste from processed chickens. The feathers were adequately washed and boiled at 140-145°C for about fifty minutes. It was later dried in the sun and ground in the hammer mill using a 1.5 mm screen mesh and then incorporated into the diets of the birds at the levels of 0, 25, 50 and 75% corresponding to treatments 1, 2, 3 and 4 respectively (Tables 1 and 2). A completely randomized design (CRD) was used. One hundred and forty-four (144) day old "Sayyed" broiler chicks were used for the research work. Each treatment had thirty-six birds with three replicates consisting of twelve birds each. Feed and water were given *ad-libitum* and vaccinations were given as at when due according to standard practices. The initial weight of the birds was taken at the beginning of the study 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. Data collected were subjected to analysis of variance (ANOVA) according to the procedure. Significantly different means were separated according to the method of Duncan multiple range test. Proximate analysis of feather meal was carried out using the standard procedure of AOAC (2015). Cost benefit analysis was calculated using the following formulas;

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, vaccines, 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.

Benefit/Profit = Revenue – cost of production.

Cost benefit ratio = Cost of production/Benefit

RESULTS AND DISCUSSION

Growth performance and cost benefit analysis of broiler birds fed different levels of feather meal to fishmeal are displayed in Table 4. Data obtained showed that final body weight was superior ($p<0.05$) in treatment 2 with a value of 2520.10 g followed by those of birds in treatment 3 (2490.74 g) which was similar ($p>0.05$) to those in treatment 1 (2470.69 g). While the least value of 2315.34 g was obtained for birds in treatment 4 respectively. This suggests that the birds were able to sustain better weight which also connotes that the birds were able to utilize the bio-available protein in the feather meal and were able to convert it to extra meat. This was contrary to the report of Xaviers *et al*. (2011) who observed lower final weight in diets where feather meal was added. Effect of diet on average daily feed intake showed that there was no significant ($p>0.05$) difference across the treatment group. Birds in treatment 1 had a value of 118.60 g, which was similar ($p>0.05$) to those of 118.90, 118.68 and 118.19 g obtained for birds in treatments 2, 3 and 4 respectively. This was similar to the work of Madubuike *et al*. (2009) who observed an increase in the feed intake of broiler birds fortified with feather meal. The slight increase in the consumption rate of the birds could be due to the need of the birds to satisfy their energy requirement since the level of fibre in the diet increased concurrently across the treatments. Average daily weight gain values were higher ($p<0.05$) for birds in treatment 2 (46.72 g) which differ from those of 46.12 and 45.73 g obtained in treatments 3 and 2, which were by themselves similar ($p>0.05$) to each other. The least value of 42.56 g was observed in treatment 4. The increase obtained in treatments 2 and 3 could be due to the ability of the birds (at this phase) to be able to breakdown the amino acid in the feather meal and thereby convert them to muscle. This report disagrees with the observation of Xaviers *et al*. (2011), who noted a decline in weight gain of broiler birds fortified with feather meal. Dietary effect of treatment on feed conversion ratio showed no significant ($p>0.05$) difference. A better feed conversion ratio was observed in treatment 2 (2.55), followed by treatment 3 with a value of 2.57. The least performance was observed in treatment 4 (2.78), which was also similar ($p>0.05$) to those in treatment 1 with a value of 2.59 respectively. This implies that the inclusion of feather meal in the diet of broiler birds to replace fishmeal was able to support and sustain an increase in

Table 1. Experimental diet for starter broilers fed different levels of feather meal to replace fishmeal.

Ingredients	Treatments			
	T1	T2	T3	T4
Maize	53.50	53.50	53.50	53.50
Wheat offal	9.50	9.50	9.50	9.50
Soya bean meal	10.00	10.00	10.00	10.00
Groundnut cake	17.15	17.15	17.15	17.15
Fishmeal	3.00	2.25	1.25	0.75
Feather meal	0.00	0.75	1.75	2.25
Bone-meal	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50
Bloodmeal	2.50	2.50	2.50	2.50
Methionine	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10
Starter premix	0.30	0.30	0.30	0.30
Salt	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated analysis				
Crude protein (%)	23.40	23.58	23.76	23.94
Met. Energy (Kcal/kg)	2850.74	2846.16	2841.59	2832.02
Crude fibre (%)	3.68	3.59	3.53	3.44
Ether extract (%)	4.08	3.98	3.87	3.68

