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RESEARCH ARTICLE

Assessment of Some Performance and Egg Quality Characteristics in Lohmann Brown Layers Fed Diets with Varying Levels of Palm Kernel Oil Residue (PKOR)

Yangtul, T., Odoi, F. N. A., Adam, I. and Gyamera, E.

Animal Science Department, School of Agriculture, University of Cape Coast, Cape Coast, Ghana

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Abstract

The cost of producing eggs, a cheap source of good quality protein, is to a large extent dependent on availability of feed ingredients. An experiment was carried out to investigate the effects of including feeding graded levels of palm kernel oil residue in rations on some the performance traits and egg characteristics in layers. Ninety-six (96) Lohmann Brown layers at 32 weeks old were fed experimental layer diets, in which PKOR was used to replace wheat bran at levels of 0% (control), 5%, 10% and 15% to give four dietary treatments, in a completely randomized design feeding trial that lasted for 19 weeks. The experimental layers were housed in an open-sided deep litter pen with bird density of $0.35m^2$/bird All birds were fed diets containing 17% crude protein and 2800 kcal/kg ME during the entire laying period. Data was collected on egg production, feed intake, egg weight egg shell thickness and albumen height. Results obtained showed significant differences ($P<0.05$) in hen day egg production, feed intake and feed conversion with birds on the 5% and 10% PKOR based-diets producing significantly more ($P<0.05$) eggs and being more efficient in converting feed to egg production. There were however no significant differences ($P>0.05$) in internal egg quality characteristics like albumen height and Haugh units. Egg weight and egg shell thickness were also significantly ($P<0.05$) affected by the dietary treatments. Replacing wheat bran with PKOR up to 10% led to reduced cost of producing eggs without negatively affecting egg production levels and egg quality characteristics. Layer birds could therefore be fed on rations in which bran is replaced by up to 10% PKOR.

Introduction

According to Ojo (2000) and Okeke (2000) poultry provides an excellent source of protein. This is especially so for poor rural communities as poultry rearing requires relatively little capital, labour and land. Other attributes that give poultry an advantage over other livestock include: poultry birds being good converters of feed into useable protein in the form of meat and eggs, production cost per unit is lower, returns on investment is higher, poultry has a shorter production cycle, and eggs are more affordable in developing countries than other sources of animal protein.

In Ghana, poultry farmers usually face periodic shortages of feed items, particularly, cereals, fishmeal and wheat bran. This, coupled with the high cost of these feed ingredients, makes the supply of chicken meat and eggs very erratic and expensive (Okai *et al*., 1994). This has worsened the low animal protein intake by Ghanaians who on the average are only able to afford 46.8g of the 70.0g recommended daily adult intake (FAO, 1998). To curb this trend, more readily available and cheaper local feedstuffs as must be considered partial or complete replacement for conventional feedstuffs such as maize, fish meal and wheat bran in poultry diets. This will reduce pressure from other competing uses on these feedstuffs, reduce their cost and increase their availability to humans (Onwudike, 1986).

While the lack of reliable, adequate and low cost feed resources imposes a major technical bottleneck on increasing poultry production in Ghana, considerable quantities of agricultural by-products exist locally, particularly oil seed cakes which are presently under utilized. These constitute important sources of high-energy and high-protein that can make substantial contributions to improving animal nutrition (FAO, 1990); Palm kernel oil residue (PKOR) which is a by-product of the African palm oil industry is one typical example. This by-product is readily available, cheap and hence can potentially be incorporated in chicken diets (Perez *et al*., 2000). Several studies have been carried out on palm kernel meal (Perez *et al*., 2000) and other variants which have shown positive results. In the light of the above, the study sought to determine the suitability, as well as optimum level of inclusion of PKOR in layer diets, that will help reduce production cost (especially cost of feed) without negatively affecting egg production and quality.

MATERIALS AND METHODS

Randomly selected ninety-six (96) Lohmann Brown layers aged thirty-two weeks with a mean initial body weight of 1674.8$\pm$4.3g were used for the study at the Teaching and Research Farm of the School of Agriculture, University of Cape Coast, and Cape Coast, Ghana between 15th of November, 2008 to 6th March 2009 and 1st October, to 2nd December, 2009 (19 weeks in all). The experimental site is located in the south-western part of Ghana, with annual temperature range of 24^0C and 34^0C, and relative humidity of between 50% and 85%. The area has a bi-modal rainfall pattern, averaging annually 800mm to 1500mm. The major season spans from April to July and the minor, September to November. The experimental layers were housed in an open-sided deep litter pens at 0.35m^2/bird. The birds were randomly allocated to four (4) dietary treatments with four (4) replicates of 6 birds in each replicate group. The birds were fed diets containing an average of 17% crude protein and 2875kcal/kg ME. The four diets were formulated by replacing wheat bran with PKOR at 0 (control), 5, 10 and 15% levels. The diets were designated as 1, 2, 3 and 4 respectively. The composition of the diets is presented in Table 1. Feed and water were provided *ad libitum.* Birds were fed two times daily at 8.00am and 2.00pm; eggs were collected twice daily and weighed after the second collection. Egg quality characteristics were assessed by weighing eggs, measuring albumen height, shell thickness and Haugh unit. Feed intake was assessed every morning by difference, i. e. feed offered the previous day less left over the following morning.

