REPLACEMENT VALUE OF POULTRY VISCERAL OFFAL MEAL FOR FISH MEAL IN LAYERS' DIETS.

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ABSTRACT

The effects of replacing imported fish meal (FM) with poultry visceral offal meal (PVOM) in the diets of 200 Isa Brown laying hens on their performance characteristics and economy of egg production during 22 to 38 weeks of age were examined. PVOM replaced FM on an equal protein basis at the graded levels of 1.18, 2.37, 3.55 and 4.73% of diet B,C,D, and E respectively. The control diet A contained 4% FM as the sole source of animal protein. All diets contained ca 16% crude protein while their calculated metabolisable energy was *ca* 2600 kcal/kg diet. Observations were made at intervals of 4 weeks and entire 16-week period. Neither feed intake nor egg weight was affected ($P>0.05$) by dietary treatments during the 4, 28-day and entire 16-week periods. The results of feed intake: egg weight ratios on the respective diets for each 28-day period and entire study period showed significant differences ($P<0.05$) and similarity in the values of this parameter between some dietary treatments but the effect of PVOM inclusion levels on this parameter did not follow any consistent trend to undermine the results of other parameters. Mean daily egg production was higher ($P<0.05$) on diet A than on the rest diets during 22 to 26 weeks of age but these differences gradually disappeared towards 38 weeks of age. Daily egg yields per 10 birds on diets D and E were similar but lower ($P<0.05$) than on the rest diets whose egg yeilds were also similar for the entire 4-month period. The performance data for the 4-months period on mean daily feed intake (g/bird) stood at 78.81 (A), 80.32 (B), 85.31(C),81.70(D) and 75.88(E) while the feed intake : egg weight ratios were 1.46(A), 1.51(B), 1.58(c), 1.52(D), and 1.41(E). Mean daily egg yields were 6.85, 6.88, 6.73, 6.25 and 6.14 for diets A,B,C,D and E respectively while mean (g) were 54.15(A), 53.23(B), 54,00(C) 53.75(D) and 53.88(E) for the same period. PVOM could not replace FM beyond 59.25% of its proportion in the control diet without detrimental effect on egg production, although higher inclusion levels of PVOM did not affect feed intake and egg size but could further reduce feed cost.

Keywords: Poultry visceral offal meal, fish meal, protein, layer, performance.

INTRODUCTION

In a developing country like Nigeria, the recycling of the waste products resulting from the slaughtering and evisceration of table birds as protein supplement in the diets of the monogastrics has been receiving research attention in the recent years (Udedibie *et al.*, 1987; Udedibie *et al.* 1988; Nwokoro, 1993; and Salami and Oyewole, 1994). Unlike in a developed country like the U.S.A., less than 5% of the total slaughtering of table birds in the tropics is done through organised dressing systems (Daghier, 1975) and this had hitherto hindered investigation in the region into the feeding value of the waste products from the poultry processing plants. Large quantities of poultry processing wastes are becoming available and would constitute a nuis' ιce if not properly disposed of.

Poultry visceral offal (PVO) is a waste product of organised slaught:ring and dressing. It is made up of th edible and inedible visceral offal namely la ge and small intestines and their contents, kidney, liver, heart, bile, oesophagus and proventriculus of eviscerated table birds especially broiler finisher aged 6-8 weeks. Poultry offal meal (POM) and chicken offal meal (COM) have been produced previous' 'n Nigeria from waste products similar to PVO for feeding poultry birds by Udedibie *et al.* (1988) and Nwokoro (1993) respectively. Unlike POM which is the processed edible and inedible parts comprising the head, viscera, feather, beak, blood, discarded egg and dead birds, poultry visceral offal meal (PVOM) is produced by "wet rendering method" as described by Salami and Oyewole, (1994).

