REPLACEMENT VALUE OF POULTRY VISCERAL OFFAL MEAL IN THE DIET OF BROILER CHICKENS

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ABSTRACT

An experiment was conducted to evaluate the replacement value of poultry visceral offal meal (PVOM) substituting for fish meal (FM) on an equal protein basis in the diets of unsexed Ross-strain broiler chickens from day-old to 8 weeks of age. One hundred and fifty birds were allotted in groups of 10 into 15 equidimensional floor pens with floor space of 0.189m^2 per bird. There were three replicates per treatment diet, with 10 birds per pen serving as a replicate. Five treatment diets, each for the starter and finisher phases of 5-and 3-week duration respectively were fed *ad libitum*. Diet A (control) contained 8% FM which was gradually replaced with PVOM at 2.3,4.6,6.90 and 9.20% in diets B,C,D and E respectively for both phases. All the diets were isocaloric (*ca* 12MJ ME/kg) for both phases and isonitrogenous with 23 and 20% dietary crude protein contents for the starter and finisher diets respectively. Feed intake and feed conversion ratios (FCR) were similar ($P>0.05$) on all diets in support of complete substitution. However, weight gain for 8 weeks on the control diet was better ($P<0.05$) than those on FM/PVOM- and PVOM-diets whose weight gains were similar ($P>0.05$). The mean feed intake values of 4.031, 3.936, 3.760, 3.870 and 3.715 kg/bird were obtained for birds receiving diets A,B,C,D and E respectively while the equivalent FCRs were 2.326, 2.352, 2.233, 2.326 and 2.340. The mean weight gains for birds on diets A,B,C,D and E for 8 weeks were 1.824, 1.688, 1.689, 1.676 and 1.590 kg/bird respectively. The dressed weight and weights of back, drumsticks, thighs and wings were similar ($P>0.05$) for all diets in favour of complete substitution of FM with PVOM. Mean dressing percentages were 58.24 to 69.07%. It is concluded that PVOM could replace FM completely in broiler diets.

Keywords: Broilers, visceral offal meal, fish meal, performance and carcass characteristics.

INTRODUCTION

Broiler is a fast-growing chicken and it is commonly produced mainly to provide tender-meated carcass for human consumption, especially where there is preference for tender table meat. The gestation period for broiler chicken production ranges from 8 to 10/12 weeks of age when the slaughter weight of 1.6 to 2kg is achieved (Oluyemi and Roberts, 1979). According to Smith (1990), body weight in excess of 2kg is attainable by broiler birds with feed conversion ratio of 2 in 8 weeks.

One of the items of variable cost in broiler production is feed. Feed cost represents the largest single item of cost in poultry production (Oluyemi and Roberts, 1979; Osei and Twumasi, 1989). Increasing cost of feeding is the greatest problem facing the poultry farmers. (Pido *et al*, 1979). Hence, there is need to look for alternative feedstuffs to substitute the scarce and expensive ones in a bid to stem the increasing feed cost. Earlier studies involving the replacement of the conventional feedstuffs with agro-industrial wastes include Oluyemi *et al;* (1979); Pido *et al,* (1979); Offiong *et al,* (1982); Ologhobo and Oyewole, (1987) and Esonu and Udedibie, (1993).

Poultry visceral offal meal (PVOM) is one of the readily available and cheaper feed substitutes in Nigeria (Salami and Oyewole, 1994). While Udedibie *et al* (1988) studied the effects of replacing groundnut cake with poultry offal meal (POM) in the diets of layers and broiler finishers, Nwokoro (1993) investigated the effect of chicken offal meal

(COM) along with blood meal and fish meal as sources of methionine and lysine in the starter diet of young cockerels. Subsequently, the effects of replacing dietary fish meal (FM) with PVOM on an equal protein basis, in the starter and finisher diets on the live performance parameters of broilers were examined (Salami and Oyewole, 1994). PVOM could replace FM partially (57.5% of FM) and completely (115% of FM) in the starter and finisher diets respectively without having adverse effect on weight gain and feed conversion ratio. Carcass yield of poultry birds is always measured in terms of dressed and/ or eviscerated weights and weight of cut-up parts (Osei and Duodu, 1988); while carcass quality is determined by total weight of edible meat and bone and meat: bone ratio (Adeleye and Odunsi, 1990). Sometimes, the weight of internal organs such as lung, liver, heart, spleen, kidney etc. is also measured to examine the effect of the test ingredient on the recipient animal (Udedibie *et al*, 1988).

