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Performance of Broiler - Chickens Fed on Maggot Meal in Place of Fishmeal

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Abstract: Ninety 3-week old broiler-chickens were fed five isonitrogenous and isocaloric diets in which maggot-meal (MGM) which was first subjected to proximate analysis replaced 25, 50, 75 and 100% fishmeal (FM). The proximate analysis showed that MGM had 55.1% crude protein, 20.7% fat and 0.2% NFE. The data analysis, showed that weight gain (WG) Feed consumption (FC) and Feed efficiency (FE) for the chickens between 3-6 weeks of age were not significantly influenced by the dietary treatment whereas the WG, FC, FE, the nitrogen retention (NR) and protein efficiency ratio (PER) for the 3-9 week old were significantly (P>0.05) influenced by dietary treatment: The diet with 25% of FM protein replaced with MGM was the most efficient in terms of average weekly WG and PER. The live, dressed and eviscerated weights as well as the relative length, breadth and weights of the pectoral and gastrocnemius muscles of the chickens at 9 weeks were not significantly influenced by the diets. It was concluded that MGM is an inexpensive replacement for FM in broiler-chick feeding.

Key words: Broiler - chicken, diet, maggot-meal, fishmeal

Introduction

The reduced poultry population of today as compared to 1983 in Nigeria has been due to the high cost and poor quality of finished feed (Tewe, 1986). Efforts to overcome this is to include relatively inexpensive feed ingredients for example the expensive fishmeal would be replaceable by the locally available maggot meal (MGM) which has a similarity in the amino acid profile (Atteh and Ologbenla, 1993; Atteh and Oyedeji, 1994). Akinwande and Bragg (1974) reported that muscle mass and carcass weights are useful parameters for determining growth performance of the chicken in response to nutritional influence. In this study, the protein utilization, performance and carcass characteristics of broiler - chickens raised on diets formulated by replacing fishmeal with maggot meal on equi-protein basis were explored to ascertain the potential of this locally available raw material as protein resource in broiler feeding.

Materials and Methods

One hundred and two ANAK - 3000 strain of day - old broiler - chicks were procured, brooded and fed 24% protein formulated broiler - starter diet for a pre - experiment al period of three weeks during which they were vaccinated at interval against New castle disease, Infectious bursal disease and fowl pox. The proximate constituents of the maggot meal and those of other protein raw materials used for the feed as well as the experimental diet were determined.

At 3 weeks of age, 90 of chicks were divided into 5 treatment groups of 18 chicks, such that the mean group weights were identical. The chicks were thereafter randomly assigned to the treatment diets formulated with maggot meal (MGM) replacing 0, 25, 50, 75 and 100% of the fishmeal (FM) on equi-protein basis (Table 2) Each treatment was replicated thrice. All diets were made isonitrogenous containing approximately 21.76 ± 0.15% crude protein with FM level of inclusion being limited to 4% for cost effectiveness. The broiler - chickens were fed *ad-libitum* until they were nine weeks during which their group daily feed consumption and weekly weight changes were recorded.

The feed consumed by each group of broiler-chickens and the corresponding amount of faeces voided in the last 3 days to the end of the sixth week and the end of the 9th week of age were recorded. The procedure for collection and processing of the faecal samples for chemical analysis and computation of the N-balance indices are as reported by Aletor *et al.* (1989)

At the end of the feeding trial, two chickens were randomly selected per replicate; each chicken was slaughtered, dressed, eviscerated and weighed. Three major muscles (outer and inner pectorals of the chest and the gastrocnemius of the leg) were dissected, weighed and/or measured using the electronic Meter balance/meter rule as applicable. From these values, the relative weights, length or breadth of the muscles to the chickens' body weight were calculated and recorded as gkg^{-1} or $cmkg^{-1}$

All the data obtained during the study were subjected to the analysis of variance (ANOVA). Where treatment means were significantly different, they were compared using the Duncan's multiple range test (Steel and Torrie, 1960).

Results

Proximate analysis and feed composition: The proximate analysis (g/100 DM) of the maggot meal, groundnut cake and fishmeal which were used to

Table 1: Proximate analysis (g/100g DM) of the maggot meal compared with other protein raw materials

Protein sources	Ash	Moisture	C.P	Fat	Fibre	NFE (CHO)
Maggot Meal	10.4	7.4	55.1	20.7	6.3	0.2
Groundnut Cake	7.9	6.6	45.1	9.9	4.0	26.5
Fish Meal	19.1	6.3	64.5	5.3	1.0	3.8

CP = Crude protein; NFE = Nitrogen-free Extracts.