While POM has been used successfully to replace groundnut cake (GNC) in layers' and broiler finishers' diets (Udedibie *et al*, 1988); COM had also been used along with fish meal and blood meal as sources of methionine and lysine in the starter diets of cockerels (Nwokoro, 1993). Subsequently, PVOM has been similarly used to replace imported fish meal (FM) partially (57.5% of FM) and completely (115% of FM) in the broiler starter, and finisher diets respectively as well as in grower pullet diets. (Salami and Oyewole, 1994; (Salami and Oyewole, Unpublished data) but is yet to be fed to laying chickens. The present study reports the effects of replacing FM with PVOM in the diets of Isa Brown layers on their performance characteristics and economy of egg production during 22 to 38 weeks of age.

MATERIALS AND METHODS

The fresh PVO used in this study was collected in batches from the processing plant of Folawiyo Farms Ltd, Ilora, near Oyo in Afijio Local Government Area of Oyo State, Nigeria. The fresh PVO collected were subjected to the "wet rendering" method of Salami and Oyewole, (1994) to produce the test ingredient, PVOM.

Five treatment diets were formulated in which PVOM replaced FM at the graded levels of 0, 1.18, 2.37, 2.37, 3.55 and 4.73% in diets A,B,C,D, and E respectively to supply 0, 25, 50, 75 and 100% dietary animal protein supplied by 4% FM as the sole source of animal protein in the control diet A (Table 1). Substitution of FM with PVOM was done on the basis of the crude protein (CP) contents of 56 and 65% for PVOM and FM respectively after Salami and Oyewole (1994). The experimental diets were similar in their CP (16%) and ME contents (2600 kcal/kg diet).

Two hundred Isa Brown Layers, 22 weeks of age at the start of the study, were divided into twenty groups of 10 birds per group, having a mean body weight of 1.35kg. The birds had been previously fed *ad libitum* on the appropriate diets at the Teaching and Research Farm of St. Andrew's College of Education, Oyo for the starter pullets for 8 weeks, grower pullets for 10 weeks and layers for 4 weeks in chronogical order from day-old.

The experimental arrangement was a completely randomised design with five test diets. Each test diet was replicated four times in space with 10 birds per replicate. The layers were raised in two-tier battery cage placed inside an open-sided poultry house. Birds per replicate were housed in twos per cage compartment measuring 30 x 38 x 43cm for breath, length and height respectively.

Test diets and drinking water were provided ad libitum during the study period that lasted 6 weeks. The water troughs were washed daily before fresh water was served.

The birds were duly dewormed and vaccinated before the commencement of the experiment. Vitalyte was administered occasionally during the experiment against stress.

Observations were made for four periods at four weeks interval. Average daily feed intake, daily egg yield in terms of number of eggs collected from 6-18 hours, egg weight and feed intake: egg weight ratio were obtained for the four periods and entire 16-weeks period. Egg weight was determined by randomly picking 5 eggs daily from each replicate during the last 3 days of each observation period (totalling 15 eggs) and eggs sampled from each replicate were weighed individually using Triple Bean Balance.

The cost of PVOM was determined as the sum of expenditures incurred on purchase of raw PVO, transportation, fuel, labour and milling of the sundried PVOM per quantity produced.

TABLE 1: PERCENTAGE COMPOSITION OF TREATMENT DIETS

FEEDING STUFFS	Cost Price (₦/kg)	Treatment Diets A	B	C	D	E
Maize	3.50	33	33	33	33	33
Cassava Root Meal (Lafun)	3.00	6	6	6	6	6
Groundnut Cake	13.00	12	12	12	12	12
Fishmeal (Danish)	34.00	4	3	2	1	-
PVOM[a]	16.50	-	1.18	2.37	3.55	4.73
Maize offal	1.20	32	32	32	32	32
Brewer's Dried Grain	1.20	3.25	3.07	2.88	2.70	2.52
Bone meal	1.20	2.5	2.5	2.5	2.5	2.5
Oyster Shell	0.80	6.75	6.75	6.75	6.75	6.75
Salt	3.20	0.25	0.25	0.25	0.25	0.25
Premix[b]	112.00	0.25	0.25	0.25	0.25	0.25
TOTAL		100	100	100	100	100
[c]**Calculated Proximate Fractions:**						
Crude Protein (%)	15.65	15.57	15.52	15.48	15.42	
Crude Fibre (%)	6.0	5.4	5.4	5.4	5.4	
Ether Extract (%)	3.3	3.4	3.5	3.6	3.7	
Calcium (%)	3.58	3.56	3.54	3.52	3.50	
Phosphorus (%)	0.58	0.58	0.57	0.57	0.57	
Metabolizable Energy (Kcal/Kg)	2621	2623	2625	2627	2630	

[a]See Salami and Oyewole (1994) for proximate composition and metabolisable energy.

