EFFECTS OF REPLACING DIETARY FISHMEAL WITH MAGGOTS ON PERFORMANCE AND NUTRIENT RETENTION OF LAYING HENS

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ABSTRACT

Laying hens (53 weeks old) were fed a basal diet with 9% fish meal and diets in which housefly maggots (Musca domestica, Linn) replaced 33.3, 66.7 and 100% of the fish meal in the basal diet during a 6-week trial period.

Average daily feed intake were 125.1, 115.1, 109.1 and 105.7g respectively ($P<0.05$). Corresponding total weight gain per bird during the trial period were 210, 180, 20 and 37g respectively ($P<0.05$). There was however no significant effects of increasing dietary level of maggots on egg production, egg weight or feed/dozen eggs ($P>0.05$). There was also no significant effects of the treatments on protein or fat retention by laying hens. It is concluded that housefly maggots could replace fish meal (9%) in layer's diet without detrimental effects on their performance. Maggots is a cheap alternative to fishmeal in laying hen diets, the cost of its production being only 15% of the equivalent weight of fishmeal.

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

INTRODUCTION

Houseflies constitute a nuisance in the layers house, in addition to being an agent for dissemination of disease causing organisms (Matanmi, 1990). However, houseflies through their eggs are known to be agents of biodegradation. Poultry droppings being organic materials are suitable media for coprophagous insects like housefly to lay their eggs. The eggs develop into larvae, using the nutrient content of the manure for their development into adult. The larvae in the process of development remove protein from manure and transform it into animal protein (Calvert, 1979) which could be recycled. In many laying operations today, both the adult flies and the maggots constitute a nuisance. The maggots being animal protein have a potential for use in livestock feeding.

Calvert *et al.* (1969) and Miller and Shaws (1969) reported that housefly eggs could be used to convert waste materials into usable high quality nutrient supplement. Teotia and Miller (1973) showed that housefly maggots and adults are sources of high quality protein. Maggots have an amino acid profile that is superior to that of groundnut cake (Calvert *et al.* 1969, NRC,1984). With these qualities, housefly maggots have a potential to replace some of the high cost protein supplements in livestock feeds if well processed. Atteh and Oyedeji (1990) replaced the dietary groundnut cake (22%) in broiler diets with maggots without detrimental effects on performance and nutrient retention. In another study Atteh and Ologbenla (1992) observed that maggots could provide a partial replacement for fishmeal in broiler diets.

The current study was undertaken to investigate the effects of replacing dietary fishmeal with maggots on the performance and nutrient retention of laying hens. A successful replacement of expensive fishmeal with cheap maggots will help to reduce the high cost of poultry feeds.

MATERIALS AND METHODS

Seventy two Harco laying hens (53 weeks old) were used for this trial. They were housed in laying cages in an open sided poultry house. They were fed the experimental diets shown in Table 1.

The treatments involved quantitative substitution of maggots, for fishmeal in layer's diets. Maggots used in the trial were harvested from under laying cages using the method described by Miller et al. (1974). Harvested maggots were washed, dried and ground prior to including in the diets. Composition of the maggots used was reported by Atteh and Ologbenla (1992). The dietary inclusion levels of maggots were 0, 3, 6, and 9%, replacing 0, 33.3, 66.7 and 100% respectively, of fishmeal (9%) in the control diet. Thus there were four treatments, each with three replicates of six birds. The experimental diets and water were supplied *ad libitum* during the trial period that lasted 6 weeks. Data were collected on daily feed intake and egg production, while egg weight was taken twice each week. Birds were weighed at the beginning and end of the trial.

A nutrient retention trial was carried after the birds have been on the diets for two weeks. Hence the two weeks formed the preliminary adjustment period prior to fecal collection. Weighed quantities of feed were supplied and excreta samples collected in weighted aluminium foil spread under the

TABLE 1 COMPOSITION (%) OF FOUR DIETS FED TO LAYING HENS

	DIETS			
	1 (control)	2	3	4
Basal ingredients	91.00	91.00	91.00	91.00
Fish meal	9.00	6.00	3.00	-
Maggots	-	3.00	6.00	9.00
Nutrient content				
Dry matter	90.88	90.58	90.26	90.16
Crude protein	16.60	16.23	15.88	15.19
Fat	3.00	3.23	3.64	3.92
Crude fibre	2.96	2.98	3.43	3.66

*Made up of 56% maize, 9.49% ground cake, 15% maize offal, 0.62% bone meal, 8.29% oystershell, 1.05% grit, 0.3% salt, 0.25% mineral-vitamin premix (Zoodry) providing/kg of diet; 8000 IU vitamin A, 1200 UI vitamin D3, 11mg Vitamin E, 2mg Vitamin k3, 7mg riboflavin, 10mg nicotinic acid, 7mg panothenic acid, o0.08mg cobalamin, 900mg choline, 1.5mg folic acid, 1.5mg biotin, 125mg antioxidant (santoquin), 25mg.fe, 80mg Mn, 2mg Cu, 50mg Zn, 1.2mg.I, 0.2mg co, 0.1mg Se)

cages during a 72 hours period, using the total collection procedure. 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 methods of A.O.A.C. (1980). Nitrogen was determined using the Kjeldahl procedure while fat was determined by Petroleum ether (bp 40-60°C extraction in a Soxhlet apparatus. Gross energy value were determined using the ballistic bomb calorimeter.