Data Analysis

Body weight, hen day production, FCR, feed intake, egg weight, albumen height, shell thickness, etc. were subjected to one-way analysis of variance (ANOVA) with dietary treatment effects using the general linear model of the GenStat Discovery Edition. Where statistical differences in means existed, these were separated using the least significant difference test at 5% probability level.

Table 1: Composition of the experimental diets

	Level of Palm Kernel Oil Residue (PKOR) inclusion			
Ingredients	0% PKOR	5% PKOR	10% PKOR	15% PKOR
Maize	50 .0	50.0	50.0	50.0
Wheat bran	23.7	18.7	13.7	8.7
Fish meal	18.0	18.0	18.0	18.0
PKOR	0.0	5.0	10.0	15.0
Oyster shell	7.6	7.6	7.6	7.6
Vit/mineral premix	0.3	0.3	0.3	0.3
Common salt	0.4	0.4	0.4	0.4
Total	100.0	100.0	100.0	100.0
Calculated analysis				
Crude protein (%)	17.24	17.41	17.56	17.72
ME (kcal/kg)	2875	2875	2875	2875
Crude fibre	3.0	3.5	4.2	6.2

[1]Analysis of palm kernel meal (as-fed basis): dry matter, 92.5%; crude protein, 20.15%; ether extract, 13.39%; ash, 3.52%; and crude fiber, 16.23% (all analyzed at the Animal Nutrition Laboratory, University of Cape Coast, Cape Coast, Ghana); [2]The vitamin and mineral premix provide the following quantities per kilogram of diet: vitamin A, 5,500 IU (all-trans-retinal); cholecalciferol, 1,100 IU; vitamin E, 11 IU (dl-α-tocopheryl); vitamin K3, 1.5 mg; riboflavin, 9.0 mg; niacin, 26 mg; D-calcium pantothenic acid, 12 mg; choline chloride, 220 mg; vitamin B12 , 0.01 mg; folic acid,1.5 mg; manganese, 55 mg; zinc, 50 mg; iron, 30 mg; copper, 5 mg; iodine, 1.5 mg; selenium, 0.1 mg; and antioxidant, 125 mg.

Table 2: The effect of feeding varying levels of PKOR on the performance of layers

	Level of palm kernel oil residue (PKOR) in diet				
Parameters	1 (0%)	2 (5%)	3 (10%)	4 (15%)	SEM
Feed intake /bird/d (g)	117.7^{a}	116.7^{b}	116.3^{b}	116.1^{b}	0.30
FCR	2.6^{b}	2.5^{c}	2.5^{c}	2.7^{a}	0.05
Hen-day prod (%)	83.4^{a}	85.4^{a}	84.0^{a}	79.7^{b}	0.95
Total feed cost/bird (GH¢)	5.0^{a}	4.9^{b}	4.8^{c}	4.7^{d}	0.01
Total revenue/bird (GH¢)	10.8^{b}	11.0^{a}	10.8^{b}	10.3^{c}	0.12
Net revenue/bird (GH¢)	5.8^{b}	6.1^{a}	6.0^{a}	5.6^{c}	0.12
Cost-Benefit ratio	0.5^{a}	0.5^{a}	0.4^{b}	0.5^{a}	0.02
Egg weight (g)	57.5^{b}	57.7^{b}	57.8^{b}	59.9^{a}	0.26
Shell thickness (mm)	0.4^{a}	0.3^{b}	0.3^{b}	0.3^{b}	0.01
Albumen height (mm)	9.8	10.1	9.8	10.4	0.21
Haugh Units	90.5	90.3	90.3	90.5	0.93

Means within a row having common superscripts are not significantly different (P>0.05). FC = feed cost, S.E.M. = standard error of means.

