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COMPARATIVE UTILISATION OF ALKALI-TREATED AND UNTREATED COCOA BEAN IN DIETS OF EGG-TYPE CHICKENS

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Target Audience: Poultry farmers, livestock feed millers, poultry nutritionists.

ABSTRACT

Fifty, 32 weeks old commercial layers were allocated to 5 groups and fed *ad libitum* on diet comprising a basal control (without cocoa bean cake) and those based on 10 and 20% untreated cocoa bean cake (UCBC), and, 10 and 20% alkali-treated cocoa bean cake (ACBC). Experimental duration was 12 weeks. Cocoa-pod ash solution was used as alkali source. Results showed that egg production and feed intake were higher ($p<0.05$) for control than other dietary treatments. Higher levels of UCBC and ACBC reduced ($p<0.05$) performance and increased mortality. Dry matter digestibility was highest ($p<0.05$) on the control and 10% ACBC diets and least ($p<0.05$) on 20% UCBC diet. The use of cocoa ash solution appears to be a feasible strategy for improving the utilisation of cocoa bean cake in layer diets.

Keywords: Cocoa bean cake; egg-type poultry; alkali treatment; nutrient digestibility.

DESCRIPTION OF PROBLEM

The poultry industry in many tropical developing countries is faced with the problem of providing good quality feed at affordable prices. In these countries, food production has lagged behind population growth thereby creating an unsatisfied demand for food. To bridge this gap, non-conventional feed resources have been severally evaluated (1, 2, 3) at all stages of animal life to reduce the competition between man and livestock (especially monogastrics) for feed ingredients which in most cases are similar.

Discarded cocoa bean cake is one of these ingredients under investigation. Previous studies (4, 5) suggested inclusions of up to 20% UCBC in pullet chick diets and 10% for grower pullets. However, the adverse effects of prolonged feeding of UCBC at levels higher than 5% have been reported (6). Sexual maturity and attainment of 50% hen-day production were delayed at

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higher levels when pullets were fed from day old to 54 weeks of age. Improvement in the utilisation of cocoa bean cake was envisaged through reduction or neutralisation of the antinutrient (theobromine) present in the cake. Thus, better response was achieved (7) in broiler starter performance with hot-water or alkali-treated cocoa bean cake over the untreated cake. The performance of the control birds was however, still better than the treated cakes at higher levels of inclusion.

The present study aimed at investigating the response of mature adult chickens to alkali-treated cocoa bean hence, performance and nutrient digestibilities in layers were reported over a 12 week feeding trial.

MATERIALS AND METHODS

The origin, collection and processing of cocoa bean cake (CBC) used have been previously reported (4, 7). Essentially, cocoa-pod ash (CPA) was obtained by burning dried cocoa-pod husk (CPH) in a perforated 200 litre drum with opening out at the lower side. At the mid-section, CPH was put on a wire sieve and burnt. After complete combution, the ash was allowed to cool and stored in airtight containers. The CPA solution was prepared to be equivalent in alkali concentration to 0.5% NaOH (7). CBC was soaked in it (1:5 w/v) for 6 hours with occasional stirring after which the supernatant was decanted and residue sundried for 48h, milled and kept until needed. The effect of processing on the proximate content and the theobromine level of CBC were reported (7).

Diets, birds and management

Five isonitrogenous diets (18% CP) were formulated such that Diet I was the control without CBC. Maize and groundnut cake in the control diet were partially replaced in diets 2 and 3 by 10 and 20% untreated CBC (UCBC) respectively while diets 4 and 5 contained 10 and 20% of the already prepared cocoa-pod ash solution treated CBC (ACBC) respectively. Other ingredients remained constant (Table 1).

Fifty Isa Brown commercial layers (32 weeks old) were randomly assigned to the diets at ten birds per diet. Feed and water were offered *ad libitum* during the 12 weeks of experimentation. Performance records (egg production, egg weight, feed intake, body weight and mortality) were taken throughout the period. The cost of feed consumed per kilogram of egg was calculated. At the 10th week, 3 birds per treatment were transferred to the metabolic cages for nutrient digestibility studies using the total collection procedures. Diets and droppings were evaluated for proximate composition (8).

Results were statistically evaluated by analysis of variance (9) while differences among means were detected using Duncan's multiple range test (10).

