Nigerian J. Anim, Sci. 2024, 26 (1): 111-119

Cost-effectiveness and performance of broiler chickens fed enzyme fortified feather meal as a replacement for fish meal

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Target Audience: *Poultry farmers, Animal nutritionists and Researchers.*

Abstract

The experiment was conducted to determine the growth performance of broiler chicks and chickens fed with enzyme fortified feather meal (EFFM) as replacement for fish meal (FM). One hundred and fifty (150) day old Ross 308 strain of broiler chicks were used for the starter phase and one hundred and fifty (150) four weeks old chicks were used for the finisher phase. The birds were randomly assigned to five treatment groups in a completely randomized design. Each treatment was replicated three times. Treatment 1 contained 0% enzyme fortified feather meal, while treatment 2, 3, 4, and 5 contained 1, 2, 3, and 4% levels of EFFM respectively. Each level of EFFM was used to partially replace fish meal in the experimental diets. Results of initial live weights, final weight, weight gain and average daily weight gain did not differ significantly (P> 0.05) but feed intake and feed conversion ratio differed significantly (P<0.05) for broiler starter chicks.Results obtained for broiler finisher followed similar trend as observed in the broiler starter phase. Live weight. final weight, weight gain and average daily weight gain did not differ significantly (P<0.05) but feed intake and feed conversion ratio were significantly different (P<0.05) between the treatment groups. However, replacement of fish meal with enzyme fortified feather meal in broiler diets at the inclusion level of 5% had no negative effect on the performance of the broilers. Hence, 4% level of inclusion is hereby suggested for optimum performance.

Keywords: growth performance; broiler finisher; broiler starter; fish meal; enzyme fortified feather meal.

Description of Problem

Fish meal is the most expensive livestock feed ingredient in Nigeria, which is needed in monogastric livestock diets as a major source of animal protein. High quality fish meals and oils are important sources of essential amino acids and long chain fatty acids, essential for most animals including humans (1). The high cost of poultry feed ingredients has led to the search for alternative but cost-effective ingredients for the poultry and livestock. Consequently, the

use of 26 less known non-conventional feed stuffs that are not edible or in direct competition with man for food have been proposed by animal nutritionists (2). Some of these ingredients which have been found to be fit for animal consumption and not competed for by humans, have been found to be able to replace the major conventional feed resources in poultry and livestock production. Some of these feed ingredients include mucuna beans (3), cassava peel meal (4) feather meal (5) etc. Chicken feathers are by products of processing, which are generally produced in large quantities because of high production capacity of the poultry industries (6). Over the years, researchers have tried degrading chicken feathers into feather meal protein for animal feeding as a more sustainable way of lowering the cost of providing the protein needs of poultry, while minimizing environmental degradation through proper disposal of biological waste (7). This is because, feathers are rich in hydrophobic amino acids and important amino acids like cystine, arginine and threonine which are important in poultry production (8). Hence, the study aims to determine the cost effectiveness and performance of broiler chicks and chickens fed diets containing enzyme fortified feather meal for partial fish meal replacement.

Materials and Methods

Experimental site: The experiment was conducted at the Poultry unit of Teaching and Research Farms, Imo State University Owerri. Owerri is located in the humid tropical climate with a mean annual rainfall of about 2500mm, mean annual temperature of 290C and relative humidity range of 70 - 80% which is high during the rainy season (9).

Sourcing and processing of poultry feather: The poultry feathers were sourced from commercial slaughter houses at Relief Market, Owerri. The feathers were washed and boiled under high pressure until the resulting process of hydrolysis converts the feathers into a more soluble form. The hydrolysis process was carried out by boiling the feathers with a batch cooker (pressure pot) at internal pressure of 50-60 Pa (Pascal) for 60 minutes. After boiling, the feathers were washed, sundried and milled to produce feather meal (EFFM).

Procurement of other feed ingredients: Fish meal (FM) and other feed ingredients were procured from Ceeking Farm Feed Milling Owerri. Proximate analysis of the feather meal (EFFM) and fish meal (FM) were conducted at Precision Analytical and Research Laboratory, Ibadan, prior to feed formulation and commencement of the experiment. Mineral analysis was carried out by the method described by Grueling (10), while gross energy was determined with Gallencamp Oxygen Adiabatic Bomb calorimeter (AOAC) (11).

