Trop. Anim. Prod. Invest.7 (1):79-88 (2004) ISSN: 1115 2540

Performance of Broiler Chicks fed Cottonseed cake-based Diets

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ABSTRACT

The potential of Cottonseed cake (CSC) at 0%, 25%, 50%, 75% and 100% replacement for Soyabean cake (SBC) as an alternative protein source in chicks was investigated. One hundred and eighty Anak broiler chicks at day old were divided into twelve groups and randomly assigned to the five dietary treatments with three replicates per treatment. The feeding trial lasted for four weeks at the teaching and research farm of the university of Ibadan Nigeria.

Feed intake revealed that chicks fed cottonseed cake-based diets had higher consumption when compared to those fed control. Though feed conversion showed significant differences ($P<0.05$) it did not follow a particular trend. There were significant ($P<0.05$) differences in protein utilization across the treatments. The highest protein efficiency ratio (PER) values were obtained with the birds in diet 3 (50% CSC) with values of 2.78 and 2.84 respectively while diet 5 (100% CSC) gave the lowest value of 1.20. Results showed there were significant ($P<0.05$) differences in weight gain from the 1st week to the 4th week. Birds fed diet 4 having 75% CSC replacement for SBC had the same value (220g) with the control (Diet 1) Mortality was low in all the treatments and a range of 1-2 % mortality was recorded during the study.

Key words: Broiler chicks, Cottonseed cake, Performance, Replacement

Short title: Response of Broiler chicks to cotton seed cake based diets.

INTRODUCTION

Poultry, particularly the chicken, is known to be highly prolific reproducing more quickly than most, if not all livestock and are good feed converters. However, the cost of feeding poultry put at about 60 – 70% of production cost (Ogundipe *et al.*, 1991) has become increasingly prohibitive and alarming. To arrest this situation, it becomes necessary to evaluate the capacity of poultry to convert unconventional feed resources especially agro-industrial by-products of primary processing industries. One of these products is CSC which is a readily available by-product from the textile industry.

Available reports on the utilization of CSC by poultry are quite conflicting, especially, as it relates to its content of gossypol, a yellow polyphenolic anti-nutritional pigment and its influence on nutritional utilization of the protein of cottonseed. (Nzekwe and Olomu, 1984; Atuahene *et al.*, 1986; Aletor *et al.*, 1990; Bamgbose and Nwokoro, 1997; Gamboa *et al.*, 2001; Henry *et al.*, 2001). Therefore, this study investigated the effect of graded levels of CSC on the growth rate, feed intake, feed conversion ratio and blood profile of broiler chicks fed from day old to 4 weeks of age.

MATERIALS AND METHODS

Experimental Birds and design.

A total of 180 day old mixed sexes Anak broiler chicks were purchased from Avians Hatchery in Ibadan. The chicks were randomly assigned to five dietary treatment groups of 12 birds with three replicates per treatment in a completely randomized design (CRD). The initial weight per bird was between 40-43 grammes.

Experimental diets.

Five isonitrogenous and isocaloric diets were formulated such that CSC protein replaced that of SBC in maize-based broiler diet at 0,25,50,75 and 100% level.

Management Practices

After the arrival of the birds, the chicks were divided into fifteen groups of 12 birds each. Each group was randomly allotted to one of the replicates of the dietary treatments. Feed and water were provided *ad libitum*. Litter was monitored and well managed to prevent Coccidiosis.

Chemical Analysis.

Proximate analysis was carried out according to the procedures described by A.O.A.C (1995) for both the test ingredient, cottonseed cake (CSC) and the compounded diets. Free gossypol content of CSC was determined according to the procedure described by the AOCS (1979) and total gossypol was measured using the HPLC method of Hron *et al.* (1999).

Performance characteristics

At the beginning of each new week feed was usually weighed for chicks in separately labelled container for each replicate group. The left over was weighed at the end of the week to obtain feed consumed for a week by difference. The average weight gain of chick per week was obtained by taking the difference between mean weights for two successive weeks. Protein efficiency ratio was obtained from the feed intake and weight gain.

$$PER = \frac{\text{Body wt gain (g)}}{\text{Protein intake (g)}}$$

Statistical Analysis

All the data collected were subjected to analyses of variance using SAS (1999). The means were separated using Duncan's multiple range tests

The gross composition of experimental starter diets is shown on table 1.

