EFFECT OF REPLACING PALM KERNEL CAKE WITH SHEABUTTER CAKE ON EGG QUALITY CHARACTERISTICS, HAEMATOLOGY AND SERUM CHEMISTRY OF LAYING HENS

B.R. OLOREDE*, AND O.G. LONGE

Department of Science, University of Ibadan, Ibadan, Nigeria.

Received 04 August, 1998; Accepted 07 July, 1999.

ABSTRACT

The study examined the effects of replacing palm kernel cake (PPKM) with sheabutter cake (SBC) in the diets of layers and the effects of such on egg quality characteristics, haematology and serum chemistry of the birds. Shea Butter Cake was included in the diets at 0, 10 and 20% levels. shea butter cake at 20% dietary level significantly ($P < 0.05$) decreased shell thickness, shell weight, egg mass and shell surface area. Haugh unit and yolk index were not affected by the treatments. Shell weight and shell thickness were positively correlated. Yolk cholesterol and hen day egg production decreased as dietary level shea butter cake increased from 0 to 20%. Birds fed 0 and 10% of SBC dietary levels had similar values for packed cell volume, haemoglobin and white blood cell count whereas, birds fed 20% SBC had the lowest values for these haematological parameters except red blood cell count which was the highest at 100% level of replacement of PKC in the diets. Generally, serum indices increased as SBC dietary levels increased from 0 to 20% except glucose and glutamate pyruvate transaminase. There was a negative correlation between serum cholesterol and egg yolk cholesterol.

Keywords: Laying hens, sheabutter cake, Egg quality characteristics, Haematology and serum chemistry.

INTRODUCTION

A major problem preventing optimum performance of chicken in the tropics is the apparent lack of good quality feeds throughout the year. This is attributable, among other factors, to the seasonal fluctuations in supply of conventional ingredients. Fajimi *et al.* (1993) and Onifade (1993) indicated that the evaluation of unconventional feed resources alongside other strategies would reduce pressure on conventional feed ingredients, and accelerate the attainment of

feed security for poultry.

Sheabutter cake (SBC) is a by-product of the indigenous technology for extraction of fat from the seed of sheabutter tree (*Butyrospermum paradoxum*). The possible use of this cake as a source of protein and energy in livestock rations, has been tested for broilers (Adegun, 1989, Olorede *et al.*, 1997), pigs (Okai and Bonsi, 1989), ruminants (Morgan and Trinder, 1980). Information is lacking on the utilization of this by-product in the laying chickens. This study is envisaged to highlight the nutritional potential of SBC in the ration of laying pullets on their egg quality characteristics, haematology and serum metabolites.

MATERIALS AND METHODS

Sheabutter cake was collected in wet form (55.4% dry matter) from local manufacturers of sheabutter in Kwara State of Nigeria. The wet cake was sun-dried for 4 days, packed in polythene bags and stored. Three diets were formulated by replacing PKM at 0, 50 and 100% with SBC in maize - groundnut cake based diet (Table I).

Thirty 28 week old Bovan - Mera pullets were randomly assigned to the three dietary treatments at the rate of ten birds, housed singly in a cage. Diets and water were offered *ad-libitum*. Food intake was measured daily and body weight weekly. Records of egg production per cage were kept daily throughout the experimental period. All eggs laid each day were weighed individually. five percent of eggs laid on 3 consecutive days, each week, were weighed individually and measured for shell thickness using a micrometer screw gauge. Albumen height was increased by using a spherometer to enable calculation of the Haugh unit.

Blood was sampled terminally from the thirty laying pullets after they had been fasted

Current Address: Department of Public Health and Animal Production, Faculty of Veterinary Medicine, Usmanu Danfodiyo University, Sokoto, Nigeria.

TABLE 1: GROSS COMPOSITION OF EXPERIMENTAL DIETS (%)

DIETARY TREATMENTS			
Ingredients	1 0% SBC Control	2 50% SBC	3 100% SBC
Sheabutter	-	10	20
Palm kernel cake	20	10	-
Maize	48.0	48.0	48.0
Groundnut cake	19.0	19.0	19.0
Fish meal	0.40	0.40	0.40
Blood meal	1.00	1.00	1.00
Bone meal	4.00	4.00	4.00
Oyster shell	7.00	7.00	7.00
Salt	0.30	0.30	0.30
Premix*	0.30	0.30	0.30
TOTAL	100.00	100.00	100.00
TOTAL	100.00	100.00	100.00
Determined chemical Composition (g/100g DM):			
Dry matter	92.0	91.0	90.0
Crude protein (N x 6.25)	17.60	16.83	17.23
Ether Extract	7.07	5.49	7.78
Crude fibre	10.87	9.45	13.61
Ash (Total)	15.5	17.0	16.0
Nitrogen free extract	40.96	47.22	35.38