[b]Premix provided (per kilogram of diet): Vitamin A 20,000 i.u; Vitamin E 25mg; Folic acid 1.25mg; Panthothenic acid 25mg; Vitamin B12 37.5mg; Vitamin B6 3.75mmg; Vitamin C 75mg; Copper 37.5mg; Cobalt 0.62mg; Selenum 0.25mg; Vitamin D3 7500 i.u; Vitamin K 5mg; Nicotinic acid 50mg; Vitamin B2 12.5mg; Vitamin B1 2.5mg; Choline Chloride 750mg; Iodine 4.38mg; Iron 100mg; Zinc 125mg; and Manganese 250mg.

[c]Values used for calculations were taken from Scott et al (1982).

The operating market prices of feed ingredients in Table 1 at the time of the experiment (April 4 to July 24, 1992) were used to calculate the cost of feed consumed to produce an egg on the respective treatment diets.

The proximate fractions of the experimental diets were determined according to the procedures of AOAC (1990). Data were subjected to Analysis of Variance (ANOVA) and Duncan's Multiple Range Test (Steel and Torrie, 1980) was used to compared treatment means.

RESULTS AND DISCUSSION

Tbale 2 shows the determined proximate composition of the experimental diets. The calculated and determined values of the crude protein of the diets (Tables 1 & 2) were in close agreement. The determined value of other nutrients for the diets also appear similar with the value ranging from 2.7 to 3.81% for crude fibre, 3.6 to 5% for ether extract and 10.19 to 12.39% for ash. The calculated and determined dietary protein level of about 16% and calculated metabolisable energy of about 2600 kcal ME/kg diet were within the range recommended for the laying birds by Oluyemi and Roberts (1979) and Scott *et al* (1982).

Table 3 and 4 show the data on performance characteristics of the birds for the four, 28-day periods and entire 16-week period respectively. The similarity in the voluntary feed intake of birds confirms that the experimental diets were uniform in their calorie contents (Wells, 1963). It is also evident that the birds did not show aversion to PVOM as a substitute for FM in their diets through reduced feed intake. Similar observations had been made previously with the laying birds and broiler finishers by

TABLE 2: PROXIMATE COMPOSITION OF THE TREATMENT DIETS (ON OVEN-DRIED BASIS)

	%Proximate Fraction				
DIETS	**Crude Protein**	**Crude Fibre**	**Ether Extract**	**Ash**	**Moisture**
Diets A	16.80	3.81	3.50	10.19	9.05
Diet B	16.40	3.23	3.70	10.68	9.99
Diet C	15.95	3.61	3.60	10.35	9.69
Diet D	16.00	3.12	4.50	12.39	9.13
Diet E	16.50	2.70	5.00	10.24	9.58

TABLE 3: LIVE PERFORMANCE CHARCTERISTICS OF THE LAYERS FOR THE FOUR PERIODS OBSERVED.

