FFECT OF FEEDING PROCESSED CASSAVA (*Manihot esculenta Crantz*) PEEL MEAL BASED DIET ON THE PERFORMANCE CHARACTERISTICS, EGG QUALITY AND BLOOD PROFILE OF LAYING CHICKEN

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Abstract

A 12 week feeding trial was conducted using three hundred and sixty point of lay Haco strain of pullets to evaluate the effect of feeding diets containing sun-dried cassava peel meal (SDCPM) and lye-treated cassava peel meal (LTCPM) on their performance. Nine experimental diets were formulated. The SDCPM and LTCPM were included at the rate of 50, 60, 70 and 80% levels respectively to replace maize of the control diet. The birds were randomly allotted to nine dietary treatment groups. Diet 1 was the control containing 0% of either SDCPM or LTCPM. Diet 2, 3, 4, and 5 had 50, 60, 70 and 80% of SDCPM respectively while diets 6, 7, 8 and 9 had 50, 60, 70 and 80% of LTCPM respectively. There were four replicates per treatment with ten birds per replicate in a completely randomized block design experiment. Treatment method had effect on the cyanide level of the cassava peels. The lye treated cassava peels had lower cyanide level than the sun-dried peels. The response criteria show that Hen day production of the birds fed 50% SDCPM (70.00%), 50% LTCPM (70.40%), 60% LTCPM (70.80%) and 70% LTCPM (69.90%) compared favourably (P > 0.05) with the birds on the control diet (71.00%). Similar trend was observed for feed conversion efficiency. Birds fed with diets containing cassava peels either SDCPM or LTCPM had lower (P < 0.05) yolk weight and blood cholesterol value than those fed with maize based diets. The PCV, RBC, HB and WBC values of birds fed 70%, 80% SDCPM and 80% LTCPM were lower (P < 0.05) than the values observed for the birds fed the control diet.
It can be concluded that up to 50% of SDCPM and 70% of LTCPM can be used in layer diet to replace maize without adverse effect on performance and blood characteristics of laying chickens.

Key words: performance characteristics, egg quality, blood profile, laying chicken, processed cassava peel meal

INTRODUCTION

One of the solutions to the problem of feed crisis in poultry production is, the use of unconventional feed resources like crop residues and agro-industrial by-products. Cassava peel is one of the agro-industrial by-products that are readily available in countries where cassava is cultivated and processed into food for man. The peel accounts for between 10–13% of tuber by weight. It contains about 5% crude protein and reasonable amount of minerals (Tewe and Kasali, 1982). However, the use of cassava peel as feed for non- ruminant animals is limited by its high fibre content and hydro-cyanic acid which is deleterious to their growth and development (Tewe, 2004)
Many processing methods that have been used to enhance the feeding value of cassava include sun-drying (Akinfala et al., 2007), Parboiling (Salami, 1999), Soaking in water and retting (Salami and Odunsi, 2003). These have however achieved different level of success. Treatment of fibrous feed materials with cocoa pod and palm bunch ash to enhance their feed value has been reported (Adebowale, 1985), but there is a dearth of technical information on the treatment of cassava peel with lye. Alkaline solution of lye may also have a placating effect on hydrocyanic acid in cassava peel.
This study was therefore designed to evaluate the effect of substituting maize in layers diet with different levels of sun-dried cassava peel meal and lye-treated cassava peel meal on laying performance, egg quality characteristics, haematological parameters and blood lipid profile.

MATERIALS AND METHODS

Location

The experiment was carried out at the Poultry unit of the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso in the derived savannah zone of Nigeria. The study area is located between latitudes 8°07' N and 8°12' N and longitudes 4°04' E and 4°15' E. The mean annual rainfall is 1 247 mm with relative humidity of between 75 and 95%. The location is situated at about 500 mm above sea level with a mean annual temperature of 26.2°C (Oguntoyinbo, 1978).

Collection of test ingredient

Cassava peels: Fresh cassava peels from the sweet variety TMS 30552 harvested at 1 year after planting were collected from the 'gari' processing unit of the University farm.
The peels were divided into two equal halves.
Lye: Wood ash was collected from the University bakery and used at one part of wood ash to nine parts of water (w/w basis). The mixture was thoroughly mixed and allowed to stay for 12 hours. The mixture was then filtered to obtain the lye (filtrate).