Experimental diets: Five experimental diets T1, T2, T3, T4 and T5 were formulated such that T1 which served as control treatment contained 0% enzyme fortified feather meal (EFFM) while 27 diets T2, T3, T4 and T5 contained 1.00%, 2.00%, 3.00% and 4.00% EFFM at 100g of Biozyme for 100kg weight of feed respectively according to the manufacturer's prescription. All other ingredients were measured out and mixed properly in order to obtain homogeneity (Table 1.0). The enzyme used in processing the feather meal in this study is Biozyme (Pancrellpase). It is a combination of three enzyme (proteins) lipase, protease and amylase. They are normally produced by the pancrease and are important in the digestion of fats, proteins and sugars (12).

Experimental birds: A total of one hundred and fifty (150) day old Ross 308 chicks procured from a reputable hatchery were used for the experiment. The chicks were divided into five treatment groups of thirty (30) birds each. Each group was randomly assigned to one of the experimental diets in a completely randomized design. Each group was further sub-divided into three replicates of 10 birds.

Management operations: The birds were brooded for 21 days. Sources of heat and light were provided. Feed and water were also provided ad libitum. Routine managements which include washing of the feeder and drinker were done daily. Good biosecurity as maintained. Vaccination and medicare schedule of the teaching and research farms were strictly followed.

Data Collection: Data were collected on initial body weight, weekly weight, final body weight and feed intake. Feed conversion ratio was calculated from daily feed intake divide by daily weight gain.

Body weight: Birds were weighed on arrival and thereafter every week using electronic using electronic digital scale of 0.01 sensitivity.

Feed intake: The daily feed intake was determined by taking the differences between the feed supplied and the leftover

Weight gain: This was calculated by subtracting the initial body weight from the final body weight.

$$\textbf{Average Weight gain:} \quad \frac{\text{Final weight gain}}{\text{No of days}}$$

$$\textbf{Feed conversion Ratio:} \quad \frac{\text{Average daily feed intake}}{\text{Average daily body weight}}$$

$$\textbf{Percentage mortality:} \quad \frac{\text{No of dead bird}}{\text{No of live birds in a group}} \times \frac{100}{1}$$

Data Analysis: Data obtained were subjected to one-way analysis of variance using the analytical software statistical package for social sciences (SPSS) (13). The differences in means 28 were equally separated using the Duncan Multiple Range Test as outlined by the same SPSS package.

Results and Discussion

Performance of broiler starter 30

The result of the performance of broiler starter chicks fed enzyme fortified feather meal (EFFM) as fish meal replacement is presented on Table 4. The result obtained showed non-significant differences ($P>0.05$) between the experimental chicks, and the birds in control treatment for most of the performance characteristics like the final weight, weight gain and average daily weight gain. The results of average daily feed intake and feed conversion ratio differed significantly ($P<0.05$) between the control and other treatments. Values were declining marginally as the level of EFFM in the diets increased. No mortality was recorded in all the treatment groups. This result agrees with the reports of Hasni et al. (14) on non-mortality and non-significant differences of broiler chicks fed various levels of enzyme treated feather meal as a replacement of fish meal. Xavier et al. (15) and Laboissiere et al. (16) reported that the inclusion of feather and blood meal processed with different methods in broiler starter diets did not elicit negative response in young broilers which agrees with the findings of this study. However, reduction in final weight and mean daily weight gain of broilers fed diets containing feather meal was reported by Madubuike et al. (17) which differed with the observations made in this research.

