PERFORMANCE AND EGG QUALITY TRAITS OF EGG-TYPE CHICKENS FED COTTONSEED CAKE BASED DIETS

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ABSTRACT

The study evaluated the performance of egg type chickens fed diets where Cottonseed cake (CSC) replaced Soybean cake (SBC) in five experimental rations such that 0% (control), 15%, 30%, 45% and 60% of CSC replaced SBC. The design of the experiment was completely randomized design (CRD). Chemical analysis was carried out to determine the crude protein (CP) and gossypol contents of CSC. Seventy-five 23 week - old egg type chicken were fed with experimental layer diets for 12 weeks. Parameters evaluated include hen-day production (HDP), Feed conversion ratio (FCR), egg weight (EW) and haugh units (HU). All data were analyzed using descriptive statistics and analysis of variance. The determined CP of CSC was 35.11% and its gossypol content was 570g/ton. FCR ranged from 1.6 to 4.9, HDP from 47% to 68%, EW from 47.5 to 62.8 g, and HU from 3.1 to 6.7. Chickens on 60% CSC replacement for SBC had higher values for the parameters measured which were not significantly different from the control. CSC can replace up to 60% SBC without adverse effects on performance and egg quality characteristics of egg type birds.

Key words: Cottonseed cake, Egg quality, Egg type Chicken, Performance

INTRODUCTION

In poultry production, diets are formulated to supply the nutrients needed by chickens to grow and lay eggs. These diets are composed of ingredients whose components can be digested and absorbed by chickens (Adeyemo, 2010).Oilseed cakes have been reported to represent potential sources of protein and energy in poultry feeding. However, the cost of finished feeds containing the well-known cakes like soyabean cake and groundnut cake has become prohibitive because of competition for the oilseeds by man. Therefore, it became necessary to find suitable plant protein alternatives less competed for by man. Cottonseed cake comes in as a useful alternative because of its relatively high crude protein content, cheapness and ready availability. Cottonseed cake has not been extensively used in diets of egg-type chickens because of its potential deleterious effect on egg quality. Reid *et al.* (1987) reported that the presence of gossypol in CSC fed to layers resulted in egg yolk dis-colouration during storage.

Feeding trials on the use of CSC in chicken diets shows that it is necessary to reduce the content of gossypol to fairly low levels in order to avoid the unfavourable physiological effect of this anti-nutrient (National Animal Production Research Institute Report, 1984). Secondly, the protein quality of CSC is usually lowered because of the heat processing methods which reduce lysine availability, especially in the presence of free gossypol which causes the formation of a protein-complex limiting the digestion of protein.

This study was designed to provide further information on the utilization of CSC in egg type chickens when incorporated as a substitute for soybean cake in layer diets. Effect on performance and egg quality were evaluated.

MATERIALS AND METHODS

Experimental diets and birds: A total of 75 exotic ISA Brown adult egg-type chickens of 23 weeks of age were randomly allotted to five dietary treatments each group having 15 layers. The experiment lasted 12 weeks. Cottonseed cake (CSC) was incorporated at 0.0, 4.53, 9.10, 13.60 and 18.13% into a basal diet which served as control which represented 0, 15, 30, 45 and 60%replacement of SBC with CSC respectively. The five diets were formulated to provide approximately 2.60 kcal ME.

Performance characteristics: Weekly records of feed intake were taken from which, the average weekly feed intake was determined. The number of eggs laid per day by the birds was taken hence, the average hen-day production was determined. The weight of the eggs for each group was taken using a sensitive digital top loading balance. Feed conversion ratio was calculated using the formula:

Feed Conversion Ratio = Average Feed Intake / Average Egg weight

Physical characteristics of eggs: Egg Shape Index was calculated by finding the ratio of width to the length of eggs. The egg width and length were measured using a vernier caliper. Yolk index was calculated by dividing the yolk height by the yolk width; both were measured with the vernier caliper. Shell thickness was calculated by getting

RESULTS

The determined proximate composition of the diets fed in the trial is presented in Table 2.

Nutrient composition: The determined crude protein ranged between 16.73% (diet 5) and 17.61% (diet 3). Crude fibre increased from 6.00% (diet 1) to 9.00% (diet 5), ether extract also increased from 0.50% (diet 1) to 5.00% (diet 5). Ash values also increased from 8.00% (diets1 and 3) to 10% (diet 4).

