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Original article

Replacement value of fishmeal by poultry hatchery wastemeal in the diets of pullet growers and layers

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A B S T R A C T

Fishmeal is one and possibly the major conventional source of protein in poultry feeds in Nigeria. At present the astronomical rise in the prices of this and other conventional ingredients has put enormous pressure on the poultry farmers to look for alternatives. The effect of poultry hatchery waste meal on the replacement of fish meal on equal protein basis of 0,25, 50, 75 and 100% in the diets of 100 Isa brown pullet groves and layers on their performance characteristics and egg characteristics during 14 to 20 weeks was investigated. Five dietary treatments were randomly applied to 10 groups of 10 birds each. Observations were made at four weeks is nitrogenous with 2600kcal/kg/ME and 15% crude protein respectively.

It was observed that replacement of fishmeal (FM) and poultry hatchery waste meal (PHWM) did not produce significant ($p>0.05$) effect on the performance characteristics. Significant differences ($p<0.05$) was obtained for birds on treatments 1, II and III to that of birds on treatments IV and V during 5th periods. There were also significant difference ($p<0.05$) between treatments during the 4th and 5th periods. Poorer values were obtained for food than the values obtained during the 1st period. Mean daily egg yield also show a significant difference ($p<0.05$) in the egg yield produced by birds on diets I and V for the 5th periods. Egg quality characteristics show a similarity ($p>0.05$) during 3rd, 4th and 5th period except for eggs length and egg volume showing significant differences ($p<0.05$) between diets I and IV. It is therefore recommended that PHWM could replace FM completely in layers diet without any adverse effect on the performance characteristics.

1. Introduction

The most critical threat to the survival of the Nigerian livestock industry today is lack of relatively cheap feed. The expansion of this industry has however been hampered by many constraints among which are the high cost of conventional ingredients, ban on importation of conventional feed ingredients such as fishmeal, maize, groundnut cake, soybean, fluctuation in the supply of good quality feeds, high cost of finished feeds which has caused tremendous economic losses in commercial poultry production.

Scarcity of animal feed stuffs has ostensibly assumed an emergency state in Nigeria and conceivable for other less developed countries. In fact, this singular problem is conspicuously responsible for the widening animal protein intake shortage in these countries because animal products are produced at costs out of reach of the populace. Invariably, the negative feed balance sheet has resulted into food and nutrition crises not only in our livestock but also in human beings (Aderemi *et al*., 2006). However, Poultry farmers are faced with the problem of increasing cost of feeding especially in the developing countries such as Nigeria. This is largely attributed to the global inflation which is biting harder and also the current economic meltdown, coupled with the fact that some of these conventional ingredients are imported into the developing countries (Alaba, 1993). Recently, prices of feed ingredients have jumped so much that poultry producers in Nigeria are focusing on unconventional alternatives to conventional ones like fishmeal, soybean, maize and other possible ingredients to meet reduced cost of production. The poultry industry accounts for about 90% of the total commercial foods produced in Nigeria compared with pigs (3%), cattle, sheep and goats (3%), fish (2%) and rabbits (1%) (FDL, 2005). Fishmeal is one and possibly the major conventional sources of protein in poultry feeds in Nigeria. At present, the astronomical rise in the prices of this and other conventional ingredients has put enormous pressure on the poultry farmers to look for alternatives (Iyayi, 2008). Alternatives to fishmeal that have been investigated include maggot meal, shrimp waste meal, blood meal, hydrolyzed feather meal, hatchery by-product, poultry processing by –product meal and abattoir wastes (Iyayi, 2008). Unconventional feedstuffs are feed items which are not normally the first choice materials for the supply of respective nutrients when formulating livestock rations. Most often they can be whole products, part of a product or by-products of processing industry. They are of both plant and animal origins. Unconventional feedstuffs are lower in prices but their nutritional contents need to be improved before they can be considered as adequate for use in ration formulation. Their availability and prices are more stable than the conventional ones whose supply and prices are often sporadic. Because they are of low nutritional quality requiring additional cost of improvement through further processing, their level of inclusion is usually not as high as that of the conventional ingredients. While some can totally replace the conventional counterparts most others are used to supplement or replace part of the conventional ones. (Iyayi, 2008). Poultry hatchery waste meal (PHWM) (the test ingredient) is a by-product of the poultry hatchery plant. It is composed mainly of embryo, dead-in-shell and egg shell which are either allowed to rot or set on fire. It could constitute a nuisance to the environment if improperly disposed. The aim of this study, therefore, was to evaluate the effect of replacing fishmeal with poultry hatchery waste meal in the diets of pullet growers and layers.