Statistical Analysis:

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

RESULTS

Performance:

There was a decrease in feed intake and weight gain with increase in dietary level of maggots ($P<0.05$) (Table 2). Birds fed diets in which maggots replaced 66.7 and 100% of fishmeal in the control diet had identical feed intake and weight gain that were significantly lower than those fed the other diets. There was however no significant effects of the dietary treatments on egg production, egg weight or feed dozen eggs ($P>0.05>$).

Nutrient Retention:

There was no significant effects of replacing fishmeal with maggots on protein or fat retention or the metabolizable energy values of the diets ($P>0.05$) (Table 3). There was only a marginal reduction in protein and fat retention when maggots replaced all the fish meal in the control diet.

DISCUSSION

The proximate composition of the maggots used in this trial was similar to that reported by Atteh and Ologbenla (1992). Gado *et al.* (1982) fed diets in which housefly larvae replaced soybean meal and fishmeal to broilers and observed comparable feed intake and weight gain. Nugaer (1982) observed no difference in feed intake when housefly larvae was added to diets at the expense of meatmeal or fishmeal. In contrast to the above observations, increasing the dietary level of maggots at the expense of fishmeal in this trial reduced feed intake. Dhaliwal *et al.* (1980) and Atteh and Ologbenla (1992) had earlier observed similar reduction in feed intake when broilers were fed diets in which maggots replaced fishmeal. The reduction in feed intake is thought to be related to the high energy content of maggot relative to fishmeal. Maggots used in this trial had 21% fat compared to 10.72% for the fishmeal. The ME of maggots used in this trial was found to be 5282 kcal/kg (Atteh and Uthman, Unpublished) which is higher than the ME value reported for fish meal (NRC,1984). With quantitative substitution of maggots for fish meal, ME value of the diets increased as dietary maggot increased thus explaining the reduction in feed intake.

The productive performance of birds fed diets in which maggots replaced fishmeal was comparable to those fed the control diet. Birds fed diets in which maggots replaced fishmeal were also in positive nutrient balance as indicated by their weight gains. This coupled with comparable performance with birds fed the control diet showed that maggots could support production in laying hens. Earlier studies (Parshikova *et al.* 1981, Molchanova *et al.* 1983) showed an increase in egg yield and egg weight when housefly larvae replaced fishmeal in the diet. Ernst *et al.* (1984) had also replaced meat meal with maggot meal in the diet of laying hens and

TABLE 2 EFFECTS OF INCREASING DIETARY LEVELS OF MAGGOT ON PERFOPMANCE OF LAYING HENS[1]

Dietary level of maggots (%)	Feed Intake g/bird	Body wt. gain (g/ bird)	Egg Production (Henday Basis (%)	Egg wt. (g)	Feed/ dozen eggs (Kg)
	*	*			
0	125.1b	210b	61.4	62.7	2.3
3	115.1ab	180b	60.7	61.3	2.3
6	109.1a	20a	58.2	61.3	2.6
9	105.7a	37a	51.1	61.2	2.6
S. E. (8 D.F.)	4.03	1.03	4.57	0.79	0.51

1 Average for 42 days.
*P 0.05

TABLE 3 EFFECTS OF INCREASING DIETARY LEVELS OF MAGGOTS ON NUTRIENT RETENTION BY LAYING HENS

Dietary level of maggots (%)	Protein (%)	Fat (%)	Metabolizable Energy (Kcal/Kg)
0	68.6	78.0	2559
3	64.9	73.5	2969
6	68.2	75.0	2958
9	58.8	65.7	2780
S. E. (8D.F.)	7.33	5.76	166.3

observed a 3.6% increase in egg yield. Peter *et al.* (1985) reported that the egg laying ability of
Japanese quail was not adversely affected by 5% dietary poultry excreta dressed with housefly pupae.

There was a reduction in the cost of each diet as maggots replaced fishmeal in the diets. Atteh and Ologbenla (1992) reported the cost of harvesting and processing of maggots to be ₦5.38 per kilogramme, which was about 15% of the cost of equivalent weight of fishmeal (₦32.00/kg). Thus the cost of fishmeal used for 100kg of the control diet was ₦288.00 as opposed to ₦47.52 worth of maggots used in 100kg of diets 4.