Performance characteristics of layers fed CSC based diets:

There were no significant differences (P>0.05) in the feed intake of layers fed CSC based diets. The feed intake increased from 138g/day/bird fed diet 1 (control) to 148g/day/bird fed diet 5 (Table 3). The Feed Conversion Ratio did not follow any trend. Diet 2 had the best FCR of 2.46, even though this was not significantly different from diet 1 (control) with 2.56 or diet 5 with 2.63. Table 3 shows the values obtained for the live weight changes of layers fed CSC based diets. Birds in diet 4 had the highest increase in weight gain of 170 g gain while the least value came from diet 1 (control) which gave no increase in weight gain (0.0g).

The values of hen-day production are shown in table 3. Birds fed diet 2 gave the highest value of 80.5 % which was not significantly different (p>0.05) from diet 1 (control) which gave the lowest value of 72.8%.

Table 4 shows the results of egg weight of layers fed CSC based diets. The test diets did not differ significantly (p>0.05) in their effects on the egg weight of the birds. The highest value came from diet 3 with 56.1g while the lowest value was from diet 4 (54.8g) indicating that no particular trend of numerical differences was obtained.

Egg quality characteristics of layers fed CSC based diets:

Egg quality characteristics of layers fed CSC based diet from 23 – 35 weeks of age are presented in Table 4.

Birds that were fed diet 2 gave the lowest value of shell thickness (0.21mm), while diets 3 to 5 gave the same value of 0.24mm. The differences between the shell thickness of eggs from the different dietary treatments were not significant (p>0.05).

For the values of yolk index of eggs laid by birds fed with CSC based diets; the highest yolk index (0.54) was obtained in birds fed diet 3 while those fed diets 1 and 2 had the lowest value of 0.51. Other group value was 0.53 for both diets 4 and 5. No significant differences (p>0.05) were obtained between treatment means.

Table 4 showed that there were no significant differences (p>0.05) in the mean values of egg shape index across the treatment groups. The lowest egg shape index (0.75) was obtained in eggs produced from birds fed diet 2 while those fed diets 4 and 5 gave the highest egg shape index of 0.78 and values for other treatments were within these ranges.

The values of albumen height from eggs of birds fed with different dietary treatment are shown in Table 4. While birds fed 15% CSC gave the lowest value of 1.30, birds fed the lowest level of CSC (0%) gave the highest value of 1.42. Other groups gave values ranging between 1.36 and 1.41. Values were not statistically significant (P>0.05).

Table 4 showed the treatment mean values of haugh unit for the diets. No significant treatment effects were obtained. The highest value of 4.60 was obtained for diet 3 while the lowest value was from diet 4 (4.17). Other values ranged between 4.26 and 4.54.

DISCUSSION

Chemical composition: All the experimental diets, met the nutrient requirements for layers as recommended by NRC (1994). Ryan *et al.* (1986) also reported values of 46.8% crude protein, 6.0% moisture, 14.0% crude fibre, 0.9% ether extract and 6.5% ash. While Reid *et al.* (1987) reported chemical composition of 44.5% crude protein, 0.15% ether extract, 8.83% moisture.

Performance characteristics: Although the amount of feed consumed did not indicate any significant response to the treatment effects on the layers, a relatively higher consumption was recorded as the CSC level in the diet increased. The inclusion of CSC in the experimental diets correspondingly increased the fibre content as the level of CSC increases. Increased dietary fibre level is often associated with faster rate of passage which inhibits optimal benefit from feed intake through the gut filling effect with a consequential reduction in the feed consumption (Thorne *et al.*, 1991). The observed increase in feed intake as CSC level increases may be due to the natural instinct of the layers to eat to meet their energy needs. The increasing rate of inclusion of CSC inadvertently lowered available dietary energy. (Fetuga, 1984, Summers and Leeson, 1986; Gous *et al.*, 1990 and Fahey *et al.*, 1992). Therefore, the propensity of birds to consume more at higher dietary fibre gave a clear indication of the natural reactions to events of lower energy. The high fibre content of CSC prevented 100% replacement of SBC with CSC to ensure diets do not have more than 5% fibre level recommended for layers. FCR values increased in birds fed increasing amount of CSC in the experimental diets (Table 1). This could be explained by the higher feed intake in relation to the egg weights of the birds. Card and Nesheim (1975) reported that poor feed conversion in egg laying ventures can be an indicator of the poor quality of feed given to the birds. Mamputu and Buhr (1991) also observed high FCR in layers fed varying amount of oil seed cakes. However, dietary treatment did not influence the FCR significantly.