Age (Wks)	**Performance Characteristics**	Dietary Treatments					
		A	B	C	D	E	±SEM
I	Mean Daily Feed Intake (g/bird)	79.03	76.63	78.70	74.20	71.40	2.52
	Mean Daily Egg yield	7.24^{a}	7.40^{b}	6.70^{c}	6.70^{c}	6.60^{c}	0.04
22-26	Mean Egg Weight (g)	49.30	47.00	48.50	48.90	47.80	0.74
	Feed Intake: Egg weight ratio	1.69^{b}	1.63^{c}	1.62^{c}	1.52^{a}	1.49^{a}	0.01
II	Mean Daily Feed Intake (g/bird)	75.86	77.31	81.40	73.00	67.70	6.04
	Mean Daily Egg yield	6.27^{a}	6.16^{a}	6.20^{a}	5.60^{b}	5.44^{b}	0.03
26-30	Mean Egg Weight (g)	53.60	52.90	53.40	53.80	53.70	0.70
	Feed Intake: Egg weight ratio	1.41^{c}	1.40^{d}	1.52^{d}	1.35^{b}	1.26^{a}	0.01
	Mean Daily Feed Intake (g/bird)	75.90	77.64	90.10	88.98	82.01	11.26
III	Mean Daily Egg yield	6.94^{a}	6.81^{a}	7.00^{a}	6.50^{b}	6.11^{c}	0.05
	Mean Egg Weight (g)	55.30	55.10	55.80	56.10	55.50	0.05
30-34	Feed Intake: Egg weight ratio	1.37^{a}	$1..40^{a}$	1.61^{c}	1.58^{c}	1.47^{b}	0.01
IV	Mean Daily Feed Intake (g/bird)	84.44	89.70	91.03	90.63	82.41	13.49
	Mean Daily Egg yield	6.94	7.14	7.03	6.23	6.41	0.04
	Mean Egg Weight (g)	58.40	57.90	58.90	56.20	58.50	0.70
34-38	Feed Intake: Egg weight ratio	1.44^{b}	1.55^{c}	1.55^{c}	1.61^{c}	1.41^{a}	0.004

^{a,b,c,d} Means with unidentical superscripts are significantly different ($P<0.05$)

Udedibie *et al.* (1988) while replacing GNC with POM and also by Salami and Oyewole (1994) while substituting FM with PVOM in the diets of broiler starters and finishers. The gradual increase in the feed intake of the birds on the respective diets as they advanced in age is expected since the birds would require more nutrients for increase in body weight,egg production and egg size especially during 22 to 42 weeks of age (Scott *et al*, 1982).

The feed consumption of birds in this study ranged from 75.88g/b/d for diet E to 85.31 g/b/d for diet C (Table 4). These values of feed intake appear lower than the values quoted in similar studies elsewhere (Onwudike, 1981; among others) Several factors including age and strain of birds used as well as dietary energy concentration might be responsible for the observed difference in the feed intake of birds in this study and those used in other reported studies.

Since no trend was followed, it is difficult to explain the significant difference in the values of feed intake: egg weight ratio for the control birds and the birds on some PVO substituted diets during the four, 28-day periods (Table 3); and the entire 16-week period (Table 4). The values of feed intake: egg weight ratio observed presently were better than those reported for birds of the same age and light strain by Summers and Leeson (1978). This is expected beacuse birds tend to overconsume

TABLE 4: LIVE PERFORMANCE DATA OF LAYERS AND ECONOMY OF EGG PRODUCTION FOR THE FOUR PERIODS COMBINED (22 TO 38 WEEKS OF AGE)

	Performance Characteristics	Dietary Treatments					
		A	B	C	D	E	±SEM
1.	Mean Daily Feed Intake (g/bird)	78.81	80.32	85.31	81.70	75.88	2.85
2.	Mean Egg Weight (g)	54.15	53.23	54.00	53.75	53.88	0.53
3.	Mean Daily Egg Yield	6.85^{a}	6.88^{a}	6.73^{a}	6.25^{b}	6.14^{b}	0.14
4.	Feed Intake: Egg weight ratio	1.46^{b}	1.51^{c}	1.58^{d}	1.52^{c}	1.41^{a}	0.04
ECONOMY OF EGG PRODUCTION:							
5.	Cost per grame feed (kobo)1	0.50	0.49	0.48	0.46	0.45	
6.	Cost of feed consumed per g egg produced (Row 4x5) (kobo).	0.73	0.74	0.76	0.70	0.63	
7.	Cost of feed per egg produced (Rows 2x6) (kobo)	39.52	39.39	41.04	37.58	33.94	

[a,b,c,d] Means with unidentical superscript are significantly different ($P<0.05$) while those without superscript are not significant ($P \ngtr 0.05$).
[1]Computed from Table 1.

feed in the temperate region in order to maintain their body temperature (Scott *et al*, 1982). Furthermore, the values of feed intake: egg weight ratios on the respective diets were similar to the value of 1.6 and 1.4 derived from Esthiett and Ademosun (1981) and Udedibe *et al.*, (1988) respectively. On the other hand, the values of other workers were less comparable with the values obtained presently due to the reasons given earlier.