2. Materials and methods

2.1. Preparation of the Test Ingredients

Poultry hatchery waste meal (PHWM) (the test ingredient) was collected in batches from the hatchery section of a reputable farm in Oyo State, Nigeria. It was processed locally into poultry hatchery waste meal (PHWM) in this procedure:

Raw poultry hatchery waste was soaked in boiled water at 100 °C boiling point in which the volume of water was twice that of the poultry hatchery waste. It was then allowed to cool down naturally for 12-14hours. This was done to kill the bacteria in the raw material prior to crushing. The material was carefully removed from the drum (used for soaking) into a basket to allow drainage for 10-15 minutes and later crushed in a locally made wooden mortar. This was to ensure quick and uniform drying of the waste material (PHW). The PHW was thereafter spread thinly on trays drying in a forced drought oven at 60^0C for 24 hrs. Some contaminants that were present in the PHW such as feather and stones were handpicked followed by hammer-milling and sieved to obtain PHWM. One hundred Isa Brown layers aged 14 weeks in a randomized complete block design experiment were divided into ten groups of similar initial body weight and raised in a two-tier battery cages. The ten birds per replicate treatment were randomly accommodated in twos in the five adjacent compartments so that they could eat from the same dietary treatment. Five diets were formulated so that PHWM replaced 0, 25, 50, 75 and 100% Danish fish meal in diets I, II, III, IV and V on equal protein basis respectively (Table 1) and were randomly applied to replicates of each treatment. Diets I and IV has varying levels of Danish fish meal inclusion in the diets while diets V was without fish meal inclusion having the highest inclusion level of poultry hatchery waste meal above other diets. The diets were isocaloric and isonitrogenous with 2600kcal/kg ME and 15% crude protein respectively. Routine management was carried out. Feed and water were provided *ad-libitum*. The birds were vaccinated before the commencement of the experiment against Newcastle, Gumboro and fowl pox. Anti-stress drug was also administered occasionally. Parameters measured were body weight, daily feed intake, feed conversion efficiency, daily feed intake and daily egg yield. Body weight and feed intake were measured for five periods while feed conversion efficiency was measured for periods 1 and 2. Initial body weight and body at the end of each period were measured. Mean daily egg yield was measured for periods 3, 4 and 5 and it is obtained as the total eggs laid per replicate for each period divided by 28 days. Egg mass ratio for periods 3, 4 and 5 was obtained by dividing mean daily feed intake by mean egg weight for each replicate. Also, quality characteristics of eggs laid by layers receiving various levels of poultry hatchery waste meal were measured. Egg quality characteristics measured are weight, volume width, length, shell weight and shell thickness.

Table 1
Composition of experimental diets with different levels of poultry hatchery waste meal.

Ingredients	**Diets**				
	I	**II**	**III**	**IV**	**V**
Maize	34.00	34.00	34.00	34.00	34.00
Maize offals	40.00	39.64	39.28	39.92	38.56
Groundnut cake	8.00	8.00	8.00	8.00	8.00
Fish meal	8.00	4.00	4.00	2.00	-
Poultry hatchery waste meal	-	4.72	4.72	7.08	9.44
Bone meal	2.50	2.50	2.50	2.50	2.50
Oystershell	7.00	7.50	7.00	7.00	7.00
Salt	0.250	0.250	0.250	0.250	0.250
Premix	0.250	0.250	0.250	0.250	0.250
Total	100.00	100.00	100.00	100.00	100.00
Calculated Proximate Analysis[2]					
Energy (Kcal/kg)	2607.56	2608.86	2610.15	2611.45	2612.74
Metabolizable Energy (MJ/kg)	10.86	10.87	10.88	10.88	10.89
Crude protein (%)	16.26	16.45	16.65	16.84	17.04
Ether Extract (%)	3.32	4.28	5.24	6.21	7.17
Crude Fibre (%)	5.96	6.14	6.30	6.48	6.65
Lysine (%)	0.68	1.64	2.61	3.59	4.56
Methionine (%)	0.31	0.70	1.12	1.54	1.93
Calcium (%)	0.52	1.83	3.14	4.47	5.79
Phosphorus (%)	0.33	0.98	1.63	2.27	2.92

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

2.2. Chemical analysis

The test ingredient: PHWM was analysed for proximate composition (AOAC) of 1984.