Table 1: Composition of tests diets fed to egg-type chicken %

	Control	UCBC		ACBC	
Ingredients	0	10	20	10	20
Maize	49.15	43.10	37.05	42.35	35.45
Groundnut Cake	18.00	14.05	10.10	14.80	11.70
Cocoa bean cake	0.00	10.00	20.00	10.00	20.00
Fixed[1]	32.85	32.85	32.85	32.85	32.85
Total	100.00	100.00	100.00	100.00	100.00
Determined Analysis (%)					
Crude Protein	18.05	18.14	18.06	18.08	17.98
Ether Extract	2.60	3.05	2.59	3.09	3.02
Ash	5.40	5.86	3.73	5.97	6.87
Calculated Analysis					
Theobromine[2] (%)	0.00	0.02	0.45	0.06	0.13
Feed Cost (₦/kg)	18.66	17.46	16.27	17.80	16.95

[1]Fixed ingredients supplied to each diet, %; palm kernel meal, 18.90; blood meal, 2.00; Oyster shell, 7.00; Bone meal, 4.00; Salt, 0.5; Methionine, 0.25; Vitamin - Mineral Premix[3], 0.25.

[2]Calculated theobromine in diets

[3]Odunsi (1997)

RESULTS AND DISCUSSION

Alkali treatment was employed in the present study with the aim of improving utilisation of CBC in layer diets through the reduction of the theobromine in the cake. About 5g CPA was found to be equivalent to 1g NaOH and the influence of CPA treatment on chemical contents gave 20.19% versus 23% crude protein, 8.77% versus 16.5% ether extract, 9.36% versus 8.37% ash and 0.63% versus 2.24% theobromine for ACBC and UCBC respectively (7).

Performance and nutrient digestibility data are presented in Table 2. Layers on the control diet had the highest ($P<0.05$) feed intake and egg production while similar values were recorded for 10% UCBC, 10% ACBC and 20% ACBC; the lowest value was for those on 20% UCBC diet. The reduced performance noticed with CBC fed birds could be linked to feed consumption which was depressed with increasing dietary CBC. Such findings were earlier reported on chick and grower pullets (4, 5). Reduction in feed intake caused by a feed refusal factor (11), or through deliberate feed restriction (12) elicit different responses in layers. In this study, intake was reduced by 15.3, 17.3, 20.7 and 38.7% on 10% ACBC, 10%UCBC, 20% ACBC and 20% UCBC diets respectively, which was affirmed the effects of the theobromine as a feed refusal factor.

Laying rate and egg weight were decreased while body weight gain was not markedly affected, a response which was similar to the observations with White Leghorn layers (13). The latter study reported that egg rate and egg weight decrease had little effect on body weight when consumption was restricted up to 20%.

Table 2: Performance and nutrient digestibility of egg-type chickens fed diets containing untreated and alkali-treated CBC

Parameters	Control	UCBC		ACBC		SEM
	0	10	20	10	20	
Hen day production (%)	65.8^{a}	57.7^{bc}	44.8^{c}	62.4^{b}	56.6^{bc}	2.21
Feed intake(g)	113.9^{a}	95.9^{bc}	84.1^{c}	98.0^{b}	92.4^{bc}	0.53
Egg Weight (g)	62.5^{a}	60.4^{ab}	57.2^{b}	59.9^{ab}	59.9^{ab}	20.1
Body Weight gain (g)	-88.0	-187.0	-218.0	-157.0	-88.00	0.20
Feed: egg weight (g:kg)	2.60^{b}	3.49^{b}	4.44^{a}	2.98^{b}	3.09^{b}	0.20
Feed cost:kg eggs (₦: kg)	51.6^{b}	48.0^{b}	53.4^{bc}	44.5^{a}	45.5^{a}	18.4
Mortality (%)	0.00	30.0	50.0	10.0	40.0	
Digestibility						
Dry matter(%)	73.9^{a}	70.4^{b}	66.3^{c}	72.9^{a}	69.9^{b}	0.74
Crude Protein (%)	66.9^{a}	63.5^{a}	57.0^{b}	67.2^{a}	63.9^{a}	1.09

Means without a common superscript in a row are significantly different ($P < 0.05$)