Table 1: Ingredient composition of the experimental broiler starter diets (%)

	Diets				
Ingredients	**T_1(Control)**	**T_2**	**T_3**	**T_4**	**T_5**
Maize	58.00	58.00	58.00	58.00	58.00
Soyabean	18.00	18.00	18.00	18.00	18.00
Groundnut cake	15.00	15.00	15.00	15.00	15.00
Fish meal	4.00	3.00	2.00	1.00	0.00
Fortified feather meal	0.00	1.00	2.00	3.00	4.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Lime stone	2.00	2.00	2.00	2.00	2.00
Common salt	0.25	0.25	0.25	0.25	0.25
Vitamin/mineral premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated nutrient content of the experimental feed analysis					
Crude protein	22.71	22.75	22.80	22.84	22.89
Calcium	1.62	1.61	1.60	1.58	1.57
Phosphorus	0.62	0.59	0.58	0.57	0.56
Crude fibre	3.15	3.14	3.12	3.11	3.09
ME (Kcal. Kg)	3003.52	3013.23	3022.94	3032.65	3042.36

Birds fed the control diet significantly consumed more feed than the experimental birds. Naveed et al. (7) observed feed intake reduction of birds fed feather treated diets compared with the standard meal. This however, is in contrast with the findings from other studies on the significant increase in feed intake with feather meal inclusion. Birds usually eat more feed to adjust the energy-protein requirements especially if the diet is deficient in essential amino acids like methionine (18). It is therefore probable, that the non-significant improvement in performance and superior FCR despite feed intake reductions as a result of feather meal inclusion in the diet maybe linked with the hydrolysis and treatment of the feather meal with an enzyme additive (19). Kirpinar et al. (20) earlier reported that the inclusion of poultry by-product meal and enzyme prebiotic supplementation in grower diets enhance feed utilization in young broilers.

Broiler Finisher phase

The result of the growth performance of finisher broilers fed varying levels of enzyme fortified feather meal (EFFM) for fish meal (FM) replacement as presented on Table 5 revealed that the values for final weights, weight gain, average daily weight gain and feed conversion ratio did not differ significantly ($P>0.05$) between treatments. However, only the values for

Table 2: Ingredient composition of the Experimental broiler finisher diets

Ingredients	**T_1(Control)**	**T_2(1.00%)**	**T_3(2.00%)**	**T_4(3.00%)**	**T_5(4.00%)**
Maize	59.00	59.00	59.00	59.00	59.00
Soyabean	16.00	16.00	16.00	16.00	16.00
Groundnut cake	9.00	9.00	9.00	9.00	9.00
Fish meal	4.00	3.00	2.00	1.00	0.00
Fortified feather meal	0.00	1.00	2.00	3.00	4.00
Palm kernel cake	6.00	6.00	6.00	6.00	6.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Lime stone	2.00	2.00	2.00	2.00	2.00
Common salt	0.25	0.25	0.25	0.25	0.25
Vitamin/mineral premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated nutrient content of the experimental feed analysis					
Crude protein	20.48	20.53	20.58	20.62	20.67
Calcium	1.64	1.63	1.61	1.60	1.59
Phosphorus	0.93	0.92	0.90	0.89	0.88
Crude fibre	3.58	3.57	3.55	3.54	3.52
ME (Kcal. Kg)	2977.71	2987.42	2997.13	3006.84	3016.55

average daily feed intake differed significantly ($P<0.05$) which was observed to be decreasing marginally as the inclusion levels of enzyme fortified feather meal (EFFM) increased across the dietary treatments.

The partial replacement of fish meal with EFFM caused reduction in feed intake but had similar FCR, weight gain, average weight gain, and final weight with the control. The results obtained in this phase of the study may not be unconnected with the enzyme fortification of the feather meal which had been reported to increased digestibility and nutrient release (14), (20). The feather meal though contains a complex and low digestible protein (Keratin), but its feeding value is improved through processing and additive inclusion of enzyme (7), (21). Reports of improved performance and nutrient utilization have been reported in poultry when fish meal was replaced with feather meal (22), (14). Ochetim (23) suggested the inclusion of feather meal in both starter and finisher diets at 3% level, while (24) suggested 7.5% inclusion rate without having any negative effect. Again, the replacement of fish meal with a hydrolyzed feather meal fortified with an enzyme up to 6% caused improved body weight gain, but however did not improve the final weight of broilers when compared to the control (25).