*Premix supplied the following vitamins and minerals per Kg of diet. Vit. A, 8,000,000 IU; Vit. D₃, 1,500,00 IU; Vit. E, 3 g; Vit. K, 3.2 g; Vit. B₂, 2.5 g; Nicotinic acid, 8 g; Calcium D-Pantothenate, 3g; Vit. B₆, 0.3 g; Vit. B₁₂, 8 mg; Mn, 10g; Zn, 4.5 g; Cu, 0.2 g; I, 0.15 g; Co, 0.02 g; Se, 0.01 g; Layer diet - Vit. A, 8,000 IU; Vit. D₃, 2,000 IU; Vit. E, 5 IU; Vit. K, mg; Riboflavin, 4.2 mg; Vit. B₁₂, 0.01 mg; Pantothenic acid, 5 mg; nicotinic acid, 20 mg; folic acid, 0.5 mg; Choline chloride 3000 mg; Mn, 56 mg; I, 1 mg; Fe, 20 mg; Cu, 10 mg; Zn, 50 mg; Co, 1.25 mg.

overnight. Haematological specimens were collected in ethylene diaminetetra-acetic acid anticoagulant treated bottles while serum chemistry samples were collected without anticoagulant. Packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC) and haemoglobin were determined using Wintrobe's micro haematocrit, improved Neubauer haemocytometer and cyanomethaemoglobin method, respectively. Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCHC) were computed according to Jain (1986). Serum protein, albumin, globulin and urea were analysed

using sigma kits, glucose according to Feteris (1965) and cholesterol according Roschlan *et al.* (1974).

The proximate analysis of SBC, PKM and diets were carried out (AOAC, 1990). All data were subjected to analysis of variance and means were separated by Duncan's multiple range test (SPSS, 1988 Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The chemical composition of the test ingredients and experimental diets are shown in Tables 1

TABLE 2: PROXIMATE COMPOSITION OF SHEABUTTER CAKE AND PALM KERNEL MEAL (g/100g dm).

Chemical Composition	Sheabutter cake	Palm Kernel cake
Dry matter	90.85	91.60
Crude protein	18.1	18.00
Ether extract	15.8	6.50
Crude fibre	10.7	12.10
Ash (total)	4.8	5.67
Nitrogen-free extract	14.40	49.33

SHEABUTTER CAKE IN LAYERS DIET

TABLE 3: EGG QUALITY CHARACTERISTICS OF LAYERS FED EXPERIMENTAL DIETS DIETARY TREATMENTS

Egg Quality Characteristics	DIETARY TREATMENTS			SEM
	1 0% SBC Control	2 50% SBC	3 100% SBC	
Egg weight (g)	58.52 ^a	58.15 ^a	55.44 ^b	0.6
Haugh Unit	94.04	91.92	94.85	2.01
Shell thickness (mm)	0.39 ^a	0.40 ^a	0.37 ^b	0.01
Egg shape index	0.76	0.75	0.76	0.01
Egg shell surface area (g/cm ²)	70.21 ^a	69.70 ^{ab}	67.63 ^b	0.41
Hen-day production%	57.79 ^a	54.77 ^b	46.07	3.2
Egg mass (g/day)	33.86 ^a	31.88	25.58	2.01
Egg yolk cholesterol (mg/g)	11.35 ^a	10.21 ^b	9.46 ^c	1.35
Egg shell density (mg/cm ²)	82.0	82.0	81.0	0.01

abc: Means within same row with different superscripts were significantly different ($P < 0.05$).

TABLE 4: HAEMATOLOGY AND SERUM CHEMISTRY OF LAYERS FED EXPERIMENTAL DIETS

Parameters	DIETARY TREATMENTS			SEM
	1 0% SBC Control	2 50% SBC	3 100% SBC	
PCV %	28	28.1	27.3	1.2
Hb g/100ml	8.14	8.16	7.85	0.36
RBC 10 ⁶ /L	1.66	1.67	1.8	0.23
WBC 10 ³ /L	17.4 ^a	14.7 ^b	13.3 ^b	2.71
MCH fPL	169.7 ^a	169.09	172.0 ^b	15.2
MCH Pg	46.9	48.6	49.1	4.9
MCHC %	29.2	29.2	29.0	0.23
Total protein g/dl	6.22	6.4	6.23	0.17
Albumin g/dl	2.25	2.24	2.32	0.10
Globulin g/dl	3.97	4.16	3.85	0.02
Glucose mg/dl	118.1 ^a	93.7 ^b	102.0 ^b	11.6
Urea mg/dl	4.22	4.6	4.34	0.38
Cholesterol mg/dl	96.9 ^a	106.2 ^b	106.6 ^b	8.05
Triglycerides mg/dl	67.5 ^a	79.7 ^b	78.8 ^b	5.16
Creatinine mg/dl	0.83	0.92	0.83	0.05
S.G.P.T.(i.u./L)	24	23.7	23.4	3.84
S.G.O.T. (i.u/L)	116.3	121	115.6	6.84

ab: Means within same row with different superscripts were significantly different ($P < 0.05$).

