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HOUSEFLY MAGGOT MEAL AND POULTRY VISCERAL OFFAL MEAL AS PROTEIN SUPPLEMENTS IN THE DIETS OF STARTER PULLET CHICKS

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Target Audience: Animal scientists, poultry farmers, feed millers

ABSTRACT

A 6-week feeding trial involving 140 day-old Isa Brown pullet chicks was conducted to evaluate housefly maggot meal (HFMM) and poultry visceral offal meal (PVOM), substituting for Danish fish MEAL (FM) on equi-protein basis in their diets. Diet A (control) contained 8% FM as sole source of animal protein contributing 26% of the dietary crude protein content (20% CP). Fifty, seventy-five and one hundred percent of protein supplied by the proportion of FM in the control diet were supplied by the equivalent proportions of HIFMM in diets B,D, & F and of PVOM in diets C,E & G on the basis of their respective crude protein contents. The diets were also isocaloric (*ca* 2900 kcal/kg ME).

Results on weight gain, feed intake and feed conversion ratio showed that FM could be replaced partially or completely with HFMM and PVOM without detrimental effects. This is an indication that the protein sources could satisfy the nutrient requirements of the starter pullet chicks. However, it was apparent that HFMM protein was slightly inferior to those of FM and PVOM. This is evident in the slower growth rate [though not significant] and higher feed cost per unit of gain, especially on the HRMM-based diet F than PVOM - based diet G. Conclusively, the use of HFMM and PVOM as substitutes for FM could lower feed cost. The novel protein sources could also be blended in certain ratios to substitute FM to reduce feed cost.

Key words: Fishmeal, housefly maggot meal, poultry visceral offal meal, protein, pullet chick.

DESCRIPTION OF PROBLEM

The objective of substitution studies is twofold. It is to expand the feed resource base for formulating efficient feeds at minimal cost for farm animals, especially the monogastrics through the use of inexpensive feedstuffs at the expense of the expensive ones without having adverse effect on animal performance. As established for the conventional feedstuffs (1), it is also

designed to establish the safe inclusion levels of the lesser known or unconventional feedstuffs in animal feeds at different stages of production. In table egg production, the starter, growing and laying stages are involved while the starter and finisher phases are applicable to broiler chicken production. The nutritional implication of these stages is on the nutrient and energy requirement of the animal which must be met for optimal performance.

There is, therefore, the need for caution in the use of inclusion level of a novel feedstuff obtained for a class of the chicken for another class. This is necessary because the response of a class of birds to a feedstuff as a substitute for another is affected not only by the age and/or stage of production but also by the nutrient or energy content and/or antinutritional composition of the substitute. The alternative feedstuff may be deficient in one or more essential nutrients and/or energy or *vice versa* compared with the conventional feedstuff it is replacing thereby affecting the requirement of the recipient animal (2,3,4) Furthermore, the substitute may contain one or more anitinutritional factor(s which may equally affect the health and production of the animal (3,5,6,7).

Housefly maggot meal (HFMM) and poultry visceral offal meal (PVOM) are examples of cheaper substitutes for the expensive and scarce conventional protein sources such as fishmeal (FM) in poultry diets in Nigeria (8,9,10). According to the respective authors, HFMM is produced from the housefly maggots *(Musca domestica Linn)* harvested from the droppings of caged poultry birds while PVOM is produced from the evisceration wastes of slaughtered table birds. Their proximate composition has also been given by the authors (Table 2). HFMM could replace FM completely in layers' diet (11) and partially in broiler starter diet (8). On the other hand, PVOM could also replace FM completely in broiler finisher and grower pullets' diets (10) and partially in broiler starter and young layers' diets (12).

The response of starter pullet chicks to each of HFMM and PVOM as dietary animal protein source, substituting for FM in their diets has not been reported in the local literature in Nigeria. Thus, this paper gives an account of the study carried out to evaluate the two novel protein supplements, substituting for FM on equi-protein basis. It was also aimed at determining their safe inclusion levels in the diet of the starter pullet chicks from day old to 6 weeks of age.