RESULTS AND DISCUSSION

According to Perez *et al*. (2000), crop by-products obtained from various methods of processing may vary widely in their nutritional composition. In this particular case, the nutritional composition of PKOR varied compared with other palm kernel by-products reported from previous studies. Dietary crude protein and crude fibre levels in PKOR from this study, 20.15% and 16.23% respectively varied slightly from the levels of 18.94% and 18.30% respectively previously reported by Odoi *et al*. (2007). As well, similar variations were noted with regard to ether extract, ash and dry matter as would be expected when working with by-products of such origin. Feed intake and percent hen-day production were significantly (P<0.05) influenced by the addition of PKOR. There was a significantly (P<0.05) higher feed intake by birds on the control diet (0% PKOR diet), but birds fed on the 3 PKOR-based diets recorded similar feed intakes. Percent hen-day egg productions, except at the 15% inclusion level, were similar; egg production decreased at 15% inclusion level (Table 2). This agrees with the findings of Perez *et al*. (2000) who also reported a significant decrease in egg production with increasing levels of palm kernel meal. Dietary crude fibre content increased markedly with increasing levels of palm kernel oil residue (Table 1). This might account for the observed changes but this needs further study. For example, The significantly (P<0.05) lower percent hen-day egg production for the 15% level of inclusion might be attributed to the higher CF content of the diet which rendered birds unable to efficiently utilize feed for egg production. This is supported by observations of Connel (1981), Parson *et al*. (1993), Perez *et al*. (2000) and Hishamuddin (2001) that higher dietary fibre in feed reduces digestibility of feed in monogastrics, increases flow rate of feed through the gastro-intestinal tract (GIT) resulting in lowering of actual metabolizable energy (ME) of diet, as well as provoking increased sloughing of intestinal epithelial cells leading to losses of endogenous amino acids. The end result is that feed is inefficiently utilized for body metabolic functions; thus negatively influencing performance of laying hens. Observations by Deaton *et al*. (1977), Yeong *et al*. (1981), Onwudike (1988), Radim *et al*. (1999), Perez *et al*. (2000) and Chong *et al*. (2008) show however that inclusion levels of palm kernel by-products below 25% in layer rations were unlikely to adversely affect laying performance of hens.

Egg weights were significantly (P<0.05) influenced by the dietary treatments, with birds on diets containing 15% PKOR laying significantly bigger eggs compared to those on diets with lower levels of PKOR inclusion. This phenomenon could be attributed to the high oil content (6.04%) or the higher energy level in the diet with the 15% level of inclusion (Table 2). This argument is supported by Whitehead (1981), Freeman (1984), Griffin *et al*. (1984), Grobas *et al*. (2001), Senköylü *et al*. (2004) and Bohnzack *et al*. (2007) that diets containing unsaturated fatty acids (which are more easily absorbed into the portal blood) may supply a readily available source of lipid for direct deposition in egg yolk which may help to increase egg weight; or on the other hand, increased energy intake through oil addition rather than the increased oil content of the diet could increase egg weight. The observations by these authors are further buttressed by the fact that residual oil in PKOR also contains unsaturated fatty acids (Wardlaw, 1991) could easily be absorbed into egg yolk, leading to heavier eggs.

The birds on the PKOR-based diets laid eggs with significantly (P<0.05) thinner shells than their counterparts on the control diet. This is consistent with results of Yeon *et al.* (1981) that egg shell thickness seems to be influenced by the inclusion of palm kernel meal in the diet of laying hens because shell thickness appeared to reduce with higher inclusion levels of PKOR in the diet. Values obtained by Dairo *et al*. (2007) showed a similar pattern to egg shell thickness values in this work. This could be due to the higher CF content of the PKOR-based diets which causes faster feed passage through the GIT of birds leading to insufficient absorption of calcium for thicker egg shell formation. This implies that inclusion of PKOR may interfere with the rate of calcium deposition to form egg shell. Egg shell thickness, particularly eggs from PKOR-based diets, showed a tendency to reduce with increasing size of the egg. As indicated by Butcher and Miles (2003) this is because the same amount of calcium is spread over the egg whether large or small; implying that smaller eggs are usually thicker than bigger ones. Nevertheless, eggshell thickness recorded for eggs from the PKOR-based dietary treatments in this study were within the recommended range of 0.25mm and 0.35mm (Smithy, 2001).

Internal egg quality characteristics, such as albumen height and Haugh Unit –accepted research and commercial standards for measuring egg quality (Haugh, 1939), were not affected by the different dietary treatments. The Haugh Unit values obtained were within the recommended range (70% or higher) of high quality eggs (FAO, 1990), an indication that the inclusion of PKOR did not have any detrimental effects on the quality of eggs laid.

Feed cost was significantly (P<0.05) reduced with increasing levels of inclusion of PKOR (Table 2); with the control diet being the most expensive. The results also show that the 5% level of PKOR inclusion yielded the highest total value for eggs (GH¢11.0) and net revenue of GH¢6.1 per bird (Table 2). The cost–benefit (i. e. cost of producing eggs against revenue, calculated as total cost of feed per bird divided by total revenue per bird) analysis presented show that PKOR-based diets were cheaper to use in layer rations than the conventional wheat bran based feed. This confirms the observation by Perez *et al*. (2000) that the use of palm-kernel by-product reduced cost of feed and hence cost of production.

CONCLUSIONS

From the results obtained, it could be concluded that PKOR could be a suitable substitute for wheat bran at an optimum level of probably up to 10%; and it could be used in animal feeds, particularly poultry, to help reduce the periodic problem of unavailability of wheat bran in Ghana which tends to create panic among farmers. In this study, the equally good egg production levels by birds fed the PKOR-based rations (i.e. wheat bran replaced with PKOR) suggest that PKOR could substitute for wheat bran in times of shortage. Its nutrient composition is better, compared with that of wheat bran and substituting it for wheat bran, up to the 10% level in layer rations, will yield positive performance for layer hens without any adverse effect on egg production and egg quality.

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