REPLACEMENT OF FISH MEAL WITH MAGGOTS IN BROILER DIETS: EFFECTS ON PERFORMANCE AND NUTRIENT RETENTION

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ABSTRACT

The effects of replacing 0, 33.3, 66.7 or 100% of dietary fish meal (9%) with housefly maggots (*Musca domestica. Linn*) was investigated using broilers from day old to 5 weeks of age.

Increasing the dietary level of maggots reduced feed intake and weight gain while increasing the feed; gain ratio ($P>0.05$). There was however no significant effect of dietary maggots on mortality rate ($P>0.05$). Replacement of dietary fish meal with maggots caused significant reduction in nitrogen retention ($P<0.05$) but an increase in fat retention ($P>0.05$). There was no significant effect of replacing dietary fish meal with maggots on the metabolizable energy value of the diets ($P>0.05$).

It is concluded that maggots could replace only 33% of dietary fish meal (9%) without compromising performance and nutrient retention in broiler chicks. The cost of harvesting and processing maggots is about 15% of equivalent weight of fish meal, making even partial replacement of fishmeal with maggots economical.

Key words: **Maggots, fishmeal, broiler performance, nutrient retention.**

INTRODUCTION

The cost of poultry feed has continued to increase in recent times. This high cost of poultry feed can be traced to the scarcity and high cost of feed ingredients particularly the protein supplements. Groundnut cake and fishmeal which used to be the conventional sources of protein supplements in poultry diets are becoming difficult to come by and when available the prices are usually prohibitive. Fishmeal is most expensive, currently costing more than twice the cost of groundnut cake. There is hence a need to find alternatives to these high cost protein supplements, in chicken diets. Such alternatives should have comparable nutritive value but cheaper than the conventional protein sources.

For the expensive, fish meal, maggots would seem to satisfy the criteria for alternatives. Maggots grow easily on poultry droppings or any organic waste in a short time of 5-6 days (Miller and Shaw (1969), the organic waste serving as source of food for growth once their eggs are laid by the flies. Bondari and Sheppard (1981) showed that 1-2 tonnes of maggots could be produced in a month in a 20,000 hen laying house. It requires little effort and money to harvest and process maggots, making them a lot cheaper than fishmeal. Reported proximate composition of maggots showed that it has a good potential as a source of nutrients for livestock feeding (Calvert *et al.*, 1969, 1971; Teotia and Miller, 1973). The amino acid profile of maggots reported by Calvert *et al.* (1969) and Teotia and Miller (1974), shows that the biological value of maggot protein should be close to that of fishmeal and certainly superior to that of groundnut cake and soyabean meal.

Atteh and Oyedeji (1990) successfully replaced all dietary groundnut cake (22%) in broiler diets with maggots without detrimental effects on performance and nutrient retention. However, there is lack of adequate information on the nutritive value of maggots relative

to fishmeal for chickens. A successful replacement of fishmeal with cheap maggots will definitely help to reduce the cost of poultry diets.

The current study was undertaken to investigate the effects of graded replacement of dietary fishmeal with maggots on performance and nutrient retention of broiler chicks.

MATERIALS AND METHODS

Seventy-two day old Cobb broiler chicks of a mixed sex were housed in electrically heated battery brooders and fed the experimental diets shown in Table 1. The treatments involved the quantitative substitution of dried maggots (Table 2, for fishmeal in the diets). The maggots used were harvested from under laying cages using the method of Miller *et al.* (1974). Diet 1 had 9% fishmeal, while in subsequent diets, maggots were added at 3, 6 and 9%, replacing 33.3, 66.7 and 100% respectively of the fishmeal in the control diet. Thus there were four treatments, each with three replicate cages of six birds. Diets and water were offered *ad libitum* during the trial period lasting for five weeks. At the end of the trial feed consumption and weight gain were determined.

A nutrient retention study with these birds was conducted after the chicks had been fed the diets for two weeks. Weighed quantities of feed were supplied and excreta collected over a 72 hr. period, using a total collection method. Excreta samples were oven dried at 70°C, weighed and ground prior to chemical analysis.

Chemical Analysis

Feed and excreta samples were subjected to chemical analysis using the method A.O.A.C. (1980). Nitrogen was determined using the

Table 1 COMPOSITION (%) OF FOUR DIETS FED TO BROILER CHICKS (0-5 WEEKS)

	DIETS			
	1 (Control)	2	3	4
Basal ingredients*	91.00	91.00	91.00	91.00
Fishmeal	9.00	6.00	3.00	-
Maggot	-	3.00	6.00	9.00
Analyzed Nutrient content				
Dry matter	91.47	90.40	90.58	90.10
Crude protein	23.61	22.53	22.53	21.47
Fat	5.43	6.05	6.47	7.47
Crude fibre	3.21	3.45	3.70	4.50

* Made up of 51.83% maize, 22% groundnut cake, 11.45% maize offal, 3% palm oil, 0.3% salt, 0.89% bone meal, 1.28% oyster shell, 0.25% mineral-vitamin premix (Zoodry) (providing/kg of diet: 8000 IU. Vitamin A; 1200 IU Vitamin D3; 13mg Vitamin E, 2mg Vitamin K3, 3mg riboflavin, 10 mg 0.06mg cobalamin, 1.5mg folic acid, 0.25mg biotin, 125mg antioxidant (santoquin), 25mg fe, 80mg Mn, 50mg Zn, 2mgCu, 0.2mg Co. and 0.1mg Se).