The efficiency of feed utilisation showed little variation but was adversely influenced ($P<0.05$) on the 20% UCBC diet. The cost of producing a unit weight of the diet declined with increasing levels of either UCBC and ACBC based diets. The slight variations in feed efficiency could be explained on feed intake reduction and corresponding reduction in egg output. Mortality was 30 and 50% for layers fed 10 and 20% UCBC while 10 and 40% were recorded for layers on 10 and 20% ACBC diets respectively. Control birds recorded no mortality. The lower mortality in ACBC fed layers compared to UCBC fed birds was apparently related to the reduced theobromine in their diets (Table 1). Detheobrominsation was reported to improve the feed value and reduce mortality in pigs and cows fed cocoa husks (14).

Dry matter digestibility was highest ($P<0.05$) on the control and 10% ACBC diets and least ($P<0.05$) on the 20% UCBC diet. Crude protein digestibility was likewise depressed ($P<0.05$) on the 20% UCBC diet. The digestibilities of dry matter and crude protein which were improved on ACBC diet also lent credence to the fact that theobromine affects nutrient uptake which invariably influences productive performance.

CONCLUSION AND APPLICATIONS

Based on the result of this study, it can be concluded that:

(1) Performance decreased with increasing level of UCBC or ACBC in the diet of layers.

(2) Although, the inclusion of ACBC at 10% level resulted in a slightly lower performance than the control diet, some beneficial effect were observed over the untreated cocoa bean cake.

REFERENCES

1. **Sobamiwa, O. and Akinwale, T. O.** 1999. Replacement value of cocoa husk meal for maize in diets of growing pullets. Trop. J. of Anim. Sci. 1:111-116.
2. **Olorode, B. R. Onifade, A. A. Okpara, A. O. and Babatunde, G. M.** 1996. Growth, nutrient retention, haematology and serum chemistry of broiler chickens fed shea butter cake or palm kernel meal in the humid tropics. Jour. of Appl. Anim. Res. 10: 173 - 180.
3. **Ravindran, V.** 1995. Evaluation of a layer diet formulated from non-conventional feedstuffs. Br. Poult. Sci. 36: 165 - 170
4. **Odunsi A. A. and Longe, O. G.** 1995a. Cocoa bean cake in Poultry diets. 1. Chemical composition and nutritive value of coca bean cake in pullet chieck diets. J. Appl. Anim. Res. 7: 91 - 98.
5. **Odunsi A.A. Longe O.G.** 1995B. Cocoa bean cake in poultry diets. 2. Effects of feeding cocoa bean cake on growth and laying performance of pullets. J. Appl. Anim. Res. 7: 137-144.
6. **Odunsi A.A.** 1997. Inclusion rate and physiological effects of prolonged feeding of cocoa bean cake on layers. Nig. J. Anim. Prod. 24 :31-36.
7. **Odunsi A.A. Longe O.G.** 1998. Nutritive value of hot water - or cocoa-pod ash solution-treated cocoa bean cake for broiler chicks. Br. Poult. Sci. 39: 519-525.
8. **AOAC 1990.** Association of Official Analytical Chemists. Official Methods of Analysis. 15th edn, Washington, D.C.
9. **Steel, R.G.D. and Torrie, J.H.** 1980. Principles and Procedures of statistics, 2nd edn, McGraw-Hill Book Co., New York.
10. **Gomes, A.K. and Gomez, A.A.** 1986. A statistical procedures for Agricultural Research. Wiley, New York.
11. **Tillman, A.B. and Waldroup, A.W.** 1988. Performance and yield of broilers fed extruded grain amaranth and grown to market weight. Poult. Sci. 67: 743-749
12. **Johnson, R.J., Amanda, C., Farrell, D.J. and Cumming, R.B.**1984. Production responses of layer strain hens to food restrictions during rearing. Br. Poult Sci 25:
13. **Degen, A.A. Kam, N and Rosantbraugh, S.**1998. Efficiency of utilisation of energy for egg production in feed restricted single comb White Leghorn hens. J. Agric Sci. Camb. 3: 303-308

14. Bonadonna, T., Collanghis, B. and Curtis, G. 1963. Tests of tolerance for meals of detheobrominised cocoa husks in diets for pigs and lactation cows. Nutr. Abst. Rev. 33 Abs No 7102