Performance , digestibility and carcass yield of broiler chickens fed diets containing two types of fishmeal

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Abstract

A feeding trial was conducted with one hundred and eighty day-old Anak broiler randomly allocated four dietary treatments containing imported fishmeal (IFM) and ground smoked fishmeal (GSFM) to investigate the performance response of broiler chickens fed diets containing 2.5 and 5.0 % IFM and GSFM respectively. Bodyweight and bodyweight gain increased linearly with increased levels of inclusion of fishmeal in the diets ($P < 0.05$). Better performance were notice at higher levels of inclusion of both IFM and GSFM. Final bodyweight and gain were significantly ($P < 0.05$) influenced by fishmeal type and level of inclusion. Feed conversion ratio (FCR) of the birds on IFM diets at 2.5 and 5.0% were not significantly different ($P > 0.05$) from that of GSFM during the starter and finisher phases. Daily protein intake and cost of feed per kilogram weight gain showed no significant treatment effect. The substitution of IFM by GSFM however reduced feed per kilogram weight gain and increasing the level of fishmeal in broiler diets from 2.5 to 5.0 % resulted in reduction of cost of feed per kilogram weight gain. There was a linear increase ($P < 0.05$) in the percentage protein retention and the digestibility percentages of dry matter and fat as the level of fishmeal increased from 2.5 to 5.0%. The inclusion of IFM both at 2.5 and 5.0% levels resulted in a relatively superior ($P < 0.05$) dry matter digestibility and crude protein retention when compared with values obtained for GSFM. The dressed weight percentage increased slightly ($P > 0.05$) with increased level of inclusion of fishmeal while the abdominal fat and other carcass proportions were not significantly influenced by the dietary treatments. Birds that were fed GSFM had a significantly higher ($P < 0.05$) gizzard and kidney percentages. It was therefore concluded that the use of higher levels of local fishmeal (above 5%) in practical diets of broiler chickens could be advantageous where and when improved fishmeal is in short supply and very expensive.

Keywords: Broilers, fishmeal, carcass yield, performance

Introduction

Research into use of cheaper feedstuffs and wastes at various levels of dietary inclusion for chickens and other livestock in Nigeria has gained attention within the last 20 years. Various

attempts have therefore been made to replace fishmeal and other expensive convectional protein sources. Such attempts include: replacement of blood meal for fishmeal in the diets of broiler chickens (Offiong *et al.*, 1982), equi-protein replacement of fishmeal with

soyabean meal in broiler diets (Aletor *et al.*, 1989), replacing dietary fish meal with maggot meal in diets of laying chickens (Atteh and Ologbenla, 1993), substitution of shrimp waste meal for fish meal in broiler chicken rations (Fanimo *et al.*, 1996), use of poultry visceral offal meal as a substitute for fish meal in pullet, laying and broiler chickens' diets (Udedibie *et al.*, 1988 and Salami and Oyewole, 1997) while Ojewola *et al.* (2002) used grasshopper meal instead of fish meal in the broiler chicken diets.

Fishmeal (FM) in the Nigerian market is obtained as either ground smoked fishmeal (GSFM) also known as local fishmeal or imported fishmeal (IFM). Imported fishmeal is a product obtained by drying and grinding whole fish or parts of various fish species (Redfern, 1980, Windsor and Barlow 1981, McDonald *et al.*, 1988). Local fishmeal is a cheaper feedstuff obtained from ground smoked fish species. The use of ground smoked fishmeal (GSFM) attracted attention because of the cut-throat price of imported fishmeal. In Nigeria today, there is a practice of using a higher percentage of cheaper LFM in formulated diets to compensate for the high quality protein that is obtainable when a lower percentage of IFM is used. The nutritive value and composition of locally prepared fishmeal for broiler chickens has been compared with that of imported type by Olomu and Nwachuku (1977) and they reported that the protein value obtained was very close to that of the commercial imported fishmeal (Mullet local fishmeal had the lowest CP (56.7%), followed closely by Crayfish local meal (60.0%) , Sardine local fishmeal (60.1%) and Mudskeeper local fishmeal had the highest CP (62.4%) while the imported Herring fishmeal was 61.3% respectively).