The purpose of this work was to evaluate the effects of replacing imported fish meal with PVOM in the diet (on an equal protein basis) on live performance and carcass characteristics of unsexed Ross-strain broiler chickens from day-old to eight weeks of age.

MATERIALS AND METHODS

Birds and their management: Day-old unsexed Ross-strain broiler chicks av. weight 40g were allotted on equal weight basis in groups of 10 into fifteen equidimensional floor pens with floor space of 0.189m^2 per bird for 8 weeks. Adequate warmth and light were provided by a 60-watt electric bulb per pen during the starter period of 5 weeks. Each of the treatment diets for both phases (Table 1) was randomly applied to three replicate groups. The starter and finisher diets were fed for 5 and 3 weeks respectively. Feed and drinking water were provided *ad libitum* throughout the duration of the experiment.

Glucose and terramycin chick formula were administered orally to the birds during the first week of age. Amprolium and Embazin forte were administered against coccidiosis at 3 and 7 weeks of age respectively. The birds were duly vaccinated.

Experimental diets: The test ingredient (PVOM) was produced from PVO using the "wet rendering" method of Nwokoro (1993) as modified by Salami and Oyewole (1994). The fresh PVO used in this study was collected in batches from the eviscerating plant of Folawiyo Farms, Limited, Ilora, in Afijio Local Government Area of Oyo State, Nigeria.

Five treatment diets were each formulated for the starter and finisher phases. Diet A served as control and contained 8% fish meal supplying 100% of the dietary animal protein. Diets B,C,D and E were formulated by replacing the FM content (8%) of diet A gradually with PVOM at 2.3, 4.60, 6.90 and 9.20% of the diets to supply dietary animal protein contents of 25, 50, 75 and 100% respectively (Table 1). therefore, All diets were isonitrogenous with 23% and 20% dietary crude protein for the starter phase (0-5 weeks) and finisher (6-8 weeks) phase respectively as per calculated and determined analyses. The crude protein contents of 56 and 65% for PVOM and FM respectively were used as the basis of substitution of the latter with the former. Metabolisable energy (ME) for PVOM was not determined but the value of 2910 Kcal/kg for poultry by-product meal (a similar product) was assumed for the former after Scott *et al* (1982).

Measurements: Live body weight and feed intake of the replicates per treatment diet were recorded on weekly basis from which weight gains, feed intake and feed conversion ratio for 8-week period were subsequently computed. Mortality was also monitored on the respective treatment diets.

At the end of the eighth week, two birds per replicate (whose body weights were similar to the mean weight of the replicate) were selected and sacrified after withdrawing feed but not water for four hours. The birds were killed as described by Aina (1990) and feathers removed manually following scalding in hot water. Each bird was dressed and eviscerated as described by Oluyemi and Roberts (1979) for carcass evaluation.

TABLE 1: PERCENT COMPOSITION OF EXPERIMENTAL DIETS

	STARTER DIETS					FINISHER DIETS				
INGREDIENTS (%)	A	B	C	D	E	A	B	C	D	E
Yellow maize	55.20	54.90	54.60	54.30	54.00	60.50	60.20	59.90	59.60	59.30
Soyabean Meal	27.30	27.30	27.30	27.30	27.30	17.00	17.00	17.00	17.00	17.00
Fish Meal	8.00	6.00	4.00	2.00	-	8.00	6.00	4.00	2.00	-
Poultry Visceral Offal Meal	-	2.30	4.60	6.90	9.20	-	2.30	4.60	6.90	9.20
Maize Offal	5.00	5.00	5.00	5.00	5.00	10.00	10.00	10.00	10.00	10.00
Oyster Shell	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Bone Meal	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Salt (NaCl)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Premix[a]	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
	100	100	100	100	100	100	100	100	100	100
Calculated analysis:										
Crude Protein (%)	23.00	23.79	23.75	23.72	23.68	19.91	19.87	19.84	19.80	19.77
Metabolisable Energy (MJ/Kg)	11.70	11.76	11.76	11.76	11.72	12.06	12.06	12.06	12.06	12.06
Crude Fat (%)	3.85	3.88	3.99	4.07	4.15	3.61	4.68	4.76	4.80	4.89
Crude Fibre (%)	3.42	3.43	3.48	3.51	3.55	3.50	3.50	3.50	3.60	3.62
Calcium (%)	1.24	1.28	1.32	1.36	1.39	1.21	1.25	1.40	1.33	1.84
Total Phosphorus (%)	0.84	0.86	0.88	0.89	0.91	0.62	0.59	0.65	0.67	0.69