Preparation of test ingredients

One half of the peels was rinsed in water to remove sand and other foreign particles and then spread out thinly on polythene sheets to sun dry until constant weight was obtained. The peels were turned at regular intervals to prevent fermentation and to allow even drying.
The other half was soaked in lye by pouring 10 kg of fresh cassava peels into 10 litres of lye and allowed to stay for 10 minutes. It was then drained and packed in thick polyethylene bags, tied and left for 24 hours before been dried in the sun by spreading thinly on polyethylene sheets with turning at intervals to prevent fermentation and allow even drying. The peels were sun-dried until constant weight was obtained.

Preparation of diet

A corn (yellow)/soybean based diet was formulated which served as the control diet. In the other diet SDCPM or LTCPM replaced 50, 60, 70 and 80% maize in

Tab. 1: Percentage composition of experimental diet

Ingredient	Control	SDCPM Level of substitution (%)				LTCPM Level of substitution (%)			
	$0_{(1)}$	$50_{(2)}$	$60_{(3)}$	$70_{(4)}$	$80_{(5)}$	$50_{(6)}$	$60_{(7)}$	$70_{(8)}$	$80_{(9)}$
Maize (Yellow)	42.4	21.2	17.0	12.7	8.5	21.2	17.0	12.7	8.5
Cassava peel	0.0	21.2	25.4	29.7	33.9	21.2	25.4	29.7	33.9
Maize offal	10.0	20.0	20.0	18.0	17.0	20.0	20.0	18.0	17.0
Rice bran	16.2	4.4	1.5	1.0	0.5	4.4	1.5	1.0	0.5
Palm kernel oil	2.0	2.0	4.0	4.5	4.0	2.0	4.0	4.5	4.0
Fish meal	3.5	4.0	4.5	5.0	5.0	4.0	4.5	5.0	5.0
Soybean meal	15.7	17.0	17.5	19.0	21.0	17.0	17.5	19.0	21.0
Bone meal	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Oyster shell	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Lysine	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
*Premix	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Crude Protein	16.3	15.8	15.8	16.3	16.7	15.7	15.5	16.2	16.6
Crude Fibre	5.1	5.2	5.3	5.4	5.5	5.5	5.5	6.0	5.9
Metabolizable Energy (Kcal/kg)	2 754	2 749	2 837	2 868	2 816	2 735	2 830	2 852	2 806

*Premix composition: Vitamin A, 200 000.00 IU, Vit. D3, 40 000.00 IU, Vitamin E (mg) 460, Vitamin K3 (kg) 40, Vitamin B1 (mg) 60, Vitamin B2 (mg) 120, Niacin (mg) 1 000, Calcium pantothenate (mg) 200, Vitamin B6 (mg) 100, Vitamin B12 (mg) 05, Folic acid (mg), 20, Biotin (mg) 1, Chlorine chloride (mg) 8 000, Manganese (mg) 2 400, Iron (mg) 2 000, Zinc (mg) 1 600 Copper (mg) 170, Iodine (mg) 30, Cobalt (mg) 6, Selenium (mg) 24, Anti-oxidant (mg) 2 400 the control diet. All diets were Iso-nitrogenous and Iso-calonic. The percentage composition of the diets is presented in Table 1.

Animals and housing

Three hundred and sixty (360) points of lay Haco strains of pullets obtained from a reputable commercial hatchery was used for the experiment. The birds were feed proprietary layer diet from point of lay at 22 weeks until they were twelve weeks in laying to ensure that they were at 50% average laying percentage. The birds were randomly divided into 9 treatment groups of forty birds each. Each treatment was replicated four times with 10 birds per replicate in a complete randomize block design experiment. The birds were housed at the rate of 2 birds per cell in two tier galvanized cages. Feed and water were offered *ad libitum*. Deworming and prophylactic medication with vitamins was done and routine vaccination with Newcastle disease vaccine (Lasota) was done once. This was administered orally during the experiment to minimize handing of the birds which could predispose them to stress. The experiment lasted for twelve weeks.

Data collection:
Feed intake was monitored daily while egg collection was done twice daily in the morning at 9:00–10:00 hour and evening at 14:00–15:00 hour. Records were taken of these parameters.

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Egg weight: The weight of each egg was measured with Ohaus electronic top loading weighing balance to the nearest 0.01 g while the egg length and breadth were measured using a ruler in centimetre.

Percentage hen-day production: This was calculated as:

$$\frac{Number\ of\ eggs\ produced}{Number\ of\ hens \times number\ of\ days} \times 100$$

Egg quality analysis: Twelve eggs per treatment were randomly picked from eggs collected during the last three days of the week and weighed individually and carefully broken into a clean smooth flat surfaced to measure the following internal characteristics.