Table 1: Composition of Experimental Starter Diets Fed to Broiler Chicks

	Diets				
Ingredients	1	2	3	4	5
Maize	47.20	45.75	44.20	41.10	44.00
Soyabean cake	32.30	24.22	16.15	8.10	0.00
Cottonseed cake	0.00	9.68	19.40	29.05	38.80
Wheat bran	13.46	13.31	12.21	13.71	9.16
Blood meal	1.00	1.00	2.00	2.00	2.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Oyster shell	1.50	1.50	1.50	1.50	1.50
Methionine	0.04	0.04	0.04	0.04	0.04
*Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
CP (%)	22.89	22.77	22.78	22.88	22.74
ME (kcal/kg)	2,977	2,975	2,983	2,985	2,988

*Premix supplied per kg of diet: Vit A, 10,000 IU; Vit D, 2,800 IU; Vit E, 35,000 IU; Vit K, 1,900mg; Vit B_{12} 19mg; Riboflavin, 7,000mg; Pyridoxine, 3,800mg; Thiamine, 2,200mg; D-Pantothenic acid, 11,000mg; Nicotinic acid, 45,000 mg; Folic acid, 1,400mg; Biotin, 113mg; Cu, 8,000mg; Mn, 64,000 mg; Zn, 40,000mg Fe, 32,000mg; Se, 160mg; Iodine, 800mg; Cobalt, 400mg; Choline, 475,000mg; Methionine, 50,000mg; BHT, 5,000mg; Spiramycin, 5,000mg.

RESULTS

Feed Intake

Generally, feed intake increased with the age of the chicks as shown in table 2. Significant differences ($P<0.05$) were observed in weeks 1, 3 and 4; it was only in week 2 that significant differences were not observed.

Table 2: Average Feed Intake (g) of Broiler Chicks fed CSC-based Diets

Treatment	1	2	3	4
1	150.00^{a}	390.00	630.00^{a}	850.00^{ab}
2	140.00^{a}	400.00	480.00^{b}	830.00^{ab}
3	90.00^{b}	370.00	490.00^{b}	660.00^{c}
4	150.00^{a}	370.00	670.00^{a}	890.00^{a}
5	130.00^{a}	360.00	640.00^{a}	820.00^{b}
SEM	8.00	14.00	10.00	15.00

ab: Means in the same column with different superscripts are significantly different ($P<0.05$).

Live weight Changes

Weekly growth rate was observed to increase with age for all the diets. There were significant ($P<0.05$) differences in weight gain from the 1st week to the 4th week. The mean weight gain is shown in figure 1 the value obtained in treatment 4 was the same as that of the control (treatment 1)

Feed Conversion Ratio (FCR)

FCR increased with the age of birds but values obtained did not follow a particular trend. Significant differences ($P<0.05$) were obtained between the different treatments for the four weeks that the feeding trials lasted. The mean FCR values obtained is shown in figure 2, a slight gradual decrease was observed from treatment 1 to 3 before a gradual increase which peaked at treatment 5.

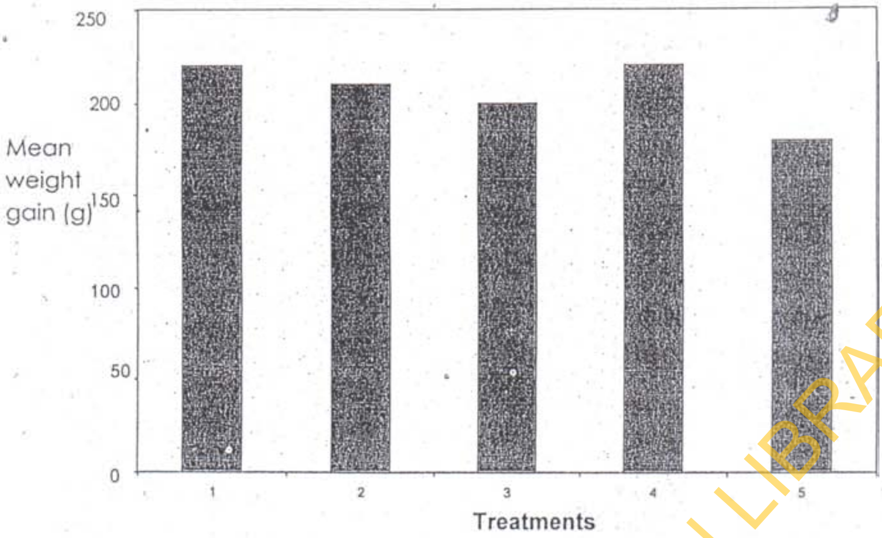

Figure 1: Average weight gain (g) of broiler chicks fed CSC based diets.