Table 2: Composition of the experimental diets (g/100g)

	Diets				
	1	2	3	4	5
	% FM Protein replaced by MGM Protein				
Raw feed materials	0	25	50	75	100
Maize	57.00	56.83	56.66	56.47	56.32
Groundnut Cake (GNC) (45.1%)	28.00	28.00	28.00	28.00	28.00
Fishmeal (FM) (64.5%)	4.00	3.00	2.00	1.00	0.00
Maggot Meal (MGM) 55. 1%)	0.00	1.17	2.34	3.51	4.68
Brewers dried grain (BDG)	5.00	5.00	5.00	5.00	5.00
Palm oil	2.00	2.00	2.00	2.00	2.00
Bone Meal	2.50	2.50	2.50	2.50	2.50
Oyster shell	0.50	0.50	0.50	0.50	0.50
Vitamin/Mineral premix*	0.50	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50	0.50
	100	100	100	100	100
Calculated analysis					
Crude protein (g/ 100g)	21.78	21.76	21.75	21.73	21.71
ME (Mcal kg^{-1})	3.09	3.09	3.09	3.09	3.09
Methionine + cystine	1.08	1.14	1.09	1.11	1.16
Lysine	3.00	2.95	2.95	2.92	2.92

*Composition of vitamin in 2.5kg premix: Vitamins A (10,000,000 IU); (2,000,000 IU): E (35,000IU); K (1,900mg); B_{12} (19 mg); Riboflavin (7,000 mg); Pyridoxine (3,800 mg); Thiamine (2,200 mg); D. Pantothenic acid (11,000); Nicotinic acid (45,000 mg) Folic acid (1,400 mg); Biotin (113 mg) and Trace elements as Cu (8,000 mg); Mn (64,000 mg); Zn (40,000 mg); Fe (32,000 mg); Se (160 mg); I_2 (8,000 mg) and other items as Ca (400 mg); Choline (475,000 mg); Methionine (50,000 mg); BHT (5,000 mg) and spiramycin (5,000 mg) in 2.5 kg of premix.

Table 3: Proximate composition (g/100g DM) of the different diets formulated by the replacement of fish meal with maggot meal

Sample	% of FM Protein Replaced by MGM *Protein	Ash	Moisture	CP	Fat	Fibre	NFE (CHO)
Diet 1	0	7.8	2.3	21.8	8.7	4.0	55.5
Diet 2	25	9.6	2.8	21.8	9.7	3.3	53.0
Diet 3	50	8.4	2.3	21.8	14.2	2.6	50.8
Diet 4	75	5.9	3.0	21.7	16.8	2.9	49.8
Diet 5	100	6.4	2.3	21.7	14.0	2.6	52.1

*Level of MGM: Diet 1 = 0% Diet 2 = 1.17%; Diet 3 = 2.34%; Diet 4 = 3.51% Diet5 = 4.68%

compound the experimental ration is shown on Table 1, while the composition of the five experimental diets (g/100g) and their proximate analysis are shown on Table 2 and 3 respectively.

Performance and Carcass characteristics: Presented on Table 4 are the WG, FC, FE, NR for the 5 groups of the broiler - chickens at 3-6 and 3-9 weeks of age. It also shows the "operative" PER, live weight (kg) and both dressed and eviscerated weights (as % live weight) for all the groups of broiler-chickens at 9 weeks while the relative dimensions ($cmkg^{-1}$) and weight (gkg^{-1}) of the special muscles studied are shown on Table 5.

Discussion

Proximate analysis: The crude protein and ash content of the three different ingredients were both in the order of FM> MGM> GNC, while the fat was in the order of

Table 4: Effect of varying levels of FM replacement with MGM on performance and some Carcass characteristics of broiler-chickens

	Diets				
	1	2	3	4	5
	% FM Protein replaced by MGM Protein				
Parameters	0	25	50	75	100
Weight gain (g) (3-9 wks)	1929.10^{a} ± 95.0	1819.80^{a} ± 39.10	1440.00^{b} ± 217.0	1527.00^{b} ± 295.0	1514.71^{b} ± 39.20
Feed consumption (g) (3 – 9 wks)	4206.00 ± 280.0	4021.30 ± 139.70	3706.00 ± 271.0	3887.00 ± 283.0	3818.87 ± 24.50
Feed Efficiency (3-9 wks)	2.21 ± 0.04	2.21 ± 0.04	2.60 ± 0.27	2.60 ± 0.47	2.53 ± 0.08
N R at 6 wks	2.57 ± 0.13	2.45 ± 0.05	2.35 ± 0.39	2.47 ± 0.30	2.49 ± 0.30
N R at 9 wks	3.71 ± 0.36^{a}	2.72 ± 0.56^{b}	2.25 ± 0.35^{b}	2.57 ± 0.51^{b}	2.46 ± 0.23^{b}
P.E.R.	1.88 ± 0.08^{a}	1.86 ± 0.04^{a}	1.70 ± 0.12^{ab}	1.52 ± 0.22^{b}	1.62 ± 0.05^{b}
Live weight (kg)	1.90 ± 0.1	2.01 ± 0.2	1.9 ± 0.1	1.8 ± 0.1	1.9 ± 0.2
Dressed weight (as % Live weight)	90.60 ± 0.3	89.70 ± 2.6	90.69 ± 0.8	89.26 ± 2.8	91.00 ± 1.5
Eviscerated weight (as % Live weight)	75.37 ± 2.0	74.03±1.7	75.58 ± 0.1	76.88 ± 1.2	74.87 ± 0.5

