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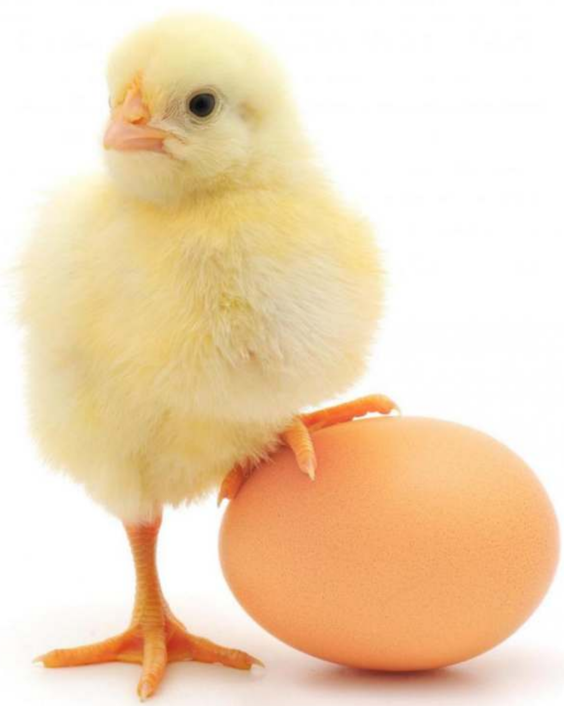

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Evaluation of Sun and Oven-Dried Broiler Offal Meal as Replacement for Fishmeal in Broiler and Layer Rations

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Abstract: Two feeding trails were conducted to determine the replacement value of broiler offal meal for fishmeal, if it is processed by oven-drying in addition to sun-drying. Fishmeal was replaced at the rate of 0%, 50%, and 100% with sun and oven dried offal meal (SOBOM) in broiler and layer diets each. While the broiler rations had 230g/kg crude protein and 2906 Kcal/kg of metabolizable energy, the layer diets had 175g/kg crude protein and 2700 Kcal/kg of metabolizable energy in a completely randomized designed experiment. The three treatments were replicated thrice in experiment I using 315 *Anak* 2000 broiler chicks, while experiment II had 360, 32-week *Lohmann brown* layers. The birds were randomly assigned to three treatments with three replicates in each group. The broiler results showed that, the body weight and feed conversion ratio were significantly ($P<0.05$) superior in birds fed with fishmeal than those on SOBOM diets. However, in the layers; hen-day production, egg-size, shell thickness, feed intake and feed conversion ratio were statistically similar in all groups. The study showed that broiler offal meal was inferior to fishmeal in broiler performance, but was comparable even at 100% replacement level for layers performance.

Key words: Broiler offal, processing, fishmeal, performance, broilers, layers

Introduction

The nutrient requirement for poultry embodies the use of animal protein sources, such as fishmeal which enhances feed quality to ensure optimum production and maximization of profit in the poultry enterprise. However, in most third world countries, including Nigeria such feat may not always be feasible because of the scarcity and high cost of imported feed ingredients such as fishmeal which is the preferred animal protein source for poultry because of the quality and balance of its amino acid profile. The importation of fishmeal to ensure its availability constitutes a drain on these countries foreign exchange reserve. Oluyemi and Roberts (2000) asserted that about 60-70% of the cost of poultry production is attributed to feeds. Further, a critical cost appraisal of poultry feed formulae shows protein, especially protein of animal origin, to be the most expensive per unit cost.

Because of this precarious situation, recycling poultry processing by-products and other livestock processing wastes have been extensively investigated in previous work (Hegedus *et al.,* 1986; Heinz and Sichtling, 1990; Fanimo, 1991 and Isika *et al.*, 2001). Fanimo (1991) and Isika (1995) using simple low cost technologies, processed broiler offal into meal and substituted same for fishmeal in pigs and broiler rations, respectively. These authors made deliberate effort to enhance cost-effectiveness by a combination of frying and sun-drying methods which eliminated the use of expensive dryers and ovens.

The result of the trial indicated that processed broiler offal meal was poorer than using fishmeal as ingredient and tended to worsen with increasing dietary percentage of the processed broiler offal meal. It was suspected that the result obtained reflected the extent to which the ingredient was dried and drained of oils. The latter might have adversely affected the protein-energy balance of the diets, and could be that the ingredient was not sufficiently dried.

The present study was, therefore, designed to determine whether the nutritional potentials of the broiler offal meal could be improved by oven-drying in addition to sun-drying, before using it as a replacement for fishmeal in two different feeding trails with broilers and pullets.