However, some associated problems have been identified (Redfern, 1980) with the use of local feed alternatives such include: variability and

inconsistency in the nutrient quality (in that nutritive value of self prepared local fishmeal as done by Olomu and Nwachuku (1977) was quite different from that sold by feedstuff vendors in the feedmills) there is therefore the problems of adulteration and absence of sufficient data on the correct usage of commercial local fishmeal. This calls for further scientific investigations as regards the nutritive value of what is sold in the market and what is prepared by the farmer themselves and the effective ways of increasing the utilization of GSFM without impairing the performance of the chickens. This study therefore, was designed to investigate the comparative effects of market type and levels of inclusions of GSFM and IFM on the performance, digestibility and carcass characteristics of broiler chicken.

Materials and Methods

Experimental birds management and design

One hundred and eighty day- old Anak broiler chicks of mixed sexes were used. The chicks were randomly allocated into 12 replicate groups. The birds were subjected to standard brooding conditions, health procedures and raised on experimental diets. The IFM and GSFM purchased from local vendors were subjected to proximate analysis (AOAC, 1990). Based on their proximate composition (Table 1) four diets were formulated for each of the starter and finisher phases (Tables 2 and 3). All diets were formulated to be isocaloric and isonitrogenous. Diets 1, 2, 3 and 4 had 2.5% LFM, 5.0% LFM, 2.5% IFM and 5.0% IFM respectively. The only animal protein source in all the diets was fishmeal.

Three replicate groups (15 birds /replicate) were assigned to each of the 4 dietary treatments during the starter and finisher phases respectively. The experimental birds were housed in adequately ventilated deep litter house that

Table 1: Proximate analysis of fishmeal (composition on air dry basis)

	IFM	GSFM
Dry Matter (%DM)	91.00 $\pm$ 0.06	90.00 $\pm$ 0.03
Crude Protein (%CP)	64.70 $\pm$ 1.11	58.00 $\pm$ 0.86
Ether extra (%EE)	15.00 $\pm$ 1.76	13.60 $\pm$ 1.13.99
Ash (%)	15.00 $\pm$ 0.58	8.00 $\pm$ 0.88
Nitrogen free extract (%NFE)	0.30 $\pm$ 0.01	0.40 $\pm$ 0.00

IFM: Imported fishmeal . GSFM : Ground smoked fishmeal

Table 2: Percentage composition of experimental rations (starter)

Ingredients	Treatments			
	1	2	3	4
Maize	53.90	55.90	53.90	57.90
Fishmeal: Imported	-	2.50	-	5.00
Local	2.50	-	5.00	-
Soyabean meal	25.00	23.00	22.50	18.50
Groundnut cake	10.60	10.60	10.60	10.60
Rice bran	4.25	4.25	4.25	4.25
Oyster Shell	0.50	0.50	0.50	0.50
Bone Meal	2.50	2.50	2.50	2.50
Salt	0.35	0.35	0.35	0.35
*Premix	0.25	0.25	0.25	0.25
Methionine	0.05	0.05	0.05	0.05
Lysine	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	
100.00				

Calculated Analysis

M.E. (K cal/kg)	2998	3012	3002	3021
Crude Protein (%)	23.07	23.06	23.11	23.03
Protein	1.33	1.33	1.48	1.47
Calcium	0.69	0.68	0.75	0.73
Phosphorus	0.40	0.39	0.43	0.41
Methionine	1.24	1.19	1.28	1.18
Lysine	3.79	3.70	3.65	3.47
Fibre				

***Composition of vitamin/trace mineral premix**

A vitamin/trace mineral mix Agricare - mix ® - Pfizer) for starter broiler chicken to supply per kg feed the following: Vit A (I.U.) 1500; Vit. D₃ (I.U.) 2500; Vit E (I.U.) 11; Vit B₁ (mg) 10; Vit B₂ (mg) 40; Vit B₆ (mg) 20; Choline Chloride (mg) 400; Mn (mg) 120; Fe (mg) 70; Cu (mg) 10; I₂ (mg) 2.2; Se (mg) 0.2; Zn (mg) 45; Co (mg) 0.02.

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Table 3: Percentage composition of experimental rations (finisher)

Ingredients	Treatments			
	1	2	3	4
Maize	52.82	54.82	53.32	56.82
Fishmeal: Imported	-	2.50	-	5.00
Local	2.50	-	5.00	-
Soyabean meal	17.00	17.00	16.00	12.50
Groundnut cake	10.00	10.00	10.00	10.00
Rice bran	12.00	12.00	12.00	12.00
Oyster Shell	0.50	0.50	0.50	0.50
Bone Meal	2.50	2.50	2.50	2.50
Salt	0.35	0.35	0.35	0.35
*Premix	0.25	0.25	0.25	0.25
Methionine	0.03	0.03	0.03	0.03
Lysine	0.05	0.05	0.05	0.05
Total	100.00	100.00	100.00	100.00