With comparable performance of birds, irrespective of the dietary maggots level in this trial, use of maggots as an alternative to fishmeal is considered economical.

Ocio et al. (1980) reported that the gross protein value of housefly larvae was superior to that of meatmeal but inferior to that of fishmeal. There is no evidence in this trial to suggest this inferiority as protein retention were identical for all the treatments. Fat retention were also identical irrespective of the dietary maggot level. The relatively higher metabolizable energy content of the maggot based diets is associated with higher fat and ME of maggots relative to fishmeal as indicated above.

With no significant variation in nutrient retention between the different treatments, the reduction in feed intake is thought to be responsible for the lower body weight gain of birds fed diets with 6 and 9% maggots. However, since body weight gain is not of paramount importance in laying hens, this negative effect could be tolerated. It is concluded that maggots could replace all the fishmeal (9%) in the diet without detrimental effects on the performance of laying hens.

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REFERENCES

ASSOCIATION OF OFFICIAL ANALYTICAL CHEMIST (A.O.A.C.) (1980). Official Methods of the Association of Analytical Chemists. 13th end, Washington, D.C.

ATTEH, J. O. & OLOGBENLA, R. D. (1992). Replacement of fishmeal with maggots in broiler diets. Submitted for publication: Nig J. Anim. Prod.

ATTEH, J. O.& OYEDEJI, J. O.(1990). The replacement value of maggots for groundnut cake in broiler diet. In press. (centrpoint).

CALVERT, C. C. (1979). Use of animal excreta for microbial and insect protein synthesis. J.Anim. Sci., 48: 178-192.

CALVERT, C. C., MARTIN, R. D. & DORGAN, N. O. 1969). Housefly pupae as food for poultry. Econ. Entromology 62: 939.

DHALIWAL, J. S., VIRK, R. S. & ATWAL, A. S. (1980). The use of housefly (Musca, domestica. Linn) Pupae meal in broiler mash. Ind. J. Poultry Sci., 15:119-122.

DUNCAN, D. B.(1955) Multiple range and Multiple F tests. Biometrics, 11:1-42.

ERNST, L; VAGAPOV, R.; POZDEEVA, E.; ZHEMCHUZHINA, A. & ZVEREVA, E. (1984). A high protein feed from poultry manure. Nutr. Abstr. Rev. 54:445.

GADO, M. S., EL-AGGORY, S. M. ELGAWAAD, A. A. & MAHMOUD, A. K. (1982). The possibility of applying insect protein in broiler rations. Nutr. Abstr. Rev. 53:76.

MATANMI, B. A. (1990). The economic importance and management of pest flies in poultry production. In: Rural poultry in Africa. Proceedings of International Workshop on Rural Poultry Development in Africa. Ile-Ife, Nigeria pg.82-88.

MILLER, B. F. & SHAW, J. H. (1969). Digestion of poultry manure by diptera. Poultry Sci, 48: 1844-1845.

MILLER, B. F., TEOTIA, J. S. AND THATCHER, T. O. (1974). Digestion of poultry manure by Musca domestica. Brif. Poultry. Sci., 15:231-234.

MOLCHANOVA, N. V., PARSHIKOVA, O. S., CHAPLINSKAYA, K. N. & ROMASKO, U. V., (1983). Egg yield and some blood values of hens on a diet with various amounts of a new protein feed. Nutr. Abstr. Rev. 54:374.

NATIONAL RESEARCH COUNCIL (1984). Nutrient Requirements of Poultry. 8th Revised Ed. National Academy of Sciences. Washington, D.C.

NUGAER, S. A. (1982). Growth, development and pelt quality of mink fed diets with housefly larvae, Nute. Abstr. Rev. 53:813.

OCIO, E., VINAZAS, R., REY, J. M. & RICHELET, A. (1980). The biological value of housefly larvae estimated in chickens by the crude protein method. Nutri. Abstr. Rev. 51:277.

PARSHIKOVA, O. A., CHAPLINSKAYA, K. N., MOLCHANOVA, N. V. & ROMASKO, V. N. (1981). Metabolism and productivity of hens given diets with ground housefly larvae. Nutr. Abstr. Rev. 52:361.

PETER, V., CHIRAPPA, V., BODA, K., ZAJONC, I.& VANCO, M. (1985). Effect of poultry excreta dressed with housefly (*Musca domestica*. L) pupae in the fattening of broilers and rearing of Japanese quail. Nutr. Abstr. Rev. 56:398.

STEEL, R. G. D. AND TORRIE, J. H. (1980) Principles and procedures of statistics. A Biometrical Approach. 2nd Edn. McGraw-Hill, New York.

TEOTIA, J. S. & MILLER, B. F.(1973). Fly pupae as a dietary ingredient for starting chicks. Poultry Sci., 52: 1830-1835.