Table 2. Experimental diet for finisher broilers fed different levels of feather meal to replace fishmeal

Ingredients	Treatments			
	T1	T2	T3	T4
Maize	58.00	58.00	58.00	58.00
Wheat offal	6.90	6.90	6.90	6.90
Soya bean meal	5.00	5.00	5.00	5.00
Groundnut cake	9.00	9.00	9.00	9.00
Full fat soya	5.00	5.00	5.00	5.00
Fishmeal	1.50	1.13	0.75	0.37
Feather meal	0.00	0.37	0.75	1.13
Palm kernel cake	6.00	6.00	6.00	6.00
Bone-meal	2.50	2.50	2.50	2.50
Limestone	1.50	1.50	1.50	1.50
Bloodmeal	3.50	3.50	3.50	3.50
Methionine	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20
Starter premix	0.35	0.35	0.35	0.35
Salt	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated analysis				
Crude protein (%)	19.74	19.76	19.79	19.82
Met. Energy (Kcal/kg)	3015.60	3013.11	3010.39	3009.76
Crude fibre (%)	3.38	3.38	3.39	3.39
Ether extract (%)	4.42	4.40	4.38	4.36

Table 3. Proximate composition of feather meal

Components	% Composition
Dry matter	90.79
Moisture	9.21
Crude protein	79.50
Crude fibre	1.30
Ether extract	3.98
Ash	4.47
Nitrogen free extract	1.54

Table 4. Performance characteristics of broiler birds fed feather meal as a replacement for fishmeal.

Parameters	Treatments				SEM
	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%)	
Initial body weight (g)	230.00	230.85	230.75	230.15	-
Final body weight(g)	2470.69^{b}	2520.10^{a}	2490.74^{b}	2315.34^{c}	33.51
Average daily feed intake (g)	118.60	118.90	118.68	118.19	7.80
Average daily weight gain(g)	45.73^{b}	46.72^{a}	46.12^{b}	42.56^{c}	4.33
Feed conversion ratio	2.59	2.55	2.57	2.78	0.02

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

Parameters	Treatments				SEM
	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%)	
Final body weight(g)	2470.69^{b}	2520.10^{a}	2490.74^{b}	2315.34^{c}	33.51
Cost of day-old chick (#)	450.00	450.00	450.00	450.00	-
Cost per kg of feed (#)	172.50^{a}	161.11^{b}	149.38^{c}	141.30^{c}	14.89
Cost of feed consumed (#)	1002.47^{a}	938.64^{b}	868.69^{c}	818.31^{d}	17.11
Other expenses (#)	380.00	380.00	380.00	380.00	-
Total cost of production (#)	1832.47^{a}	1768.64^{b}	1698.69^{c}	1648.31^{d}	30.67
Revenue (#)	2347.16^{a}	2394.10^{a}	2366.20^{a}	2199.57^{b}	44.39
Benefit/Profit (#)	514.69^{b}	625.46^{a}	667.51^{a}	551.26^{c}	19.32
Cost benefit ratio	3.56^{a}	2.83^{b}	2.55^{c}	2.99^{b}	0.06

weight in relation to the quantity and quality of feed the birds were able to consume per time. This contradicts the results obtained by Ahaotu and Ekenyem (2009) who observed a better feed conversion ratio in the control when broiler birds' diets were supplemented with feather meal.

Results obtained for cost benefit analysis (Table 5) revealed that a superior ($p<0.05$) revenue value was observed in treatment 2 (₦2394.10) which was similar to those in treatments 3 (₦2366.20) and 1 (₦2347.16), while the least value for revenue was seen in treatment 4 (₦2199.57). Similar trends were observed for profit and cost benefit ratio where treatment 3 had the highest ($p<0.05$) value of ₦667.51 and a better cost benefit ratio of 2.55. This was closely followed by those in treatment 2 (₦625.46 and 2.83). While the least value of profit and cost benefit ratio was observed in the control (₦514.69 and 3.56) respectively. This report agrees with the observation of Olabode *et al*. (2020) who observed better revenue, profit and cost benefit ratio when an alternative protein source was used to supplement the diet of broiler birds.

Conclusion

It can be concluded that feather meal up to the level of 75% can be used conveniently to replace fishmeal in the diet of broiler birds, without any negative impact on the performance of the birds and cost benefit analysis.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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