Yolk: The yolk height of the broken egg was measured directly without removing it from the albumen using tripod micrometer and recorded to the nearest 0.1 cm. The yolk diameter was measured using a pair of vernier calipers, while the yolk colour was determined with the aid of Roche colour fan. The yolk index was calculated as the ratio of the yolk height to the diameter.

$$Yolk\ index = \frac{Height\ of\ yolk\ (cm)}{Diameter\ of\ yolk\ (cm)}$$

Shell thickness: The shell of the broken egg was further broken into small pieces, the shell membrane was manually removed and the thickness of the egg shell was measured using a micrometer screw guage expressed in millimetres.

Albumen height: This was measured by using a tripod micrometer calibrated in 0.1 mm. The dimension measured was taken between the yolk edge and the external edge of the thick albumen. The values obtained were used together with the egg weight to calculate the Haugh unit.

Haugh unit: The Haugh unit of egg was calculated using the formula of Haugh (1937).

$$HU = 100\log (H + 7.57 - 1.7W^{0.37})$$

Where:
HU = Condition of thick albumen in haugh units
H = Height of thick albumen in mm
W = Weight of egg in gram

Feed conversion: This was calculated as kilogram feed consumed per kilogram egg lay.

Egg length and breadth: These were measured using a ruler in centimeter.

Egg yolk cholesterol: This was determined using a method described by Folch et al. (1957)

Blood collection: Blood was collected from eight birds per treatment at 28th and 56th day of the study via the wing web veins for haematological and biochemical analysis. Blood meant for haematological analysis was collected into plastic bottles containing anti-coagulant (Ethylene diamine tetra acetic acid –EDTA); while the blood meant for serum analysis was collected into plastic bottles that contained no anti-coagulant.

Analytical methods: Packed cell volume (PCV) was determined using micro – haematocrit centrifugation method of Jain (1986). Red blood cell counts (RBC) and white blood cell counts (WBC) were determined using haemocytometer method described by Jain (1986). Serum alanine aminotransferase (ALT) and aspartate aminotrasferase (AST) were determined according to Reitman and Frankel (1957). Blood total cholesterol was determined using the method of Kim and Goldberg (1969).

Serum phospholipid was determined using the methods described by Tietz (1995).

Total lipid was determined by the methods of Folch et al. (1957), free fatty acid by the method of Pearson (1976). Triacylglycerol was determined by the methods of Fletcher (1968).

Feeds, SDCPM and LTCPM were analyzed for proximate composition using the methods of AOAC (1990) while the gross energy was determined using bomb calorimeter.

Tab. 2: Proximate composition of sun-dried cassava peel meal and lye treated cassava peel meal (%)

Component	SDCPM	LTCPM
Dry matter	88.80	88.60
Crude protein	5.24	5.20
Crude fibre	12.38	12.20
Ether extract	3.97	3.90
Ash	5.16	7.20
Nitrogen free extract	73.25	71.50
Gross energy (MJ/kg)	4 340.12	4 338.12
Hydrocyanic acid (Mg/kg)	50.00	30.00

SDCPM = Sun dried Cassava peels, LTCPM = Lye treated Cassava peels

The hydrogen cyanide levels which gives a measure of the acidity of the peels was determined using the procedure described by Bradbury et al. (1999) and Egan et al. (1988).

Statistical analysis: All data obtained were subjected to one-way analysis of variance using the general linear model procedure (GLM) of SAS (2000) and where significance were indicated, Duncan's option of the same computer package was used to separate the means.

RESULTS

The results of the proximate composition of SDCPM and LTCPM are presented in Table 2. Sun-dried cassava peel meal and lye-treated cassava peel meal were comparable in terms of crude protein (5.24 vs. 5.20%), crude fibre (12.38 vs. 12.20%), ether extract (3.97 vs. 3.90%), NFE (62.05 vs. 60.10%) and gross energy (3340.12 vs. 3 338.12 MJ/kg). In this study, hydro-cyanic acid was however lower in LTCPM (30.00 mg/kg) than in SD-

Tab. 3: Performance characteristics and egg quality parameters of laying chicken fed diets containing differently processed cassava peel meal (n = 40)