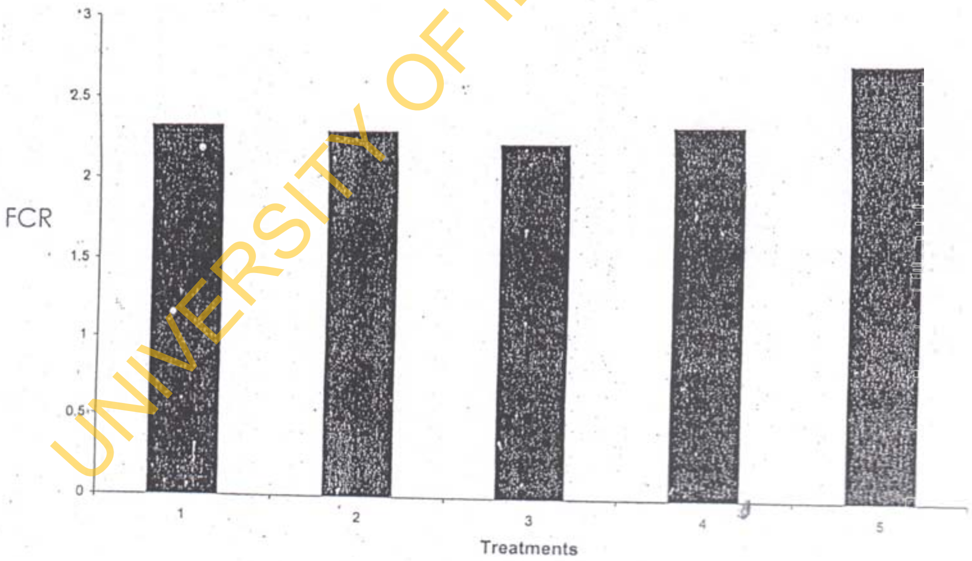

Figure 2: Feed Conversion Ratio of broiler chicks fed CSC- based diets.

Protein Efficiency Ratio (PER)

There were significant (P<0.05) differences in protein utilization across the treatments. The highest PER values were obtained with the birds in diet 3 (50% CSC) with values of 2.78 and 2.84 respectively while diet 5 (100% CSC) gave the lowest value of 1.20.

Table 3: PER of Broiler Starters Fed CSC based diets

Treatment	1	2	3	4
1	2.28^{b}	1.64^{c}	1.94^{a}	1.83^{c}
2	2.01^{c}	1.70^{b}	1.98^{a}	2.09^{b}
3	2.84^{a}	2.22^{a}	1.22^{c}	2.78^{a}
4	2.06^{c}	1.97^{ab}	1.69^{b}	1.95^{b}
5	2.11^{c}	1.74^{b}	1.20^{c}	1.83^{c}
SEM	0.27	0.65	0.49	0.25

ab: Means in the same column with different superscripts are significantly different (P<0.05).

Discussion

Birds eat primarily to satisfy their energy need. Energy is derived mainly from carbohydrates, fat and oils and at times from proteins in the diet. The quantity of the energy derived from the diet is determined by the quality and acceptability of the feed to the birds. In the cottonseed cake (CSC) diets, maize decreased to an extent particularly in the fourth diet with increasing levels of CSC in the diet. This presupposes that CSC carbohydrates and oil were expected to contribute to the energy requirement of the chicks. The results of this study showed that chicks on increasing CSC based diets consumed significantly higher feed, except for diet 3 which had a 50% CSC replacement for SBC protein.

At this starter phase, a stepwise increase in feed consumption was observed as the levels of CSC increased in the diet. This is not unconnected with the slightly higher crude fibre content of these rations which diluted energy intake leading to reduced availability of energy. The increased feed consumption therefore might be a craving for essential nutrients in an attempt to compensate for their low intake, more so, that the energy intake at this period is very crucial for growth thus explaining the significant increased in consumptions.

The feed intake observed in this study was lower than that recorded by Henry *et al.* (2001). This might be due to variation in climate, breed differences and form of processing the feed. Henry *et al.* (2001) carried out their study in the temperate region and as reported by Oluyemi and Roberts (1988) higher temperatures in the tropics as obtained in this study cause a reduction in feed consumption by birds. Feed consumption is a balance of several factors among which is the energy need of the animal, the age of the animal, the quality of the feed and the prevailing environmental humidity and temperature. These results agree with the observation of Gamboa *et al.*

(2001) who reported variations in feed consumption in CSM-based diets attributed to the presence of gossypol, decreased lysine availability, lower energy concentration, and higher fibre content of CSM compared with soyabean meal.