MATERIALS AND METHODS

Production Technology of HFMM and PVOM: Housefly maggots were harvested from the dropping pit of caged layers and broiler finishers. The harvested maggots were washed with cold water to remove the faeces through sieving. The washed maggots were immersed in hot water in order to kill them prior to sundrying, to prevent them from escaping from the drying slab. The dead maggots were spread thinly on the concrete slab to sundry 3 to 4 sunny days. While sundrying, feathers, larva and pupa of other insects were removed and

the resulting product was milled and stored in air-tight bag until needed for preparation of experimental diets. The recovery rate was 1 kg dried maggot from 6 kg wet weight of maggot.

Poultry visceral offal meal was produced from the collections of fresh poultry visceral offals using a wet rendering methods as described in earlier studies. (10, 13).

Formulation of Treatment Diets: Seven 20% crude protein starter diets with similar energy contents (*Ca* 2900 kcal/kg ME) were formulated (Table 1) Diet A (control) contained 8% fish meal (FM) as sole source of dietary animal protein. This proportion of FM in the control diet was replaced gradually with HFMM at 5.8, 8.70 and 11.60% in diets, B,D and F respectively and also with PVOM at 4.65, 6.97 and 9.30% in dies C,E, and G respectively to supply 50, 75 and 100% of the animal protein supplied by FM in diet A. Each diet was replicated twice, with 10 birds per replicate on deep litter pens.

Table 1: Composition of the Treatment Diets (g/100g Air-Dry Basis)

Feed Ingredients	Price (N/kg)	Treatment Diets						
		A	B	C	D	E	F	G
Maize	4.60	45.00	45.00	45.00	45.00	45.00	45.00	45.00
Maize offal	2.50	25.00	23.20	24.35	22.30	24.03	21.04	23.70
Groundnut cake	14.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00
Danish Fish meal	50.00	8.00	4.00	4.00	2.00	2.00	-	-
(CP=65%)	21.00[b]	-	5.80	-	8.70	-	11.60	-
[a]HFMM (CP=45%)	37.00[d]	-	-	4.65	-	6.97	-	9.30
[c]PVOM (CP=56%)	4.00	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Bone meal	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Oyster shell	2.00	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt(Nacl)	200.00	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Premix (starter)		100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total								
[f]Calculated Proximate Analysis:								
Crude protein	(%)	20.10	20.00	20.00	20.00	20.00	20.00	20.00
Metabolisable energy	(kcalkg)	2874.3	2880.8	2878.9	2884.6	2881.4	2887.3	2883.6
Ether extract	(%)	3.94	4.40	4.34	4.63	4.54	4.87	4.75
Crude fibre	(%)	4.88	4.85	4.88	4.86	4.88	4.83	4.88
Calcium	(%)	0.53	0.64	0.45	0.69	0.42	0.75	0.38
Available Phosphorus	(%)	0.34	0.39	0.32	0.42	0.31	0.45	0.30

[a,c] See text for full meaning.

[b] Determined as for cost price of PVOM except that no cost was incurred on maggots and transportation from source to processing site.

[d] Determined according to the formular used in an earlier report (10)

[f]Values given in (14) for calcium and phosphorus for Herring fishmeal were assumed for HFMM and PVOM while the ME value for Herring fish meal and poultry by-product meal in (14) were assumed for HFMM and PVOM respectively.

Substitution was based on the crude protein contents of 45, 56 and 65% for HFMM, PVOM and FM respectively. The metabolisable energy content of 3190 Kcal/kg for Herring fish meal (14) was adopted for HFMM.

Experimental Birds and their Management: A total of 140 day-old Isa Brown pullets was procured from a commercial hatchery. They were divided on equal weight basis into fourteen groups of 10 birds per group at day-old for the experiment which lasted for six weeks. Each group was housed in a deep litter pen measuring 90cm x 210cm equipped with a brooder box and a 60-watts electric bulb, a feeder and a drinker. A kerosine lantern per pen was used whenever there was power failure. In a completely randomized design, a treatment diet was fed *ad libitum* to two groups of birds as indicated earlier. Drinking water was also provided *ad libitum.*

The birds were given intra-occular vaccination against Newcastle disease at day-old. Neoterramycin chick formular and vitalyte were administered orally via drinking water during the first week of age. First and second doses of Gumboro vaccine were administered at second and fifth weeks of age respectively. Lasota wa given orally via water at third week of age. Neocloxin was given via drinking water against bacterial infections during 16 to 21 days of age while embazin forte was also given in water from 28 to 32 days of age against coccidiosis.