Parameter	Control	SDCPM level of cassava peel meal substitution (%)				LTCPM level of cassava peel meal substitution (%)				SEM
	$0_{(1)}$	$50_{(2)}$	$60_{(3)}$	$70_{(4)}$	$80_{(5)}$	$50_{(6)}$	$60_{(7)}$	$70_{(8)}$	$80_{(9)}$	
Weight gain (g)*	112.0	100.0	110.0	115.0	95.0	110.0	105.0	108.0	98.0	20.0
Feed Intake (g)	122.4	123.2	122.0	124.1	125.6	122.7	124.2	125.5	124.6	4.0
Hen-day production (%)	71.0^{a}	70.0^{a}	67.2^{b}	66.7^{b}	65.9^{b}	70.4^{a}	70.8^{a}	69.9^{a}	67.4^{b}	3.0
Egg weight (g)	56.2	57.1	55.9	55.8	55.8	56.9	57.1	56.9	56.9	2.8
Feed conversion (kg feed/kg egg)	2.7^{b}	2.7^{b}	3.0^{a}	3.0^{a}	3.1^{a}	2.7^{b}	2.7^{b}	2.8^{b}	3.1^{a}	0.4
Feed cost (kg)	53.5^{a}	50.9^{b}	50.5^{b}	50.0^{b}	50.9^{b}	50.8^{b}	50.6^{b}	50.2^{b}	50.0^{b}	1.0
Cost/kg egg**	139.8^{c}	138.9^{c}	162.9^{b}	170.0^{a}	169.6^{b}	138.3^{c}	138.6^{c}	138.0^{c}	170.0^{a}	2.0
Egg length (cm)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	0.4
Egg breath (cm)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	0.3
Egg shell weight (g)	6.5	6.2	5.9	6.1	6.2	6.2	6.3	6.1	5.9	1.3
Egg shell thickness (X/10^2 0 m)	34.3	33.9	33.8	33.8	33.9	35.1	35.2	35.5	36.0	4.0
Yolk weight (g)	11.8	11.8	11.9	11.7	11.9	11.8	11.9	11.8	11.6	1.0
Albumen weight (g)	30.8	30.8	30.7	30.6	30.7	30.7	30.5	30.6	30.7	1.0
Yolk index	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.1
Yolk colour score	3.6^{a}	2.5^{b}	2.5^{b}	2.4^{b}	2.5^{b}	2.4^{b}	2.4^{b}	2.4^{b}	2.4^{b}	0.6
Haugh unit	86.5^{a}	84.2^{a}	79.2^{b}	78.8^{b}	78.6^{b}	85.4^{a}	85.3^{a}	85.2^{a}	78.6^{b}	3.0
Yolk cholesterol (mg/g)	1.9^{a}	1.7^{ab}	1.6^{ab}	1.4^{b}	1.3^{b}	1.6^{ab}	1.6^{ab}	1.5^{b}	1.5^{b}	0.4

^{abc} Means with different superscripts along the same row are significantly different ($p < 0.05$)
*From 32 weeks to 44 weeks; **145 = 1 US dollar

CPM (50.00 mg/kg) reflecting the effectiveness of lye solution in reducing the cyanide.

The performance characteristics and egg quality parameters of birds fed SDCPM and LTCPM is presented in Table 3. Dietary treatments had no significant ($P < 0.05$) effect on weight gain, feed intake and egg weight. Hen-day production, feed to gain ratio, feed cost and feed cost/kg egg were however significantly ($P < 0.05$) affected by dietary treatments. Hen-day production of birds fed diets 2 (50% SDCPM), 6 (50% LTCPM), 7(60% LTCPM) and 8(70% LTCPM) compared favourably with that of diet 1 (control) but values obtained for those fed diets 3 (60% SDCPM), 4 (70% SDCPM), 5(80% SDCPM) and 9(80% LTCPM) were significantly ($P < 0.05$) lower. The birds were able to tolerate up to 50% SDCPM and 70% LTCPM after which egg production and feed utilization declined.

Both SDCPM and LTCPM reduced feed formulation cost significantly ($P < 0.05$) at all levels of substitution. Also, cost of feed consumed per kilogram egg of birds fed diets 2, 6, 7 and 8 compared favourably with that of control diet. Values obtained for layers fed diets, 3, 4, 5 and 9 were however higher ($P < 0.05$) than of control and other diets. The egg quality characteristics of the birds show that dietary treatments had no significant effect on egg length, egg breadth, shell weight, shell thickness, yolk weight and yolk index. However, yolk colour score, Haugh unit and yolk cholesterol were significantly ($P < 0.05$) affected by feeding cassava peel meal. Birds fed SDCPM and LTCPM had lower ($P < 0.05$) egg yolk colour score than those fed whole maize based diet.