Table 2 ANALYSED COMPOSITION (%) OF MAGGOTS USED IN THIS TRIAL (DM BASIS)

Dry matter	91.34
Crude protein	39.16
Ether Extract	20.76
Crude fibre	8.25
Ash	6.15

Kjeldahl procedure while fat was determined by petroleum ether (bp 40 - 60°C) extraction in a Soxhlet apparatus. Gross energy values were determined using the ballistic bomb calorimeter (Gallenkamp).

Statistical Analysis

Data collected were subjected to analysis of variance using the model for a completely randomized design (Steel and Torrie, 1980). Where significant difference were observed, means were further subjected to Duncan's multiple range test (Duncan, 1955).

RESULTS

Performance

There was a decrease in feed intake and weight gain ($P<0.05$) while feed/gain ration increased with increase in dietary level of maggots (Table 3). Birds fed the control diet and those fed the diet in which maggots replaced 33.3% of dietary fishmeal had identical performance. There was however no influence of the dietary treatments on mortality rate.

Nutrient Retention:

Table 4 presents a summary of the nutrient retention as influenced by the dietary treatments. There was reduction in nitrogen retention with increase in dietary level of maggots (P 0.05). The reverse was however true for fat retention (P 0.05). There was an increase (P 0.05) in dietary ME with increase in dietary level of maggots.

DISCUSSION

There is considerable variation in the chemical composition of maggots reported in literature. The reported crude protein content has varied from as high as 63% (Calvert *et al.* 1971) to as low as 45% (Gado *et al.* 1982). Analysis in our laboratory has shown a variation from 39 to 54% protein and 20.7 to 25.3% fat depending on the time of harvesting. The nearer the larvae are to the pupal stage, the lower the protein content while its fat level increases. Fat is the form of food reserve for pupation (Chapman, 1971).

Increasing the dietary level of maggots reduced intake. The reduction in feed intake could be related to energy loading of the diets. With the high fat content of maggots used, increase in dietary maggots also caused an increase in dietary energy content which would reduce feed intake.

Processed maggots is dark brown in color and tended to reduce the brightness (yellow) associated with the use of yellow maize and palm oil in the diets. Birds are known to be sensitive to colour and depend on their sense of sight for food seeking (Moran, 1982). Using feed dyed with various colours, Copper (1971) observed turkey poults to prefer and perform better when the feed colour is green. Thus the observed reduction in feed intake associated with increase in dietary maggots may be associated with changes in the colour of the feed.

The reduction in intake may also be related to palatability problem as dietary maggots increased, even though avian species do not have a well developed sense of taste judging by the number of taste buds in their mouth (Kare and Ficken, 1963; Moran, 1982). This is a subject of further research.

Weight gain by the chicks followed a trend similar to that of feed intake, suggesting that the reduction in feed intake played an important role in the reduction in weight gain. A

Table 3 EFFECTS OF REPLACEMENT OF DIETARY FISHMEAL WITH MAGGOTS ON PERFORMANCE OF BROILERS (1-5 WEEKS).

Dietary level of Maggot (%)	Feed Intake (g/bird/day)	Weight gain (g/bird/day)	Feed: Gain Ratio	Mortality (%)
0	64.4	31.3	2.1	0.0
3	64.1	29.8	2.2	0.0
6	60.9	25.7	2.4	0.0
9	58.2	20.2	2.9	0.0
S. E. (8D.F)	0.77	0.72	0.08	0.00

Table 4 EFFECTS OF REPLACEMENT OF DIETARY FISHMEAL WITH MAGGOTS ON NUTRIENT RETENTION BY BROILERS

Dietary level of Maggots (%) (%)	Nitrogen (%)	Fat (%)	Metabolizable Energy (Kcal/kg)
0	79.1	70.9	3172.5
3	77.6	80.9	3181.0
6	77.4	81.7	3237.7
9	72.8	82.6	3240.9
S. E. (8D.F)	1.08	1.01	199.9

major concern in the use of maggots in chicken diets is the possibility of disease transfer. Earlier studies showed that the risk of disease transfer is low if maggots are properly treated before incorporation into livestock diets. Koo *et al.* (1980) observed no pathological signs associated with feeding maggot based diets to chicks. Bayandina and Inkina, (1980) reported that dietary maggot had no adverse effects on the health of pigs. In the study carried out by Atteh and Oyedeji (1990), no disease symptom or mortality was observed when maggots replaced groundnut cake in broiler diets. Observations in this trial seem to confirm these earlier reports that properly treated maggots could be safely included in chicken diets.

Replacement of fishmeal with maggots even if partially done makes economic sense. The cost of harvesting and processing of one kilogramme of maggots used in this trial (₦5.38) was about 15% of the prevailing price of one kilogramme of fishmeal (₦32.00). Maggots could be cheaper if the farmer does

his own harvesting and processing.

The nutrient retention and weight gain trials revealed that fishmeal protein is of higher biological value compared to maggot protein. This confirms the earlier report of Ocio *et al* (1980) which showed that the gross protein value of maggot meal was lower than that of fishmeal. The amino acid profile of maggot meal (Teotia and Miller, 1974) showed that maggot is rich in lysine, low in methionine and deficient in cystine, Fishmeal on the other hand is rich in these sulfur amino acids (NRC, 1984). The reduction in feed intake combined with lower protein content and retention when maggots replaced fishmeal caused the observed significant reduction in weight gain in broilers. It is concluded from this study that only a third of dietary fishmeal (9%) could be replaced with maggots without detrimental effects on performance and nutrient retention.

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