The similarity in egg size for the respective diets (Tables 3&4) is an indicating that the diets were equally utilized for this purpose but not for egg production. The increase in egg size as the birds advanced in age during 22 to 38 weeks agrees with the observation of Adegbola and Olatoke (1988). The mean egg weights in Table 4 ranged from 53.23g for diet B to 54.15g for diet A were smaller than eggs laid by older birds in the studies reported by Esthiett and Ademosun (1981), and other workers.

The adverse effect of PVOM as a substitute for FM, especially at higher inclusion levels in diets D and E (Table 4) show that the quality of PVOM protein is inferior to that of FM in satisfying the protein requirements for both growth and egg production processes at the same time. This explains why the deleterious effect of PVOM at higher inclusion levels on egg production was noticeable during 22 to 34 weeks of age but disappeared during 34 to 38 weeks when growth became slower than earlier. Although the amino acid composition of PVOM has not been determined, that of POM, a similar novel protein supplement, has been reported to be slightly deficient in methionine (Udedibie *et al*, 1988). Thus, it is not impossible that PVOM is also slightly deficient in methionine or any other essential amino acid to explain why its protein is slightly inferior to that of FM, especially in the diets of broiler starters (Salami and Oyewole, 1994) and in the diets of young laying birds as observed presently. The slight methionine deficiency in POM, however, did not affect egg production because older laying birds were involved, apart from the fact that POM was used by Udedibie *et al.* (1988) to substitute GNC, which is also deficient in the same amino acid. Furthermore, our observation with the grower pullets (Salami and Oyewole, unpublished data) did not reveal that PVOM protein is inferior to that of FM, possibly due to the lower nutrient requirements of the slow-growing chickens such as pullets and cockerels compared with that of the fast growing broilers.

The daily egg production was higher ($P<0.05$) on diet A than on PVOM-substituted diets during the first period but the significant differences in egg production gradually disappeared towards the fourth period. Daily egg yields of birds on diets D and E were similar (P>0.05) but lower (P<0.05) than those on diets A,B, and C whose egg production was also similar (P>0.05) during the entire 16-week period. The mean daily egg yields per 10 birds on all diets during the four, 28-day periods (Table 3) and duration of the study (Table 4) were better than mean hen-day production values of 51.3 to 62.7% obtained for the older birds in earlier studies. On the other hand, the mean egg production data in this study are comparable with the mean hen-day production of 64.4 to 66.8% obtained for POM - diets by Udedibie *et al* (1988) and the values ranging from 67.1% to 70.5% reported by Uko *et al.* (1990).

The cost per gramme of feed and cost of feed consumed to produce an egg decreased as the replacement of FM protein (as sole source of animal protein) with that of PVOM increased towards 100% thereby making the later a cheaper substitute for the former (Table 4). The reduction in the cost of feed required to produce an egg as exemplified by diet E (compared with the control diet A) is in agreement with the previous findings in similar studies (Onwudike, 1981; Atteh and Adedoyin, 1993; Salami and Oyewole, 1994). Thus, the production of PVOM should be encouraged in Nigeria and elsewhere to reduce dependence on expensive and scarce conventional protein sources and also to solve disposal and pollution problems at the poultry processing plants.

On the basis of the performance data for the 16-week duration of the study, it is concluded that dietary FM (4%) could be replaced partially with 2.37% PVOM, representing 59.25% of FM, on an equal protein basis, in the diets of young layers without detrimental effect on egg size and production. Higher inclusion levels of PVOM did not affect egg size, and feed intake but could further reduce feed cost.

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