Materials and Methods

The broiler offal used consisted of only intestines from a batch of about 3,500, 9-week old broiler chickens slaughtered in a commercial broiler processing plant. The slaughter and processing method minimized blood and feather contamination of the materials. The offal was cooked and the fat fraction extracted by screw press in addition to oils that drained under heat (Isika *et al.*, 1999). The broiler offal was initially sun-dried SBOM, (Fanimo, 1991) and further oven-dried at $105^{\circ}C$ for 24 hours. The oven drying of the materials was undertaken

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Table 1: Composition and analysis of broiler experimental diets

Ingredient	Level of SOBOM in diets (g/kg) 0%	50%	100%
Maize	465	465	465
Fish meal	30	15	00
SOBOM	00	15	30
Fixed ingredients[a]	505	505	505
Determined nutrient composition (g/kg)			
Crude protein	232	234	230
Ether extract	68	64	60
Crude fiber	56	55	57
Met. Energy[b] (Kcal/kg)	2915	2906	2887
Methionine (% of diet)	0.39	0.36	0.32

[a]Fixed ingredients in each diet (%): Cotton seed cake, 3; Full fat Soya bean meal, 31.5; Wheat offal 12.5; Bone meal, 2; Oyster shell, 1; Mineral/Vitamin premix*, 0.25; Salt 0.25. *Broiler vitamin – mineral premix per kilogramme of diet (Pfizer recommendation). [b]According to NRC (1994)

Table 2: Composition and determined analysis of layer experimental diets

Ingredient	Level of SOBOM in diets (g/kg) 0%	50%	100%
Maize	425	423	421
Fishmeal	30	15	00
SOBOM	00	15	30
Fixed ingredients[a]	544	544	544
Determined nutrient composition (g/kg)			
Crude protein	176	176	176
Ether extract	87	92	91
Crude fiber	57	56	58
Met. energy[b] (kcal/kg)	2706	2691	2665
Methionine (% of diet)	0.48	0.45	0.41
Lysine (% of diet)	1.17	1.13	1.07

[a]Fixed ingredients supplied in the Diet (%): Fullfat soya bean meal, 20; Wheat offal 0.25; Cornbran, 13.15; Bone meal 2.5; Oyster shell, 8; Mineral/Vitamin premix*, 0.3; Salt 0.25. *Layer mineral-vitamin premix per kilogramme of diet (Pfizer recommendation). [b]According to NRC, (1994)

in bits to achieve an effective drying. The dried offal was then hammer milled for mixing with other ingredients in the feed.

Experiment 1: Three isonitrogenous diets were prepared with 231.4g/kg crude proteins and 2915, 2906 and 2887 Kcal/kg metabolizable energy respectively as in Table 1. The sun oven-dried broiler offal meal (SOBOM) replaced 50% of the fishmeal (FM) in diet 2, while it completely replaced FM in diet 3. Diet 1 with 3% FM remained the control diet. Three hundred and fifteen (315) one-week old *Anak 2000* broiler chickens were randomly divided into nine similar groups of thirty-five birds each; three such replicate groups were allotted to each ration in a completely randomized experimental design. The birds were reared on the conventional deep litter system for eight weeks. The vaccinations, antibiotics and routine management practices for broiler in the tropics as outlined by Oluyemi and Roberts (2000) were adopted. Body mass was obtained on weekly basis, and the feed intake recorded every week as the difference between the feed given and the leftover.

Experiment II: Three hundred and sixty (360) 32-week old *Lohmann brown* layers were procured from a commercial farm for the layers study using similar diets as in broiler experiment with the same replacement levels of SOBOM for fishmeal. The crude protein of the diets was 176g/kg with approximately 2700 Kcal/kg of metabolizable energy in each diet. The layers were randomly divided into nine groups of forty birds each. Three groups were assigned to each treatment. The birds were housed in a 2-bird compartment cages, fed the experimental diets, and given water *ad libitum* for eight weeks. The Hen-day production, egg-size, shell thickness, feed intake, feed conversion ratio and mortality records were kept.

Proximate analysis of experimental diets, sun-dried broiler offal meal (SBOM) and SOBOM were carried out using standard methods (AOAC, 1990). The amino acid composition of SOBOM was determined by high performance liquid chromatography (Knaure, Germany) after acid digestion (Nestares *et al.*, 1993). All the data collected were subjected to one-way analysis of variance and significant differences among the treatment means were separated using Duncan multiple range test (Steel and Torrie, 1980).