and 2. Inclusion of SBC in the ration of layers had no effect on Haugh unit score, yolk index, egg shape index, shell density and yolk cholesterol whereas, shell thickness, was decreased ($P < 0.05$) at the 100% PKC dietary replacement. Shell surface area was also reduced ($P < 0.05$) on 100% SBC (Table 3). Shell weight was also adversely affected by 100% PKC replacement by SBC. Egg mass was significantly

($P < 0.05$) decreased from control to 100% PKC. Shell weight and shell thickness were positively correlated. Yolk cholesterol and hen-day production were also positively correlated. 100% replacement of PKC decreased shell weight, shell thickness, yolk cholesterol and hen-day production. External egg qualities like egg number and weight were significantly ($P < 0.05$) reduced at 100% PKC replacement but body weight gain was unaffected. This

TABLE 5: PERFORMANCE OF LAYERS FED EXPERIMENTAL DIETS

Parameters	DIETARY TREATMENTS			SEM
	1 0% SBC Control	2 50% SBC	3 100% SBC	
Average feed intake/Bird/day (g)	124.74 ^a	117.23 ^b	97.7 ^b	3.1
Hen-day production (%)	57.79 ^a	58.15 ^a	55.44 ^b	0.6
Food conversion efficiency (Kg) feed consumed/Kg egg produced	2.50 ^a	2.58 ^a	2.70 ^b	0.2
Feed cost (N/Kg)	19.10	18.80	18.40	0.19
Cost of production/egg (N)	4.05 ^a	4.07 ^a	3.88 ^b	1.20

ab: Means within same row with different superscripts were significantly different ($P < 0.05$).

observation indicated that feed consumed by the hens was principally used mainly for body maintenance. This opinion is similar to that reported by Degen *et al.* (1988) that hens can use feed or metabolisable energy intake to fulfil maintenance requirement thereby leaving little for egg production.

The fact that shell thickness decreased as SBC inclusion increased indicated that the quality of eggs deteriorated as SBC inclusion increased in the diets. Ousterhout (1980) reported that egg shell quality depended basically on the amount of egg shell deposited per unit area of the egg. Egg weight and egg shell percentage had similar value to that of egg surface area, which confirms the poor quality and/or nutrition of SBC at high level of inclusion as has been reported by Olorede, *et al.* (1997).

Hens fed SBC based diets produced eggs whose yolks gave lower cholesterol values. This observation could be due to low level of unsaturated fat in the SBC diets (Badifu, 1989). Ogunmodede and Ogunlela (1971) reported an increase in the egg yolk cholesterol as degree of unsaturation of oil increased in diets fed to layers. This observation was similarly reported by Longe (1984) and Bartov *et al.* (1971) that feedstuffs with low level of unsaturated fat like SBC can decrease egg yolk cholesterol of bird. The results of blood indices are presented in Table 4. There were no significant differences ($P < 0.05$) in PCV, Hb, RBC, MCV, MCHC, total protein, albumin globulin, urea, creatinine and serum enzymes of hens fed the treatment diets.

However, there were significant ($P < 0.05$) difference in the WBC, MCH, glucose, cholesterol and triglycerides of hens fed treatment diets.

Triglycerides and glutamate transaminase were increased ($P < 0.05$) by 100% dietary inclusion of SBC. The serum cholesterol increased as the egg yolk cholesterol decreased for birds fed 50% and 100% replacement of PKC with SBC.

Reduction in values of Hb, PCV and WBC at 100% PKC replacement may indicate a low protein intake or liver damage or anaemia. Lindsay (1977) reported that Hb falls gradually in animals on a low protein intake, parasitological infestation, or liver damage.

However, Mitruka and Rawnsley (1977); Ross *et al.* (1978) reported 7.00 - 18.6g/dl as normal values of Hb in chickens. Feed intake was low, poor palatability of the diet could be responsible. Morgan and Trinder (1980) reported that SBC rendered diet unpalatable when present at high level because of its astringent tastes and bitterness.