[a]Contains per kg diet: Vit. A (6,000,000 i.u); Vit D_3 (1,200,000 i.u); Vit. E (6,000 i.u); Vit K (400mg); Vit B_2 (2000mg); Vit B_6 (400mg) Biotin (40mg); Niacin (12,000mg); Pantothenic acid (400mg); Folic acid (400mg); Choline Chloride (160,000mg); Vit C (400mg); Iron (24,000mg); Manganese (12,000mg); Copper (400mg); Zinc (28,000mg); Cobalt (200mg); Iodine (800mg); Selenium (40mg); Antioxidant (2400mg).

Dressed weight and weights of cut-up parts of the carcasses including those of heart and liver were measured and expressed as percentage of live body weight.

Chemical and statistical analysis: Proximate analyses of PVOM and the experimental diets were carried out according to the procedure of AOAC (1990).

Data on live performance and carcass characteristics were subjected to analysis of variance (ANOVA) and treatment means separated by Duncan's Multiple Range Test (Steel and Torrie, 1980).

RESULTS

The results of the chemical analyses of PVOM and experimental diets are presented in Table 2. The crude protein content of PVOM was 56%. Both the starter and finisher diets were isonitrogenous as per calculated and determined values of their crude protein contents. (Table 1)

Data on live performance and carcass parameters are summarised in Table 3. Feed consumption and feed conversion ratio (FCR) were not significantly ($P > 0.05$) affected by the treatment. However, there was significant ($P < 0.05$) effect of the diets on body weight gain during 0 to 8 weeks of age. Birds receiving FM/PVOM - and PVOM-diets (i.e. diets B,C,D and E) had similar ($P > 0.05$) weight gain but they were smaller ($P < 0.05$) than those receiving FM - diet (diet A) which had the highest gain of 1.824 kg in 8 weeks. No mortality was observed in any treatment group throughout the duration of the experiment.

With the exception of the weights of chest, heart and liver, there was no effect ($P > 0.05$) of replacing FM with PVOM on the other carcass parameters measured. The chest weight of the slaughtered birds on diet A was heavier ($P < 0.05$) than those on diet E but not heavier ($P < 0.05$) than those on the rest diets. The highest ($P < 0.05$) heart weight was recorded for the birds on diets C and D whose weights were similar ($P > 0.05$), followed by those on diets B and E whose weights were smaller ($P < 0.05$) than those on diet C. The least heart weight (0.37% of body weight) was obtained for birds on diet A. The liver weight ranged from 1.30% for diet A to 1.81% for diet D. The values of 1.63 and 1.52% for diets B and E respectively were similar ($P > 0.05$) but smaller ($P < 0.05$) than the value of 1.81% for diet D.

DISCUSSION

The crude protein content of 56% obtained for PVOM presently is similar to 56.4% reported by Udedibie *et al* (1988) for poultry offal meal (POM) but less comparable with the value of 59.9% obtained by Nwokoro (1993) for another similar novel protein concentrate called chicken offal meal (COM). The close agreement in the values of crude protein obtained for POM and PVOM is not expected in view of the differences in the composition of the starting raw materials (offals) and processing methods used by the respective authors. As expected, the same reasons might also account for the different crude protein values for COM and PVOM. This is supported by Skurray and Carroll (1978) who observed differences in the chemical composition of hard and soft meat meals produced from hard and soft offals respectively by "dry rendering" method.