Results and Discussion

The proximate composition of SBOM and SOBOM on dry matter basis is presented in Table 3. The crude protein and ether extract of the SBOM and SOBOM were 55.5 and 57.6g/kg and 23.4 and 19.2g/kg, respectively which showed an increase in crude protein, but a decrease in the fat content of the sample on oven drying. Table 4 shows the amino acids composition of SBOM and SOBOM.

In the experiment 1 the performance of broiler fed rations in which sun and oven-dried broiler offal meal replaced fishmeal (Table 5) showed that the average final body mass of the broilers was significantly ($P<0.05$) higher in the control diet, while the 100% replacement of fishmeal was significantly ($P<0.05$) the worst. The average weekly mass gain followed the same trend. However, the average weekly feed intake was statistically similar in all the treatments. The feed conversion ratio was significantly ($P<0.05$) superior in the control diet, followed by the 50% FM replaced diet, while the 100% FM replaced diet was significantly ($P<0.05$) the least converted. Mortality did not show any distinct pattern.

The result of the layer experiment is presented in Table 6, which shows the performance of birds fed rations in which SOBOM replaced fishmeal. The result revealed hen-day production, egg-size, shell thickness, feed intake and feed conversion ratio to be statistically

Table 3: Proximate composition of SBOM and SOBOM (DM basis)

Nutrient (%)	SBOMS	OBOM	±SEM
Moisture content	11.30	10.00	1.05
Dry matter	88.60	89.90	4.54
Crude protein	55.50	57.70	3.20
Crude fiber	4.90	4.60	0.90
Extra extract	13.40	19.20	2.60
Ash	11.40	12.10	1.22
N.F.E.	4.80	6.50	1.02

Table 4: Amino acid composition of sun and oven dried broiler offal meal

Amino acids/g/6N	SBOM	SOBOM
Arginine	2.43±0.13	2.56±0.22
Aspartic acid	3.89±0.11	4.26±1.20
Cystine	2.01±0.07	1.97±0.25
Glutamic acid	6.91±1.72	6.79±1.11
Glycine	2.34±0.13	2.64±0.06
Histidine	1.41±0.12	1.51±0.31
Isoleucine	1.92±0.00	1.88±0.02
Leucine	3.63±1.04	3.42±0.87
Lysine	2.23±0.21	2.03±0.04
Methionine	0.61±0.04	0.69±0.21
Phenylalanine	2.39±0.10	2.59±0.18
Serine	1.75±0.03	1.89±1.03
Threonine	1.63±0.28	1.85±0.04
Tryptophan	1.71±0.16	1.85±0.04
Tyrosine	-	-
Valine	2.34±0.14	2.40±0.10

(P>0.05) similar amongst the treatment groups.

The SOBOM proximate result compared with that of the SBOM indicated an apparent increase in percentage crude protein and ash, while a decrease was observed in the percentage crude fat. Whereas further processing in the oven may have increased the Kjedahl nitrogen or crude protein content of the ingredient, the method did not show adverse effect on the other nutrients. AOAC (1990) asserted that there is a direct relationship between moisture content and dry matter, which implies that as the processed samples in the study became more efficiently dried, there was a resultant increase in dry matter especially the crude protein (3.96%) content. Further more the quality of the dietary protein fed prior to slaughtering of the birds may be important, so that, if the offal was collected under high dietary condition, the quality of the gut content could probably increase the crude protein and ash content especially at further oven drying than when sun-drying method alone was used.

The better result obtained from SOBOM diets could be attributed to the different and evidently more efficient drying process adopted in the extraction of the fat fractions. The result is comparable to the work of Reddy (1988) who stated that poultry offal meal contains considerable amount of fat which when thoroughly separated enhances the crude protein content. According to Al-Bustany (1988) and Mohammed *et al.* (1990) poultry by-product (PBP) and poultry offal meal are rich sources of protein and energy, good enough for poultry feeding and that a satisfactory meal can be produced from poultry slaughter house byproducts by standardizing the processing conditions.

Contrary to what might be expected from the improved chemical composition of SOBOM and as in the previous work (Isika, 1995) broilers obtaining animal protein partly from fishmeal tended to grow faster than those deriving it totally from the offal meal. Since the diets were formulated to be isonitrogenous, any defect in meeting the requirement for essential nutrients was to be easily detected, which was the case in the study with broilers, but not layers. The performance of the broilers indicated the offal meal not to be a perfect substitute for the fishmeal, in contrast to the layers which were unaffected by the substitution.