Significant differences in weight gain were observed between the different diets except for diet 5 which had 100% CSC replacement for SBC. Birds in all other diets had favourable body weight gain as compared with the control (diet 1). Birds fed diet 4 having 75% CSC replacement for SBC had the same value (220g) with the control (Diet 1). This finding agrees with the work of Henry *et al.* (2001) who reported satisfactory results in terms of growth rate of birds fed with CSM especially at levels not more than 20% of the whole diets. Similar results were reported by Watkins *et al.* (1993) with CSM constituting 30% of the ration. There is, however, other studies that showed that CSC had a negative effect on chick performance. (El-Boushy and Raterink, 1989; Fernandez *et al*, 1994, 1995). The negative effects of CSC on chick performance observed in these studies were associated with the presence of gossypol (Couch *et al.*, 1955; Heywang and Kemmerer, 1966; El-Boushy and Raterink, 1989). This implies that the higher the level of gossypol in the diet, the lower the growth rate. This may not be surprising since growth rate is a function of the quality of feed consumed. This is in agreement with the findings of Church (1985) that the higher the feed consumed the better the growth rate. However, these results are at variance with the work of Lee and Yang (1979) that does not agree that growth rate is influenced by feed consumption.

The nutrient utilization by the birds from the feed though influenced physiological state and an environmental condition is mainly a function of the quality and amount of feed ingested. Thus, if the diet is balanced, with minimal fibre level, which allow for moderate passage time of feed in the gut. Birds have a high feed intake with proper utilization of the nutrients in the diet which promotes growth and development. FCR values would be low.

The results of this investigation recorded relatively high FCR values compared with those of Henry *et al.* (2001) and Gamboa (2001) both of whom fed higher total lysine level. However, the results agree with those of Watkins *et al.* (1993); Baber *et al.* (1995); and Fernandez *et al.* (1995). Watkins *et al.* (1993) reported that the inclusion of low gossypol CSC up to 30% of diet had no adverse effect on body weight but FCR was adversely affected.

Protein efficiency ratio shows how efficiently the protein in the diets has been utilized by the birds. Significant differences recorded across the treatments were not unconnected with the consequence of reduced intestinal absorption of amino acids caused by the interference of the anti-nutritional factor which essentially lead to an increased nitrogen excretion resulting in reduced utilization (Jaffe and Vagalette, 1968; Pusztai *et al.*, 1981). Grant *et al.* (1983) reported that decrease in net protein utilization (NPU) values of oil seed cakes could be attributed to their haemaglutinizing properties.

The major anti-nutritional factor in CSC is gossypol, consumption of which has been observed to exert a significant effect on protein utilization and feed consumption (Henry *et al.*, 2001). Anti-nutritive effects of gossypol have been attributed to the formation of a dietary protein-gossypol complex, thereby inhibiting or limiting protein digestion and consequently decreasing nitrogen retention while increasing faecal nitrogen (Ikurior and Fetuga, 1984; Aletor *et al.*, 1990).

The results obtained in this study is in agreement with that of Gamboa *et al.* (1997) who reported on the need to take into consideration not only the level of gossypol but also the proportions of isomer of gossypol present in feeding CSC to broiler chickens. They found out that minus isomer was the more toxic isomer in their research with broilers.

Fernandez *et al.* (1994) also reported decreased digestibility of all amino acids except methionine, arginine and histidine in a heat – treated CSC based diet fed to broiler chicks.

The chicks were healthy throughout the period of study. Mortality was low in all the treatments and a range of 1-2 % mortality was recorded during the study. Gossypol intake at maximum inclusion level of 100% CSC for SBC resulted in (570g gossypol/ton of feed, equivalent to 0.018 % gossypol). Although it affected protein utilization and consequently growth rate, it did not reach the threshold level of toxicity in the body of chicks to cause death. Earlier workers like Aletor *et al.* (1990); Ikurior and Fetuga (1984), Atuehene *et al.* (1986) have reported that poultry are more tolerant to gossypol toxicity than pigs

Conclusion

Differences in bird performance between treatments were remarkable, birds on diet 5 were significantly inferior in performance to birds on the first four diets. It can be deduce that broiler chicks can tolerate as high as 75% CSC protein replacement for SBC without adverse effects on their performance.

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