Although the determined crude protein contents of the diets varied slightly, the levels of 21.98 to 22.99% in the starter diets and 18.14 to 19.60% in the finisher diets were within the range recommended (Olomu, 1976; Njike and Ndife, 1980) and used by various authors in similar studies. The assumed ME for PVOM (2910 Kcal/kg) is similar to the value (3180 Kcal/kg) calculated for POM by Udedibie *et al* (1988). The calculated ME for the diets (*ca* 12 MJ ME/kg)was also within the range recommended for the broilers in the tropics (Olomu, 1976; Njike and Ndife, 1980).

The uniformity in the feed intake of the birds (Table 3) suggests that the diets had similar calorie contents since birds eat primarily to satisfy their energy requirements (Hill and Dansky, 1954). Data on feed consumption also reveal that at its inclusion levels used in this study, PVOM had no deleterious effect on voluntary feed intake.

TABLE 2: PROXIMATE COMPOSITION OF PVOM AND EXPERIMENTAL DIETS

		STARTER DIETS					FINISHER DIETS				
Fraction (%)	PVOM	A	B	C	D	E	A	B	C	D	E
Crude protein	56.00	22.99	22.99	22.22	21.98	22.18	18.98	18.14	19.60	18.43	19.18
Ether extract	13.50	4.16	6.01	7.86	4.24	4.92	7.79	4.34	4.63	5.91	7.77
Crude Fibre	0.35	6.18	5.66	5.11	6.09	5.09	4.75	4.73	5.28	5.10	5.34
Total Ash	5.11	4.16	6.01	7.86	4.24	4.92	7.96	6.41	7.11	7.03	6.05
Nitrogen-free extract	19.04	56.10	51.80	49.21	56.17	54.42	51.60	57.63	56.78	56.17	55.44
Dry Matter	94.00	93.59	92.27	92.26	92.72	92.43	91.08	91.25	93.40	92.64	93.79

TABLE 3: EFFECTS OF POULTRY VISCERAL OFFAL MEAL AS A REPLACEMENT FOR FISHMEAL ON LIVE PERFORMANCE AND CARCASS CHARACTERISTICS OF BROILER CHICKENS (0-8 WEEKS)

	EXPERIMENTAL DIETS					
PARAMETERS	A	B	C	D	E	±SEM
LIVE PERFORMANCE CHARACTERISTICS:						
Mean initial body weight (g/bird)	40.00	40.00	40.00	40.00	40.00	0.00
Mean body weight gain for 8 wks (kg/bird)	1.824[a]	1.688[b]	1.689[b]	1.676[b]	1.590[b]	0.036
Mean feed intake for 8 wks (kg/bird)	4.031	3.936	3.760	3.870	3.715	0.336
Mean feed conversion ratio	2.326	2.352	2.233	2.326	2.340	0.048
Mortality rate (%)	0.00	0.00	0.00	0.00	0.00	0.00
CARCASS YIELD[1]:						
Dressed weight (Dressing percentage)	67.31	58.24	69.07	65.00	66.00	2.873
WEIGHT OF CUT-UP PARTS[2]:						
Thighs	11.54	10.40	12.65	9.75	10.90	0.910
Drumsticks	9.10	8.60	9.10	8.90	10.30	0.485
Chest	20.80[a]	17.20[ab]	20.60[ab]	20.55[ab]	17.00[b]	0.970
Rack	14.00	13.70	13.60	14.20	15.80	0.950
Wings	8.05	8.16	7.95	8.06	8.33	0.394
ORGAN WEIGHT[3]:						
Heart	0.37[c]	0.45[bc]	0.58[a]	0.56[ab]	0.44[bc]	0.032
Liver	1.30[d]	1.63[b]	1.47[cd]	1.81[a]	1.52[bc]	0.032

a,b,c Means values within row bearing unidentical superscript are significantly ($P<0.05$) different while those with identical or without superscript are not significantly ($P>0.05$) different.

1,2,3 Values expressed as percentage of live body weight.