EL-Sherbiny *et al.* (1998) reported that poultry slaughter house by-products and poultry offal meals substitution in broiler ration yielded growth response that compared favorably with the control ration. This however contrasted the findings in the current study which showed that poultry offal meal, though a rich source of nutrients, could not completely replace fishmeal in broiler diets but agreed with some other reports (Anon, 1983 and Mohammed *et al.*, 1990).

Isika (1995) observed that broilers were adversely affected at 100% broiler offal meal substitution, presumably due to the method of drying which probably did not remove all the water and oils thereby decreasing the protein and amino acids content of the diets. In the present study, the improvement in the performance of broilers in respect to the substitution of fishmeal with offal might have arisen from a more efficient drying of the offal involving the use of the oven in addition to sun-drying. This possibly increased the overall nitrogen and amino acid concentration and lowered the fat content of the offal meal.

The slight decrease in the dietary energy, which could be due to a fall in SOBOM crude fat, may not necessarily have much adverse effect, but considered with other factors, the effect may become noticeable. Since the protein content of poultry meat and eggs is comparable in quantity and quality, growth rate and egg production should be affected in the same magnitude by dietary protein (Fileu *et al.*, 1990). Perhaps the amino acids requirement for egg production may be less than that for growth. But the requirement for maintenance and production are greater for the layers, although this is nullified by the greater requirement for movement by broilers maintained on deep litter. The difference in the results obtained for both the broilers and layers could be that broilers being fast growing, have a more fastidious nutritive requirement than layers. The SOBOM diets did not negatively affect the mortality rate in the study.

The nutrients requirement for egg production was observed to be lower (Anonnymous, 1971) than what is available in the SOBOM diets. In this respect, the

Table 5: Performance of broilers on SOBOM diets Level of SOBOM in diets

	Level of SOBOM in diets			
Parameter	0%	50%	100%	±SEM
Avg. initial body mass (g)	84.5[a]	83.9[a]	85.0[a]	9.0
Avg. final mass (g)	2109.0[a]	1769.0[b]	1574.0[c]	13.1
Avg. weekly mass gain (g)	253.1[a]	210.6[b]	186.1[c]	7.4
Avg. weekly feed intake (g)	628.8[a]	624.7[a]	628.0[a]	0.8
Feed conversion ratio	2.48[c]	2.9[b]	3.3[a]	0.1
Mortality (%)	1.9	1.2	2.2	0.0

Means ±SEM in the same row differently superscripted are significantly (P<0.05) different.

Table 6: Performance of layers on SOBOM diets

	Level of SOBOM in diets (%)			
	0%	50%	100%	±SEM
Hen-day (%)	74.0	71.8	72.1	8.3
Egg-size (g)	56.3	57.1	55.8	5.0
Shell thickness (mm)	0.3	0.3	0.3	0.1
Feed intake (g/day/bird)	127.3	126.7	127.0	12.2
Feed conversion ratio	3.2	3.3	3.3	0.2

Means ± SEM in the same row for each parameter were not significantly (P>0.05) different

requirements for methionine and lysine are lower for the layers. The view on the pattern of amino acid requirements in the study supports the assertion (EL-Sherbiny *et al*., 1989) that the varied amino acids in poultry offal meal are sufficiently extensive to be considered in the formulation of poultry rations. It also indicated the advantage of balancing dietary protein based on available amino acids.

Consequently, the requirement of protein and amino acids for production target rather than the effect of drying or SOBOM replacement for fishmeal in poultry rations should be of utmost concern.

Though there was no significant difference in the performance parameters of the layers, hen-day production tended to be apparently higher in the control diet. But provided the SOBOM diets did not significantly depress the measured production parameters and couple with the comparable nutrient content and bioavailability of the offal meal, it is indicative that the ingredient has high nutritional potential, more so when no mortality was recorded. The evidence again, in this work showed that the extent of dryness of broiler offal meal is a decisive factor in its nutritional quality. If drying equipment should be fabricated, it drying effectiveness of the offal would need to be tested (Hen and Parson, 1990).

Conclusion: It is concluded from the study that further oven- drying of broiler offal meal in addition to sun-drying improves the nutritional quality of the ingredient. However, the performance of the broiler chickens indicated that SOBOM was not a perfect substitute for fishmeal, whereas in the case of layers, the ingredient proved satisfactory in meeting nutrient requirements and this is of immense benefit particularly, if it use makes egg production cost effective.

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