Table 3: Proximate and mineral composition of fish meal and feather meal

Nutrients	Values	
	Fish Meal	**Feather Meal**
Dry Matter (%)	94.06	90.75
Crude protein (%)	55.93	60.44
Crude fat (%)	5.91	20.79
Crude fibre (%)	1.84	0.32
Total ash (%)	23.10	7.31
Nitrogen free extract	8.80	4.21
(%)	5.94	6.93
Moisture (%)	3085.35	4086.36
Metabolisable energy		
(Kcal/kg)	6.09	1.87
Mineral	3.05	0.71
compositions	2.00	0.08
Calcium (%)	1.50	0.05
Phosphorus (%)	3.70	0.001
Magnesium (%)	0.003	0.012
Iron Fe (%)		
Copper cu (%)		
Zinc (%)		

Broiler Finisher phase

Cost-effectiveness of feeding broilers with EFFM diets

Results of cost benefit analysis of finisher broilers fed varying levels of EFFM for fish meal replacement (FM) are summarized in Table 6. Results showed that feed cost per kilogramme of the diets produced differed significantly ($P<0.05$) between treatment groups and was progressively reduced with increasing inclusion of EFFM as replacement for fish meal. Birds fed 32 the control diets had the highest feed cost per kg of diet, while diet T5 (4.00% EFFM) had the least feed cost per kg. However, the feed cost per kilogramme of weight gained were similar statistically ($P>0.05$) among all the treatment groups.

Conclusion and Application

The result from this study suggests that:

The inclusion of BiozymeTm increased the feeding value of the feather meal used thus, leading to the better performance observed in finisher broilers fed enzyme fortified feather meal.

The replacement of fish meal with enzyme fortified feather meal had no negative effect on the performance of broiler starters and finishers up to 5% inclusion level as it was observed in this experiment, with chickens fed EFFM diets having similar performance as the control.

Therefore, inclusion of enzyme fortified feather meal is hereby advised in order to reduce the cost of broiler production. However, 4% inclusion level of feather meal

in broiler diets is hereby suggested for optimum broiler's performance.

Table 4: Performance of broiler starter chicks fed enzyme fortified feather meal (EFFM) for fish meal (FM) replacement.

Parameters	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**SEM**
Initial weight (g)	40.70	40.77	40.77	40.77	40.80	0.02
Final weight (g)	1025.67	1031.00	1030.33	1029.0	1028.33	1.50
Weight gain (g)	984.97	990.23	989.57	988.23	987.53	1.19
Average daily weight gain (g)	35.18	35.37	35.34	35.29	35.27	0.05
Average daily feed intake (g)	64.59[a]	62.47[b]	62.28[b]	61.50[b]	61.24[b]	0.38
Feed conversion ratio (FCR)	1.84[aa]	1.77[b]	1.76[b]	1.74[b]	1.74[b]	0.01

[ab]mean values on the same horizontal row with different superscripts are significantly different ($P<0.05$).

Table 5: Performance of finisher broiler chickens fed enzyme fortified feather meal for fish meal (FM) replacement

Parameters	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**SEM**
Initial weight (g)	1025.67	1031.00	1030.33	1029.00	1028.33	1.50
Final weight (g)	3216.72	3205.03	3200.03	3156.70	3129.44	66.55
Weight gain (g)	2191.0	2174.03	2169.70	2127.70	2101.11	65.71
Average daily weight gain (g)	78.25	77.64	77.49	75.99	75.04	2.35
Average daily feed intake (g)	185.73a	184.01b	182.67c	182.26c	182.27c	0.37
Feed conversion ratio (FCR)	2.37	2.37	2.36	2.40	2.43	0.04

[abc]means with different superscripts on the same horizontal row are significantly different ($P<0.05$).

Table 6: Profitability of finisher broilers fed varying levels of enzyme fortified feather meal (EFFM) for fish meal (FM).

Parameters	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**SEM**
Feed cost /kg	153.73[a]	148.73[b]	143.73[c]	138.72[d]	133.73[e]	1.90
Feed cost/kg weight gain)	364.34	352.49	339.20	332.95	324.97	6.56

[abc]mean on the same horizontal row with different superscripts are significantly different ($P<0.05$).

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