2.3. Statistical analysis

Data generated were subjected to analysis of variance (ANOVA) while treatment means were separated by Duncan's Multiple Range Test (SAS, 1999).

3. Results

Results on performance characteristics of layers and quality characteristics of eggs laid by layers receiving various levels of poultry hatchery waste meal are presented in Tables 2 and 3. Treatment effects were not significant (p>0.05) on mean body weight, feed intake, feed conversion efficiency, feed intake: eggs mass ratio and daily yield for the respective periods. The birds had similar growth rate on the treatment diets until the 5th period when the birds on diets I, II and III had better growth rate (p<0.05) than those on diets IV and V. Feed intake of the birds was also generally similar (p>0.05). Apparent differences were significant (p<0.05) during 4th and 5th periods (Table 2). The feed conversion efficiency on all treatments were similar (p>0.05) and the values obtained during the 2nd period were poorer (p<0.05) than the values obtained during the 1st period (Table 2). Values of the mean feed intake: egg mass ratio, were similar (p<0.05) for all 3rd and 5th periods, except (p<0.05) for the 4th period. The mean daily egg yield per 10 birds were similar (p>0.05) for all treatments during the 3rd and 5th periods. Egg yield produced by birds on diets I and V for the 5th period were significant (p<0.05). Treatment had no significant effect (p>0.05) on egg weight, egg shell weight, egg length, egg volume, egg width and egg shell thickness. There was similarity (p>0.05) in the values obtained for egg quality characteristics during periods 3, 4 and 5 except for egg length and egg volume at the 3rd period in which significant difference (p<0.05) existed between birds on diets I and V (Table 3).

4. Discussion

The results obtained herein show that the replacement of fish meal with poultry hatchery waste meal had no significant (p>0.05) effect on the life performance characteristics and quality of birds on the treatment groups and for the five periods. Meaning that the quality of PHWM used in this study is not inferior to that of imported fish meal. Hence, PHWM can be used to replace fish meal completely in pullet growers and layers diets without adverse effect on performance and egg quality characteristics since it is perceived to be cheaper than imported fish meal. This result is in agreement with such publication (Nane and Wisman, 1964) in which inclusion of 15% hatchery by-product meal in laying hen ration did not affect the performance characteristics such as body weight, daily feed intake, feed conversion efficiency and daily egg yield. It is also in agreement with the observation of Vander populiere (1977) where hatchery by-product meal was incorporated at 16% dietary level in place of soybean meal or meat meal to layers. The egg weight, egg length, egg volume and egg width increased with the age of birds and these results are in agreement with the observation of Adegbola and Olatoke (1988). There was similarity (p>0.05) in the values obtained up to the 5th period except for egg length and egg volume during the 3rd period which was significantly (p<0.05) different (Table 3).The egg length of birds on diets 1-3 (5.59cm) were similar but significantly (p<0.05) higher than those on diets 4 and 5 (5.46-5.49cm).

5. Conclusion

Hence, PHWM can be used to replace fish meal completely in pullet growers and layers diets without adverse effect on performance and egg quality characteristics especially since it is found to be cheaper than imported fish meal.

Table 2
Performance characteristics of layers fed diets with different levels of poultry hatchery waste meal.