Calculated Analysis

M.E. (K cal/kg)	3005	3019	3012	3038
Crude Protein (%)	20.89	20.83	20.74	20.74
Calcium (%)	1.32	1.32	1.48	1.46
Phosphorus (%)	0.69	0.68	0.74	0.72
Methionine (%)	0.36	0.35	0.39	0.37
Lysine (%)	1.05	1.00	1.08	0.99
Fibre (%)	4.32	4.32	4.10	4.00

*Composition of vitamin/trace mineral premix

A vitamin/trace mineral mix Agricare - mix ® - Pfizer) for finisher broiler chicken to supply per kg feed the following: Vit A (I.U.) 1500; Vit. D₃ (I.U.) 2500; Vit E (I.U.) 11; Vit B₂ (mg) 10; Vit B₃ (mg) 40; Vit B₆ (mg) 20; Choline Chloride (mg) 400; Mn (mg) 120; Fe (mg) 70; Cu (mg) 10; I₂ (mg) 2.2; Se (mg) 0.2; Zn (mg) 45; Co (mg) 0.02.

provided uniformly sized pens of 3.0m x 3.0m (1.21m² per bird). The pens were equipped with standard feeding troughs and drinkers. Feed and water were provided *ad libitum*. The starter diets (Table 2) were fed until 4 weeks of age followed by finisher diets (Tables 3) till 8 weeks of age.

Digestibility trial

Digestibility trial was done at 8th weeks of age in the metabolic cages equipped with separate

feeders and watering troughs. Three birds were randomly selected from each of the 3 replicates and housed together in a compartment. A 3-day acclimatization period was observed followed by a day fasting and 4 – day faecal collection. The nutrient retention and digestibility were determined at 8 weeks .

Carcass evaluation

At 8 weeks of age, 3 birds from each replicate pen were selected making a total 36 birds. These

birds were sacrificed by cervical dislocation, plucked and eviscerated. After evisceration, the dress weight was recorded. The body parts were removed and weighed as a criterion for the assessment of growth performance. Weights of the body parts were expressed as a percentage of live weight.

Data collection

Weekly records were kept on body weight and feed intake. Daily record of mortality were recorded and expressed as percentage at the termination of the experiment. Daily quantity of wet dropping voided and feed intake during the digestibility trials were recorded and expressed in terms of DM which were used in calculating various percentages of digestibilities and retentions. All data obtained on live weight, weight gain, feed intake, mortality, feed conversion ratio, carcass evaluation, retention and digestibility were subjected to analysis of variance (ANOVA) and significant differences in means were separated using Duncan's Multiple Range Test (SAS, 1998).

Results and Discussion

The proximate composition of the local and imported fishmeal is shown in Table 1. The dry matter (DM), crude protein, ether extract and ash content of imported fishmeal averaged 91.00%, 64.70%, 15.0% and 15.0% respectively and were considerably higher than that of local fishmeal which were 87.0%, 58.0%, 13.6% and 8.0% respectively. Lower nutritive NFE were obtained with the imported fishmeal than the local fishmeal. These proximate values are comparable with values reported in the works of McDonald *et al* (1988); Aduku (1993); Akpodiete *et al.* (1997) and Redfern, (1980).

The performance assessment of birds on the respective dietary treatments is shown in Table

4. The results showed that there was a linear response in terms of body weight and weight gain which is an indication of possibility of better performance at higher levels of either IFM or GSFM above 5% inclusion rate used in this study, even though this (5%) level is widely recommended in literatures (Redfern, 1980; Windsor and Barlow, 1981; Scott *et al.*, 1982 and McDonald *et al.*, 1988). However, very high level of inclusion of fishmeal (irrespective of type) is limited in Nigeria poultry diets due to its cost and tainting effects on the resulting broiler meat (Redfern, 1980; Idowu, 1994 and Akpodiete *et al.*, 1997). The final body weights and weight gains were significantly ($P < 0.05$) influenced by fishmeal type, level of inclusion and growth stages. Statistical examination of all the possible interactions (TYPE X LEVEL OF INCLUSION, TYPE X STAGE GROWTH, LEVEL OF INCLUSION X STAGE OF GROWTH and TYPE X LEVEL X STAGE) indicated a synergistic response in all parameters measured particularly body weight and weight gain. Irrespective of stage of growth and level of inclusion (2.5 or 5.0%) birds fed diets containing IFM had better ($P < 0.05$) performance in terms of weight gain, but the use of either GSFM or IFM resulted in a market weight above 2.0kg.