Eggs laid by birds fed diets 1, 2, 6, 7 and 8 had similar Haugh unit values which were significantly ($P < 0.05$) higher than those fed diets 3, 4, 5 and 9. Diets that gave similar egg producing ability with control diet also had comparable values in terms of Haugh unit. Egg yolk cholesterol content of birds fed diets 4 (70% SDCPM), 5 (80% SDCPM), 8 (70% LTCPM) and 9 (80% LTCPM) were lower ($P < 0.05$) than those fed whole maize based diet. Eggs of the birds fed other diets were however comparable to the control diet in terms of cholesterol content. The results of haematological, enzyme activity and blood lipid of the birds is presented in Table 4. Packed cell volume, (PCV), red blood cell counts (RBC) and haemoglobin concentration (Hb) of birds fed diets 2 (50% SDCPM), 3 (60% SDCPM), 6 (50% LTCPM), 7 (60% LTCPM) and 8 (70% LTCPM) were similar to that of the control (maize-based) diet. Values observed for those fed diets 4 (70% SDCPM), 5 (80% SDCPM) and 9 (80% LTCPM) were however significantly ($P < 0.05$) lower. No significant difference was observed in the ALT and AST values. Significant ($P < 0.05$) effects of diets were however observed on total blood cholesterol, total lipid, free fatty acid, phospholipids and triglyceride. The values observed for total cholesterol, total lipid, free fatty acid phospholipids and triglyceride was lower ($P < 0.05$) in birds fed cassava peel meal diets than those fed the control (maize-based) diet.

Tab. 4: Haematological, enzyme activity and blood lipid profile of layers fed differently processed cassava peel meal

Parameter	Control	SDCPM Level of cassava peel substitution (%)				LTCPM Level of cassava peel substitution (%)				SEM
	$0_{(1)}$	$50_{(2)}$	$60_{(3)}$	$70_{(4)}$	$80_{(5)}$	$50_{(6)}$	$60_{(7)}$	$70_{(8)}$	$80_{(9)}$	
Packed cell volume (%)	34.2^{a}	33.8^{a}	33.7^{a}	31.1^{b}	30.4^{b}	33.5^{a}	33.4^{a}	33.1^{a}	31.1^{b}	1.8
RBC (x 10^6/ml)	3.4^{a}	3.3^{a}	3.2^{a}	2.8^{b}	2.7^{b}	3.3^{a}	3.2^{a}	3.1^{a}	2.8^{b}	0.3
Hb (g/dl)	10.7^{a}	10.5^{a}	10.3^{a}	9.6^{b}	9.5^{b}	10.6^{a}	10.4^{a}	10.2^{a}	9.7^{b}	0.5
WBC (x 10^3/ml)	9.4^{a}	8.2^{ab}	7.9^{b}	7.6^{b}	7.3^{b}	8.3^{ab}	8.2^{ab}	8.0^{ab}	7.5^{b}	0.6
ALT (lU/L)	22.6	22.3	22.4	22.5	22.2	22.1	22.5	22.3	22.1	1.0
AST (lU/L)	133.8	133.7	133.6	133.4	133.3	133.7	133.6	133.2	133.4	2.0
TOTAL cholesterol (mg/ml)	2.5^{a}	2.0^{ab}	1.6^{b}	1.6^{b}	1.6^{b}	1.6^{b}	1.5^{b}	1.5^{b}	1.5^{b}	0.6
TOTAL lipid (mg/ml)	12.3^{a}	11.2^{ab}	10.0^{b}	9.8^{b}	9.8^{b}	11.2^{ab}	10.1^{b}	9.9^{b}	9.8^{b}	1.5
Free fatty acid (mg/ml)	0.6^{a}	0.4^{b}	0.4^{b}	0.4^{b}	0.4^{b}	0.4^{b}	0.4^{b}	0.4^{b}	0.4^{b}	0.1
Phospholipids (mg/ml)	0.3^{a}	0.2^{b}	0.1^{b}	0.1^{b}	0.1^{b}	0.2^{b}	0.2^{b}	0.2^{b}	0.1^{b}	0.1
Triglyceride (mg/ml)	10.7^{a}	8.0^{b}	8.0^{b}	8.9^{b}	8.9^{b}	8.0^{b}	8.1^{b}	8.9^{b}	8.9^{b}	1.0

[ab] Means with different superscripts along the same row are significantly different ($P < 0.05$)