It can be concluded that PKC may be replaced with SBC in layers ration up to 50% level without any adverse effect on internal egg qualities and health of the birds.

REFERENCES

- ADEOGUN, W.O. (1989). Sheabutter cake as an ingredient in broiler chicks rations. M.Sc. Project, Department of Animal Science, University of Ibadan, Ibadan, Nigeria.
- A.O.A.C. (1990). Association of Official Analytical Chemist. Official methods of analysis. 15th ed., Washington, D.C.

SHEABUTTER CAKE IN LAYERS DIET

- BADIFU, G.I.O. (1989). Lipid composition of Nigerian *Butyrospermum paradoxum* kernel J. Fd. Composition analysis 2: 238 - 244.
- BARTOV, I.S., BORNSTEIN and P. BUDOWSKI (1971). Variability of cholesterol concentration in plasma and egg yolks of hens and evaluation of the effect of some dietary oil. *Poult. Sci.* 50: 1357 - 1364.
- DEGEN, A. A.; KAM, M. and ROSENT BRAUCH, S. (1988). Efficiency of utilization of energy for egg production in feed restricted single Comb white Leghorn hens *J. Agric. Sci. Camb* 3: 303 - 308.
- FAJIMI, A.O., BABATUNDE, G.M., OGUNLANA, F.F. and OYEJIDE, A. (1993). Comparative utilization of rubber seed oil and palm oil by broilers in a humid tropical environment. *Anim. Feed. Sci. Technol.* 43: 177 - 188.
- FETERIS, W.A. (1965). A serum glucose method without protein precipitation. *Am. J. Med. Technol.* 31: 17 - 21.
- JAIN, N.C. (1986). *Schalm Veterinary Haematology* 4th ed. Lea and Febiger, Philadelphia U.S.A.
- LINDSAY, D.B. (1977). The effect of feeding patterns and sampling of blood parameters *Occa. Publ. No. 1 Br. Soc. Anim. Prod.* ed. by D. Lister pp. 99 - 120.
- LONGE, O. B. (1984). Effects of increasing the dietary fibre content on a layer's diet. *Br. Poult. Sci.* 25: 187 - 193.
- MITRUKA, B.M. and RAWNSLEY, H.M. (1977). In: *Clinical, Biochemical and Haematological reference values in normal experimental animals* Masson Publishing U.S.A Inc.
- MORGAN, D.C. and h. trinder (1980). The Composition and nutritional value of some tropical and sub-tropical by-product. *Occa. Pub. No. 3 Br. SOC Anim. Prod.*
- OGUNMODEDE, B.K. and OGUNLELA, B. (1971). Utilization of palm, groundnut and melon seed oils by pullets. *Br. Poult. Sci.* 12: 187 - 196.
- OKAI, D.B. and BONSI, M.L.K. (1989). Sheanut cake as a substitute for maize in the diet of growing Gilts. *J. University of Sci. and Tech.* 9(2): 45 - 50, Ghana.
- OLOREDE, B.R., A.A. ONIFADE, A.O. OKPARA and G.M. BABATUNDE (1996). Growth, nutrient retention, haematology and serum chemistry of broiler chickens fed sheabutter cake or palm kernel cake in the humid tropics *J. Appl. Anim. Res.* 10: 173 - 180.
- OLOREDE, B.R., A.A. ONIFADE and G.M. BABATUNDE (1997). Comparative utilization of sheabutter cake and palm kernel cake by broiler chickens. *Nig. J. Anim. Prod.* 24(2) 124 - 131.
- ONIFADE, A.A. (1993). Comparative utilization of three dietary fibre sources by broiler chickens. Ph.D. thesis, Department of Anim. Sci. University of Ibadan.
- OUSTERHOUST, L.E. (1980). Effects of calcium and Phosphorus levels on egg weight and egg shell quality in laying hens. *Poult. Sci.* 59: 1480.
- ROSCHLAN, P. BERNET, E. and GRUBER, W. (1974). Enzymatische bestimmung des gesamt cholesterium in serum *J. Clin. Chem. Biochem.* 12: 403 - 407.
- STALDELMAN, W. (1977). *Quality preservation of shell egg.* Egg Science and Technology 2nd ed. AC. 1 - C Inc. Wesport, C.T.
- SPSS (1988). *Statistical Package for Social Scientist* SPSS Inc. Chicago, IL.
- STEEL, R.G.D. and TORRIE, J.H. (1980). *Principles and procedures of statistics. A Biometrical Approach* 2nd edn. McGraw Hill New York.
- YEH, S.C. and LEVEILLE, G.A. (1972). Cholesterol and fatty acid synthesis in chicks fed different levels of protein *J. Nutri.* 102: 349 - 352.