It was apparent that performance at the finishing stage of growth was higher ($P < 0.05$) than in the starting stage of growth. This observation corroborated the earlier claims of Lacy (1990) and NRC (1994), that noticed a higher ($P < 0.05$) body weight, feed conversion ratio and decrease in efficiency of feed utilization as birds grew older. The protein intake and feed conversion ratio were significantly ($P < 0.05$) influenced by individual main effects of fishmeal type, level of inclusion and stages of growth, while no significant interactions effects was noticed. Thus the substitution of IFM by GSFM did not support

Table 4: Performance of broilers fed different experimental diets

Parameters	Starter Diets			Finisher Diets			SEM
	Local		Imported	Local		Imported	
	2.5%	5.0%	2.5%	5.0%	2.5%	5.0%	
Initial wt./bird(g)	50.00 ^a	50.00 ^a	50.00 ^a	50.00 ^a	710.00 ^b	710.00 ^b	78.00
Final wt./bird(g)	610.00 ^e	783.30 ^d	676.70 ^e	820.00 ^d	2019.56 ^e	2238.80 ^b	161.00
Wt. gain/day(g)	20.00 ^e	26.18 ^d	22.38 ^e	27.50 ^d	46.77 ^c	54.60 ^b	12.65
Daily protein	11.43	10.35	11.63	10.40	24.32	22.67	9.40
Intake/bird(g)							
FCR	1.89	1.35	1.72	1.28	2.53	2.03	0.09
Cost of feed							
Per kg wt.gain(N)	172.50	134.50	183.30	132.03	214.70	163.53	217.10
							175.47

^{a,b,c,d,e} : Means on the same row having the same superscript or no superscript are not significantly different ($P>0.05$)

SEM : Standard Error of Means.

Table 5: Digestibility, retention and protein efficiency ratio of experimental birds (8 Weeks)

	Experimental Treatments			SEM
	Ground smoked fishmeal		Imported fishmeal	
	2.5%	5.0%	2.5%	
Digestibility %				
Feed intake (gDM/bird)	546.50 ^a	532.20 ^b	542.70 ^a	3.17
Dry matter	64.44 ^b	67.30 ^a	73.43 ^b	0.27
Protein (retention)	79.07 ^c	81.08 ^b	83.51 ^b	0.39
Fat	77.00 ^b	79.70 ^a	73.60 ^c	0.43
PER	2.53	2.03	2.41	0.07

^{a,b,c,d,e} : Means on the same row having the same superscript or no superscript are not significantly different ($P>0.05$)

SEM : Standard Error of Means.

superior feed utilization efficiency. The explanation for this scenario was due to poor utilization of nutrient resulting in lower weight gains in birds fed GSFM based diets.

The observed superior response noticed in birds fed IFM based diets could be the average response values of the several unidentified factors, more so that all the experimental diets were formulated to be isonitrogenous and isocaloric. Several workers (Hill and Branion, 1949; Olomu *et al.*, 1981; Scott *et al.*, 1982 and Austic and Neisheim, 1990) have reported that the existence of some unidentified growth factor or Animal protein factor (amino acid profile) capable of influencing growth performance. The above workers agreed that these intrinsic factors do stimulated a better growth response that was proportional to their concentration in the fishmeal. Therefore it could also be inferred from the results of the proximate composition (Table 1) of the IFM and GSFM that the superior efficient utilization of feed by birds fed IFM diets was brought about by the higher levels of inorganic ash content of the fishmeal used. World Poultry (1987) reported that the concentrations of trace element like copper and zinc in fishmeal were capable of amplifying growth in the diets of chickens. The substitution of IFM by GSFM however conspicuously reduced the cost of feed per kilogram weight gain, it was also apparent that increasing the level of fishmeal in broiler diets could be advantageous at long run in that it resulted in reduction of the cost of feed needed to gain a kilogram of weight.

The inferior performance responses noticed in birds fed GSFM based diets may also be attributed to the presence of high concentration of some undesirable factors in GSFM. These undesirable factors were reported by Pan and Chiang (1979); Toyama (1981); Toyama *et al.* (1982); Taylor (1983); Wessel and Post (1989)

and Wagener *et al.* (1991). They observed that some fishmeal samples contained some toxic amino acids like gizzerosine and histamine which are capable of impairing digestion and utilization. Aflatoxin has been detected in some fishmeal samples whose water activity ranged between 0.41 – 0.51 (Windsor and Barlow, 1981). Opstvedt (1988) reported that smoked fish (ground mostly into local fishmeal) had poisonous nitrogen oxide due to smoking which are also capable of impairing utilization. Devegowda and Jain (1990) noticed adulteration in poorly prepared fishmeals with urea, sand, sawdust, salt and other materials which could reduce their biological value when used in monogastric feeding.