Measurements: Weight gain, feed intake and feed conversion ratio for the entire 6-week period were derived from the weekly measurements of these parameters. Mortality was also recorded as it occurred for the period of the trial.

Feed Cost Analysis: Since cost of feed consumed per unit of gain can be used as the basis of recommending efficient feed (15), feed cost and cost of feed consumed per unit of gain were also computed for comparative evaluation of the three animal protein sources in this study.

Chemical and Statistical Analysis: Samples of HFMM and PVOM were analysed for their proximate compositions according to the standard methods of AOAC (16). Live performance data of birds on the respective treatment diets were subjected to analysis of variance using the model for a completely randomised design (17). Duncan's Multiple Range test was used to compare treatment means.

RESULTS AND DISCUSSION

The effects of substituting dietary FM with HFMM and PVOM on equiprotein basis in the starter pullets' diets are summarised in Table 3. Birds receiving diet G grew faster ($P<0.05$) than those on diet B but not faster than those on the other diets. Mean daily feed intake of the birds was generally uniform ($P>0.05$) with the exception of intake on diet C which was lower ($P<0.05$) than intake on diet B. As for weight gain, feed conversion ratio (FCR) also tended to be poorer

on HFMM - containing diets but this was not significantly different from those of other diets except diet C whose FCR was similar to the other diets. Mortality rate on diet B was higher ($P<0.05$) than on diet D but the mortality rates on diets B and D were the same as for other diets. Substitution of FM with HFMM and PVOM partially or totally in starter diets caused some reduction in feed cost. However, the feed cost per unit of weight gain on PVOM - based diet G was lower for diet (2.51 kobo) than for FM - based diet (2.76 kobo) and HFMM - based diet (2.74 kobo).

Table 2: **Proximate Composition (%) and Metabolisable Energy Contents (kcal/kg) of ishmeal, HFMM and PVOM.**

Protein Supplement	[a] Proximate Fractions(%)							
	DM	CP	EE	CF	NFE	Ash	ME[b]	Reference
Herring fish meal	-	72.00	10.00	1.00	-	-	3190	(20)
Fish (Not specified)	92.10	65.14	5.43	0.96	1.19	19.38	-	(8)
PVOM	94.00	56.00	13.50	0.35	19.04	5.11	2910[c]	(17)
HFMM	91.34	39.16	20.76	8.25	17.02	6.15	5282[d]	(2)
HFMM[e]	90.40	45.00	12.50	7.50	17.80	7.60	-	Present study

[ab]DM = Dry matter, CP = Crude protein, EE = Ether extract, NFE = Nitrogen-free extract and ME= Metabolisable energy.
[c]ME for poultry by-product meal assumed for PVOM was taken from (14).
[d]Value taken from (1).
[e]Mean values are derived from quadruplicate determinations.

The generally uniform weight gains of the birds on the respective diets especially FM, HFMM and PVOM - based diets is an indication that the quality of these animal protein supplements is the same for the starter pullets. However, in an earlier study with the broiler starters (8), HFMM protein was found to be inferior to that of FM. This disparity in the quality of HFMM versus FM protein in the diets of broiler starters and starter pullets from these studies was expected since the nutrient requirement of the former is higher than the latter. The similarity in the quality of PVOM protein with that of FM in this study is partly in agreement with other earlier findings (10,18) and partly in disagreement with some (12,13). These observations could be attributed to differences or otherwise in the strain or nutrient requirements of the birds at different stages of production.