The body weight gain did not show any significant difference. Of interest however, is the trend of slight increase observed among the groups fed CSC inclusions in their diets as compared with the control which had no CSC. The body weight change at the termination of the experiment was nil. Stated more clearly, the CSC based group birds had better gain than those without CSC, which though were not significant

But as reported by Lewis *et al.* (1994) and Yannakopulos *et al.* (1995), a critical body fat content before the onset of lay was important because it profoundly influences the size of egg, no of eggs and the ability of the birds to withstand the stress associated with the process of egg production. However, the slight increase in weight of birds fed CSC was not reflected in their egg output as it did not differ significantly from birds without CSC.

Generally, the body gain of layers on the test diets obviously manifested the adequacy of the respective diets. The gain in weight almost followed the pattern exhibited by the feed consumed. Contrary to reported cases (Panigrahi *et al.,* 1987 and Dhara *et al.,* 1994) a slight but non-significant increase in body gain was recorded with CSC inclusion in diets. This observation was perhaps influenced by the residual lipid content in CSC; this alongside with the adequacy in the lysine and methionine levels of the ration may have been responsible for a better utilization of the CSC based diets. This agrees with findings of Longe and Adekoya (1988), Zatari and Sell (1990) and Panigrahi and Powell (1991) who reported higher feed intake and gain as a result of lipid/fat addition in poultry rations.

The results on percent hen-day-production shows that HDP% was not significantly influenced by the CSC based diets. The HDP% values obtained in this study72.8, 80.5 77.3, 73.1 and 78.1 were similar to values recorded by Obida and Stanford (1988) who reported 79.1, 77.4, 78.7 and 78.6 HDP% when caged layers were fed millet and sorghum grain as replacement for maize. Longe and Adekoya (1988) also recorded similar values when they fed palm kernel meal in a maize – groundnut meal based diets.

Furthermore, the values recorded in this study were higher than values recorded by Udedibie *et al.* (1988) 60.9, 64.4, 66.8 and 65.3 for hen-day production (%) when poultry offal meal was fed as protein supplement to 54 weeks old Hyline layers diets at 0, 10, 15 and 20% dietary levels. The higher values recorded in this study could perhaps be due to differences in breed, age, management system among others (Shanawany, 1988) much as birds used in this study were kept in battery cages and fed different test materials.

The average egg weight did not follow any particular trend in relation to the test diets. Values recorded were slightly lower than the 58g recorded by Oluyemi and Roberts (1979). Longe and Adekoya (1988) also reported similar values (55.4, 57.0, 57.6, 56.9 and 53.9g) for average egg weight when palm kernel meal was iso-nitrogenously substituted at 15.9 and 31.8% into a maize
– groundnut meal based diet and fed to 26 week old Ross Brown pullets for 12 weeks.

Egg quality characteristics: According to Card and Nesheim (1975), yolk index is a measure of the standing up quality of the yolk; yolk value for a normal fresh egg should range between 0.40 and 0.42. This is below the range obtained in this study (0.51 to 0.54). This can be explained with the observation of Card and Nesheim (1975) who reported that the holding conditions during storage and more importantly the genetic conditions in the hen rather than the quality of the diet have the most influence on the yolk index and Haugh units. The yolk indices obtained in this work are also within the normal range of 0.3 to 0.5 as stated by Romanoff and Romanoff (1949).

Egg shell thickness was not significantly influenced by the dietary treatments and was lower than the values reported by Oluyemi and Roberts (1979), who reported an average of 0.35mm for the humid tropics. The differences in the values might not be unconnected with breed type and the number of eggs produced during the period. The breeds available now are quite different in the higher number of eggs they can produce compared with those in the late 70's. In addition, feeding is one of the factors responsible for good quality shells. According to Stadelman (1977) egg shell thickness is one of the most direct measures of determining shell quality. Since the shell thickness did not decrease as CSC inclusion increased it indicates that the quality was not affected by CSC inclusion.

Haugh unit is a measure of albumin quality. And in this study it was not affected by dietary treatment. The Haugh unit values obtained from this study were similar to values reported by Oluyemi and Roberts (1979) and Longe and Adekoya. (1988). According to Card and Nesheim (1975), deterioration of eggs affects the yolk and albumen contents. The deterioration may occur in the form of shrinkage, liquefaction and gaseous exchange. Shrinkage involves the evaporation of moisture from the yolk and albumen contents of an egg. The numerous pores in eggs would make the albumen to lose more moisture. According to Oluyemi and Roberts (1979), egg shrinkage makes the albumen to become watery. Egg liquefaction reduces the value of the albumen as water passes from it to the yolk. This leads to lowered viscosity of the albumen white (Card and Nesheim, 1975).