The influence of type and levels of inclusion of fishmeal on digestibility of the finishing broilers indicated a linear relationship (Table 5). There was a linear decrease ($P < 0.05$) in the percentage protein retention and the digestibility percentages of dry matter and fat as the level of fishmeal increased from 2.5 to 5.0%. This could be partly linked to the fibre intake and the fibre content of the experimental diets (Table 3). In view of this, birds fed 2.5% fishmeal had higher fibre intake. The implication of this on digestibility and retention is noticed in the proportionate decline in the digestibility and absorption of nutrient due to high fibre intake resulting from higher dry matter intake (Longe and Ogedegbe, 1989). High fibre has the ability to depress metabolizable energy (ME) and protein (CP) utilization, hence the weight gain and relatively low FCR noticed in birds that received either 2.5% IFM or GSFM. The inclusion of IFM at both 2.5 or 5.0% levels resulted in a relatively superior ($P < 0.05$) dry matter digestibility and crude protein retention when compared with values obtained for GSFM. This suggested that there was a likelihood of fibre build up as a result of GSFM adulteration with chitinous fishlike

Table 6: Percentage carcass yield and organ weights of experimental birds at 8 weeks old

	Experimental Treatments				
	2.5%	5.0%	2.5%	5.0%	SEM
Live weight (g/bird)	2500	2510	2515	2505	0.00
Dressed %	77.76	79.16	78.12	79.76	0.26
Head %	3.04	3.04	2.98	3.00	0.01
Gizzard %	1.50 ^{ab}	1.70 ^a	1.36 ^c	1.46 ^b	0.23
Heart %	0.48	0.44	0.45	0.44	0.01
Liver %	1.57	1.75	1.75	1.65	0.05
Lungs %	0.63	0.61	0.74	0.54	0.03
Kidney %	0.66 ^c	0.83 ^a	0.71 ^b	0.80 ^a	0.02
Legs %	2.35	2.23	1.86	1.88	0.11
Intestine %	2.35	2.22	1.86	1.84	0.10
Abdominal Fat %	1.33	1.92	1.32	1.85	0.09

^{a,b,c,d,e} : Means on the same row having the same superscript are not significantly different ($P>0.05$)
SEM : Standard Error of Means.

materials such as prawn and shrimps that are known to assay high in chitinous exoskeleton.

The higher fat digestibility noticed in GSFM dietary treatment groups may have translated into higher abdominal fat noticed in birds fed GSFM (Table 6). PER was numerically better ($P>0.05$) in birds fed IFM at both 2.5 and 5.0% level, this observation could be responsible for the superior ($P<0.05$) protein retention observed in birds fed IFM based diets.

In terms of carcass evaluation (Table 6), birds that were fed GSFM had a significantly higher ($P<0.05$) gizzard and kidney percentages, which is of significance. Wessel *et al.* (1989) and Wagener *et al.* (1991) noticed enlarged gizzard in chickens that was related to re-growth due to gizzard erosion due to presence of toxic amino acids (gizzerosine and histamine related compounds) in fishmeals fed to chickens. The presence of such toxic amino acids at high concentration in GSFM could have contributed to the observed trend noticed in the gizzard proportion, while that of kidney may be linked to high deposition of uric acid related compounds. Opstvedt (1988) reported that smoked fishes (ground mostly into local fishmeals) had poisonous nitrogen oxide which the birds handled by excreting in form of uric acid in the excreta. The dressed weight percentage increased slightly ($P>0.05$) with increased level of inclusion of fishmeal while the abdominal fat and other carcass proportions were not significantly influenced by the dietary treatments (Table 6).

Conclusion

The results of this study showed the need for a critical evaluation of commercially available local fishmeal to ascertain the percentage level of inclusion that would yield optimum

performance response at a given physiological stage of growth. Better processing of local fishmeal to reduce urea, sand, sawdust and chitinous fishlike materials should be done to improve GSFM utilization. It was therefore concluded that the use of higher levels of local fishmeal (above 5%) in practical diets of broiler chickens could be advantageous where and when imported fishmeal is in short supply and very expensive.

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