The generally non-significant differences in the voluntary feed consumption on all treatment diets was expected in view of their similar energy content since birds eat to satisfy their energy requirement (14). This is an indication that the ME of HFMM used was lower than that (5282 Kcal/Kg ME), quoted previously (8) but similar to the ME of Herring fish meal (3190 Kcal/kg) (14).

The use of FCR and feed cost per unit of weight gain for measuring feed efficiency has been recommended (15). Although the FCRs of FM -, HFMM -

Table 3: **Effects of Replacement of Fish Meal With HFMM and PVOM in the Diets of Pullet Chicks on Their Performance Characteristics During 0-6 Weeks of Age**

Parameters	Treatments Diets							
	A	B	C	D	E	F	G	±SEM
1. Mean initial body weight (g/bd)	45.00[a]	45.00[a]	45.00[a]	45.00[a]	45.00[a]	45.00[a]	45.00[a]	0.00
2. Mean daily weight gain (g/bd)	7.72[ab]	6.08[b]	7.56[b]	7.86a[b]	7.90[ab]	6.24[ab]	8.12[a]	0.546
3. Mean daily feed intake (g/bd)	21.70[ab]	22.40[a]	18.20[b]	18.60a[b]	21.40[ab]	20.90[ab]	22.00a[b]	1.077
4. Mean feed conversion ratio	2.81[ac]	3.68[a]	2.41[b]	2.37a[b]	2.71[ab]	3.35[ab]	2.71[ab]	0.365
5. Mean mortality rate(%)	15.00[ab]	22.50[a]	15.00a[b]	10.00[b]	17.50[ab]	15.00[ab]	17.50[ab]	3.365
COST OF PRODUCTION								
6. [1]Feed cost/g diet (kobo)	0.984	0.901	0.954	0.859	0.939	0.819	0.925	_
7. [2]Feed cost/g live weight gain(k)	2.76	3.32	2.30	2.03	2.54	2.74	2.51	_

[ab]Values bearing the same superscript are not different (P>0.05) while those with unidentical superscript are different (P<0.05) significantly.

[1]Computed from Table 1.

[2]Obtained as a product of cost per gramme feed and mean feed conversion ratio.

and PVOM - based diets were not significantly different, the FCR value for HFMM - based diet F (Table 3) was poorer, suggesting that this protein source might be slightly poorer in quality than FM and PVOM.

The trend in mortality rates across the treatment diets did not reveal any treatment effects. The mortality rates observed presently are higher than the normal 5% from day old to 6 weeks of age (19). The mortality was largely attributed to hatchery - related problems such as unhealed navel which some of the birds had.

The most cost effective was diet G followed by diet F while diet A was least cost effective in favour of complete substitution of FM with HFMM and PVOM in the diets of starter pullet chicks from day old to 6 weeks of age (Table 3). Feed cost per unit of weight gain is higher for a less efficient diet. The production costs of₦ 21.00 and₦ 37.00/kg of HFMM and PVOM respectively as against the market price of₦ 50.00 per kg of FM (Table 1) were responsible for the relatively lower cost of HFMM - and PVOM - substituted diets. This is in agreement with the results in other studies (8,10,11,12).

It is pertinent to remark that the mean values of weight gain, feed intake, and feed conversion ratio in this study (Table 3) are comparable with the values given for this class of chickens in the earlier reports (18,19,20).

CONCLUSIONS AND APPLICATIONS

1. Both HFMM and PVOM could replace FM on an equal protein basis in the starter pullets' diets without jeopardising their live performance characteristics.
2. HFMM protein was slightly inferior to those of FM and PVOM as reflected in the relatively poorer weight gain and FCR and higher feed cost per unit of gain.
3. Some reduction in the cost of feed consumed per unit gain could be achieved through the use of HFMM and PVOM as substitutes for FM in the starer pullets' diets.

Since HFMM and PVOM are cheaper than FM, a mixture of two or more of these protein supplements in certain ratios could be used to lower feed cost per unit of gain. For example, a kg of a mixture of HFMM and PVOM in ratio 1:1 would cost about₦ 29.00 as against₦ 50.00 per kg of FM on the basis of the ruling market price at the time of this study.

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