	EXPERIMENTAL DIETS				
PARAMETERS	A	B	C	D	E

This is in agreement with the earlier observations by Udedibie *et al* (1988) with broiler finishers when POM replaced groundnut cake in their diets. The mean feed intake values of the birds for 8 weeks ranged from 3.715 (for diet E) to 4.031 kg/bird (for diet A) are comparable with the range of values of the earlier workers.

The results of weight gain on the respective diets (Table 3) reveal the superior quality of protein supplied by FM to PVOM in the diets of young fast-growing birds such as broilers. The control diet (containing FM as the sole source of animal protein) supported the best weight gain while those on FM/PVOM - and PVOM - diets had similar but smaller weight gain than those on the control diet. Since substitution of FM with PVOM was effected on an equal protein basis, it implies that the amino acid requirement of the birds was adequately met on the control diet thus corroborating the earlier report of Scott *et al* (1982) on the excellent amino acid profile of FM. However, it is pertinent to reiterate that the earlier report of Salami and Oyewole (1994) indicated that PVOM could be incorporated at 57.5 and 115% of dietary FM (8%) in the starter and finisher diets respectively. Thus, on this premise, the poorer weight gain on the PVOM - substituted diets in this study might have occurred largely during the starter phase. According to Udedibie *et al.* (1988), methionine is slightly deficient in POM, a novel animal protein source similar to PVOM. In this regard, it is reasonable to suppose (in the absence of determined amino acid composition for PVOM) that mild methionine deficiency in PVOM as in COM might be responsible for the poorer weight gain on PVOM - substituted diets. On the other hand, the work reported by Nwokoro (1993) showed that COM and FM supported similar growth responses when they were used as sources of methionine and lysine in plant protein - based diets for cockerels up to 8 weeks of age. This is also an indication that FM protein is not superior to that of COM (which is also similar to PVOM). Nevertheless, the final body weights (obtained as initial body weight plus weight gain for 8 weeks) for birds on all diets in this study are comparable with the values given by Oluyemi and Roberts (1979); among others. However, the values observed herein are slightly lower than those of Pido *et al*, (1979); and Smith, (1990) for birds of similar age to those used in this study.

The similarity in the feed conversion ratios (FCR) recorded for birds on all diets shows that the diets were equally efficient for weight gain in favour of complete substitution of FM with PVOM. The mean values of FCR observed herein (Table 3) agree with those reported by Offiong *et al*, (1982); and Smith, (1990). Values obtained by Pido *et al.* (1979), Udedibie *et al.* (1988) and Adeleye and Odunsi (1990), however, appear slightly poorer than those observed here.

Non-occurence of mortality among the treatment groups might be an indication of the safety of PVOM as a complete substitute for FM (on health ground) in the diets of broiler chickens. This result agrees with the earlier observations (Udedibie *et al*, 1988 and Salami and Oyewole, 1994) when POM and PVOM were used as replacements for groundnut cake and FM respectively in the diets of broilers.

Although birds fed on FM-diet had better ($P<0.05$) weight gain at slaughter time, they yielded similar ($P>0.05$) carcass weight as per dressed weight as those with poorer weight gain fed on PVOM - substituted diets B,C,D and E (Table 3). The results on dressed weight and other carcass parameters except chest, heart and liver weights are in support of complete substitution of FM with PVOM since there was no adverse effect of the latter on these parameters. While the mean values of dressed weight for birds on all diets are in agreement with the range of 59.8 to 62.2% reported by Osei and Twumasi (1989), values reported by some other workers are outside this range. The mean weights of individual cut-up parts observed in this study are comparable with those obtained by Ayorinde (1994) for broilers of about the same age as those used.

Liver weights in the neighbourhood of 2% of body weight were reported by Udedibie *et al.* (1988); and Ayorinde, 1994) while the values in this study are smaller and range from 1.30 (for diet A) to 1.81% (for diet D).

On the basis of the data on feed conversion ratio, dressing percentage and weight of most of the cut-up parts of the carcasses which were similar for all diets and are of paramount economic importance, it is concluded that PVOM could replace FM completely in broiler diets. The use of PVOM as a complete substitute for FM should be strongly encouraged especially where the latter is scarce and expensive. The cost of processing a kilogramme of PVOM has been shown to be lower than the cost of equivalent weight of imported FM (Salami and Oyewole, 1994).

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