Means are for 18 chicken/treatment (X ± SD). Means without common superscript in the same row differ (P<0.05)
NR = Nitrogen Retention (g/chick/day), PER = Protein Efficiency Ratio

Table 5: Effect of varying levels of fishmeal substitution with maggot meal on the relative lengths, breadth (cm kg^{-1} body weight) and weight (g kg^{-1} body weight) of some muscles in the broiler-chicken

Diet	% FM Protein replaced by MGM*	Pectoralis thoraces (Outer Pectoral Muscle)			Supracoracoides (Inner Pectoral Muscle)			Gastrocnemius Weight
		Length	Breadth	Weight	Length	Breadth	Weight	
1	0	8.8 ± 0.4	1.9 ± 0.6	37.3 ± 3.8	7.2 ± 0.2	2.3 ± 0.4	13.4 ± 1.2	31.3 ± 2.9
2	25	8.1 ± 0.1	3.5 ± 0.2	34.9 ± 2.0	7.1 ± 0.5	1.9 ± 0.1	12.8 ± 1.2	34.7 ± 1.3
3	50	9.1 ± 1.2	3.6 ± 0.8	37.1 ± 2.3	9.1 ± 1.2	2.6 ± 0.7	12.9 ± 0.5	34.3 ± 1.2
4	75	8.6 ± 0.8	4.0 ± 0.3	35.8 ± 0.7	8.6 ± 0.8	2.3 ± 0.0	12.6 ± 1.0	38.3 ± 0.6
5	100	8.3 ± 0.8	3.8 ± 0.2	35.3 ± 3.5	8.3 ± 0.8	2.0 ± 0.2	12.2 ± 1.0	36.4 ± 2.4

Means with the same column are not significantly (P>0.05) different. *Level of MGM: Diet 1 = 0%; Diet 2 = 1.17%; Diet 3 = 2.34%; Diet 4 = 3.51%; Diet 5 = 4.68%

MGM> GNC> FM>. The experimental diets contained identical crude protein content while the fat content increased with increasing level of FM substitution with MGM up to "diet 4". Although the fat content of "diet 4" (16.8) is high, the reduced fat content obtained for diet 5 can not be readily explained.

The protein value for the MGM used in this study (55.1%, on Table 1) compared favourably with those of earlier investigations such as: 65% by Calvert *et al.* (1971): 45% by Gado *et al.* (1982) and 39-54% by Atteh and Ologbenla (1993). In this study, MGM was found to be richer in protein than some of the protein concentrates currently used in livestock feeding for example soybean and groundnut cake. The percentage of fat (20.7%) obtained for MGM in this analysis is noteworthy because it is reflected in the analysis of the 4 different diets formulated with MGM inclusion (Table 3) where the values for fat were remarkably high.

Performance characteristics: The results of this study showed that within 3-6 weeks of age of the broiler-chickens, MGM can completely replace FM on equi-protein basis in their diets without significant effect on WG FC and FE although FE generally tended to decrease with increasing level of FM replacement with MGM. The result also shows that 25% level of replacement of FM with MGM appeared to be the optimal level beyond which there would be significant (P< 0. 05) decrease in WG. Although Calvert (1977) and Atteh and Ologbenla (1993) reported a similarity in the amino acid profile of MGM, FM and meat meal this present study suggests that young broiler - chickens (3-6 weeks of age) may utilize MGM protein differently from the adult (3-9 weeks) The values obtained for NR at 3-6 weeks were

generally comparable to the values obtained for 3-9 weeks. The significant difference ($P<0.05$) in NR between diets 1 and 2 as well as the decreasing value of the "operative" PER with increasing level of FM substitution with MGM (Table 4) are suggestive of the fact that MGM protein quality is lower than that of FM. This may have accounted in part for the observed decrease in WG when the FM substitution exceeded 25%.

Carcass characteristics: The dietary treatment had no significant effect on percent dressed and eviscerated weights. The results of the relative length, breadth and weights of the chest muscles, the pectoral and gastrocnemius (Table 5) showed that dietary treatments had no significant effect on these major muscles. Although Akinwande and Bragg (1974); Bates and Millward (1983) have demonstrated that different skeletal muscles exhibit differential rate of accretion in response to nutritional influences, the present study indicated that equi-protein replacement of FM with MGM in broiler - chickens diet has no significant effect on the relative length, breadth or weight of these muscles of major economic importance in chickens.

Conclusion: The analyzed data for this study have revealed that maggot meal can completely replace fish meal on equi - protein basis in the broiler - chicken diet at 4% without significant effect on weight gain feed consumed and feed efficiency. The 25% level of fishmeal replacement with maggot meal was the optimal level being suggested for profitable adoption. The carcass and muscle study revealed that there is no variation in either carcass or muscle development whether the chickens diets were based on fishmeal or maggot meal The performance data in this study point to the potential of MGM as an inexpensive alternative protein resource to FM especially in growing broiler - chick feeding. Consequently more research should focus on commercial MGM production to meet the anticipated massive industrial requirements.

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