Parameters	Period	Diets					
		I	II	III	IV	V	SEM
Mean body Weight(kg)	Initial (14weeks of age)	0.845	0.835	0.843	0.848	0.845	0.07
	1st (14-18)	1.34	1.39	1.39	1.32	1.19	0.00
	2nd (18-22)	1.63	1.66	1.65	1.61	1.43	0.00
	3rd (22-26)	1.86	1.81	1.85	1.62	1.64	0.00
	4th (26-30)	1.76	1.75	1.71	1.56	1.58	0.00
	5th (30-34)	1.74^{a}	1.66^{ab}	1.65^{ab}	1.52^{b}	1.55^{b}	0.00
Mean daily feed intake (g):	1st	88.12	87.02	85.34	86.52	80.09	1.25
	2nd	95.68	97.59	97.01	99.11	93.57	2.60
	3rd	94.87	97.14	99.07	89.91	92.67	3.59
	4th	103.13^{a}	87.23^{ab}	92.06^{a}	77.59^{b}	68.13^{c}	3.41
	5th	90.36^{a}	90.63^{a}	92.68^{a}	84.73^{b}	79.65^{c}	1.00
a) Mean feed conversion efficiency	1st	5.04^{b}	4.40^{b}	4.38^{b}	5.20^{b}	6.48^{a}	0.29
b) Mean daily feed intake	2nd	9.37^{c}	11.26^{b}	10.99^{b}	12.96^{a}	12.35^{a}	11.32
	3rd	1.72	1.80	1.89	1.76	1.81	0.10
	4th	1.80^{a}	1.53^{c}	1.67^{b}	1.42^{c}	1.27^{d}	0.00
	5th	1.58^{a}	1.62^{a}	1.59^{a}	1.52^{a}	1.39^{b}	0.02
Mean daily egg yield	3rd	3.61	4.49	4.23	4.80	2.93	0.80
	4th	7.60^{a}	6.30^{a}	6.48^{a}	4.55^{b}	3.39^{c}	0.34
	5th	6.07	6.25	5.69	4.96	4.95	0.69

^{abcd}Means with unidentical superscript are significant ($p<0.05$) while those without superscript are not significant ($p>0.05$).

Table 3
Egg quality characteristics of layers fed diets with different levels of poultry hatchery waste meal.

		Diets					
Parameters	**Period**	**I**	**II**	**III**	**IV**	**V**	**SEM**
Mean Egg Weight(kg)	Initial (22weeks of age)	47.91	49.14	47.35	46.39	45.90	1.67
	End of 3rd period (22-26)	55.28	53.89	52.65	51.16	51.46	1.33
	4th (26-30)	57.40	56.96	55.25	54.86	53.76	1.76
	5th (30-34)	57.42	56.09	58.30	55.74	57.36	0.89
Mean egg shell weight(g):	Initial	3.68[b]	4.29[a]	4.38[a]	480[a]	4.30[a]	0.14
	3rd	5.41	5.64	5.67	5.61	5.09	0.12
	4th	5.07	5.24	5.46	4.98	4.58	0.26
	5th	5.06	4.78	5.39	5.00	4.85	0.22
Mean egg length (cm)	Initial	5.41	5.46	5.34	5.25	5.34	0.00
	3rd	5.59[a]	5.59[a]	5.59[a]	5.46[c]	5.49[b]	0.02
	4th	5.61	5.57	5.67	5.49	5.44	0.12
	5th	5.68	5.69	5.75	5.63	5.57	0.00
Mean egg volume (ml)	Initial	45.17	46.45	41.35	42.67	43.34	1.76
	3rd	54.97[a]	48.90[ab]	48.37[ab]	47.20[b]	49.04[ab]	1.68
	4th	57.14	55.80	53.74	54.94	53.30	1.24
	5th	55.06	54.24	56.04	54.30	55.30	0.80
Mean egg width (ml) Per 10 birds)	Initial	3.99	4.03	3.77	3.95	3.91	0.07
	3rd	4.33	4.29	4.35	4.39	4.23	0.10
	4th	4.19	4.17	4.12	4.11	4.18	0.03
	5th	4.24	4.17	4.18	4.16	4.25	0.03
Mean egg shell thickness (mm)	Initial	0.29	0.30	0.32	0.33	0.35	0.00
	3rd	0.32	0.35	0.332	0.32	0.29	0.02
	4th	0.31	0.32	0.33	0.33	0.29	0.02
	5th	0.34	0.33	0.32	0.32	0.33	0.00

[abc]Means with unidentical superscript are significantly different ($p<0.05$) Mean without superscript are not significant ($p>0.05$).

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