DISCUSSION

In this study, the proximate composition of sun-dried and lye-treated cassava peel meal was similar except in terms of hydrocyanic acid concentration. This is in line with Osei and Twumasi (1989) who had earlier reported that processing method does not seem to influence the proximate composition of cassava peels. The lower concentration of hydrocyanic acid in lye-treated cassava peel meal could be due to the effect of lye. Alkaline lye could have had neutralizing effect on hydrocyanic acid thereby resulting in its detoxification. The crude protein content observed for SDCPM (5.24%) and LTCPM (5.20%) in this study was comparable with the values reported by Salami (1999) for parboiled cassava peel meal. This indicates that treatment of cassava peel with lye solution does not alter the protein content of the peel.
Birds in the study gained some weight at the end of the experiment. This is an indication that the diets were adequate in nutrient composition to sustain egg production and growth. The results obtained however did not agree with the findings of Mullar and Chou (1974) and Stevenson and Jackson (1983) who reported that a rate up to 50% cassava in the diet impaired the growth performance of poultry. Longe and Oluyemi (1977) as well as Wyllie and Kinabo (1980) also reported a linear decrease in weight of poultry resulting from progressive increase in quantity of cassava in the ration. Gomez (1985) showed that the diets having more than 10 to 20% cassava varieties with low or high hydrocyanic contents, gave similar decrease in weight. The weight increase observed in this study could be due to the fact that the birds were still growing physiologically.
The similarity that was observed in feed intake of birds fed cassava peel meal and maize based diet disagrees with the report of Sogunle et al. (2007) who observed higher feed intake of layers fed cassava peel meal based diet. However Banjoko et al. (2008) reported decreased feed intake in layers fed cassava products and attributed this to the likelihood of the presence of anti-nutritional factors particularly cyanide which according to Tewe (1977), naturally reduced feed intake. The comparable values obtained for the feed intake could be due to the addition of palm kernel oil to the diets which probably reduced the dustiness and enhanced feed intake (Tietz, 1995 and Brown et al., 1999).
In this study, birds were able to tolerate up to 50% SDCPM and 70% LTCPM after which egg production and feed utilization declined. This can be attributed to residual hydrocyanic acid which probably reached an intolerable level in these diets. This observation also suggests that sun-drying and lye-treatment of cassava peel could only reduce and not totally remove hydrocyanic acid content in cassava peel.
The reduction observed in the unit cost of diet that contained cassava peel compared with control diet can be attributed to the lower price of cassava peel compare to that of maize. The lower value observed for feed cost per kilogramme egg laid is in agreement with the report of Obikaonu and Udedibie (2008) that inclusion of cassava peel meal in pigs and poultry resulted in significant economic benefits.
The reduction in the egg yolk colour score of birds fed cassava peel-based diets could be due to less pigmentation of cassava peel compared with yellow maize.
In this study, birds fed diets 3, 4, 5 and 9 recorded lower Haugh units than those fed control diet. This could be due to hydrocyanic acid in cassava peel meal which probably reached threshold level in these diets. Fortunately however, diets that gave similar egg producing ability with control diet also had comparable values in terms of Haugh unit.
The lower egg yolk cholesterol values observed in birds at 70 and 80% inclusion level can be attributed to higher fibre content of the diets. This supports the hypothesis that increased dietary fibre often result in reduction in availability of cholesterol for incorporation into lipoproteins (Story and Furumoto, 1990). The presence of hydrocyanic acid in cassava peel can also exert hypochlesteronic influence as glycosides have ability to interfere with the intestinal absorption of the dietary cholesterol and lipid (Brown et al., 1999).
The depression that was observed in PCV, RBC and Hb of birds fed diets 4, 5 and 9 could be due to anti-nutritional factors possibly residual hydrocyanic acid in these diets. The hematological values observed in this study were higher than that reported by Ameen et al. (2007). This may be an indication of seasonal Variation and adequate nutrient composition of the diet which probably enhance the ability of the birds to tolerate cyanide. The values observed in this study however fall within the range recommended by Mitruka and Rawnsley (1977) for chicken.
The lower cholesterol value that was observed in the blood of birds fed cassava peel meal-based diet could be due to the fibrous nature of cassava peel meal (Brown et al., 1999). This effect had been attributed to the use of lipid-based moiety for energy generation rather than body fat formation (Akinfala et al., 2007).

CONCLUSION

The results obtained in this study revealed that lye treatment of cassava peels was more effective than sun drying. Although both SDCPM reduced feed cost significantly at all levels of substitution, cost/kg egg shows that SDCPM can replace up to 50% maize while LTCPM can replace up to 70% maize in commercial layer diet beyond which egg production and feed utilization decline.

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