Excessive gaseous exchange through the numerous pores in poorly formed eggs has been reported to reduce haugh units (Oluyemi and Roberts, 1979). In this study this shortcomings were not observed given an indication that CSC based diets did not have an adverse effect on haugh unit.

Egg shape index is a measure of the conformity of the shape of the egg to the oval shape of the chicken egg. The egg shape index obtained in this study is similar to values reported by Olorede (1998) who fed shea butter cake at 10% and 20% inclusion levels to layers for 10 weeks, the result also agrees with the findings of Bamgbose (1988) who fed various oil seed cakes to layers.

CONCLUSION

Cottonseed cake can effectively replace 60% Soyabean cake in the diets of egg type chickens without adverse effect on their performance and egg quality traits.

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Table 1: Composition of experimental CSC-based diets fed to egg -type chickens showing % replacement of soyabean cake with cottonseed cake treatments

Ingredients	1 (0%)	2 (15%)	3 (30%)	4 (45%)	5 (60%)
Maize	46.00	47.00	48.00	49.00	52.00
Soyabean cake	18.00	15.30	12.60	9.90	7.20
Cottonseed cake	0.00	4.53	9.10	13.60	18.13
Corn offals	13.70	10.00	8.50	8.74	5.50
Wheat offals	9.71	10.58	9.21	6.17	4.58
Fish meal	1.50	1.50	1.50	1.50	1.50
Bone meal	3.00	3.00	3.00	3.00	3.00
Oyster shell	7.50	7.50	7.50	7.50	7.50
Layer's premix	0.30	0.30	0.30	0.30	0.30
Methionine	0.02	0.02	0.02	0.02	0.02
Salt	0.27	. 0.27	0.27	0.27	0.27
Total	100.00	100.00	100.00	100.00	100.00
Calculated					
Crude protein (%)	16.41	16.39	16.28	16.21	16.11
M. E. (kcal/gm)	2.60	2.55	2.56	2.55	2.59
Crude fibre	4.30	4.45	4.65	4.82	5.09

Layer's Premix supplied per kg of diet: Vit A, 20,000 IU; Vit D, 2,000 IU; Vit E, 5 IU; Vit K, 5mg; Vit B12 7.5mg; Riboflavin, 4.2mg; Pantothenic acid, 25mg; Nicotinic acid, 45 mg; Folic acid, 0.5mg; Cu, 35mg; Mn, 250mg; Zn125mg; Fe, 100mg; Iodine, 800mg;Cobalt, 1.25mg;Choline, 750mg.

Table 2: Proximate Composition of Experimental Diets and Test Ingredient

Diets	%DM	%CP	%EE	%CF	%ASH	%NFE
1	83.27	17.11	0.50	6.00	8.50	67.89
2	82.80	17.47	2.00	7.00	8.00	65.53
3	84.80	17.61	2.00	8.00	8.00	64.39
4	84.47	17.16	4.50	8.50	10.00	59.84
5	84.10	16.73	5.00	9.00	9.50	59.77
CSC	90.15	35.11	3.00	17.00	3.50	41.39

Table 3: Performance of egg type chickens fed CSC based diets at 23-35 weeks of age

	Treatments					
Parameters	1	2	3	4	5	SEM
Initial body weight (kg)	1.51	1.52	1.47	1.43	1.50	0.04
Final body weight (kg)	1.51	1.58	1.58	1.60	1.54	0.04
Feed Intake (g/bird/day)	138.00	143.00	140.00	142.00	148.00	18.00
Body weight gain (g)	0.00	60.00	110.00	170.00	40.00	20.00
Hen Day Production (%)	72.83	80.46	77.73	73.05	78.10	7.59
Feed Conversion Ratio (FCR)	2.56	2.46	2.51	2.57	2.63	0.26

Table 4: Egg quality characteristics of egg type chickens fed CSC based diets from 23 to 35 weeks of age

	Treatments					
Parameters	1	2	3	4	5	SEM
Shell thickness (mm)	0.22	0.21	0.24	0.24	0.24	0.06
Yolk Index	0.51	0.51	0.54	0.53	0.53	0.08
Egg shape Index	0.76	0.75	0.77	0.78	0.78	0.03
Albumen height (mm)	1.36	1.42	1.39	1.41	1.30	0.11
Egg weight (g)	54.84	55.84	56.12	54.76	55.72	1.72
Haugh unit	4.37	4.54	4.60	4.17	4.26	0.80