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Growth response, carcass characteristics and some blood parameters of broiler chickens fed sun-dried and fermented cassava peel meal based diets

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Abstract
Eight weeks (56days) experiment was conducted to determine the growth response, carcass characteristics and selected blood parameters of broiler chickens fed sun-dried and fermented cassava Peel meal based diets. One hundred and fifty (150 day old fedan broiler chicks were assigned to five dietary treatment groups of thirty (30) birds each with three replicates of ten (10) birds per replicate in a completely randomized design. The experimental diets were formulated to contain O, 15 and 30% levels of either sundried or fermented cassava peel meal and designate T_1 (0% CPM), T_2 (15% DCPM), T_3 (15% FCPM0, T_4 (30% DCPM) and T_5 (30%FCPM), respectively. Birds fed the diets with 30% DCPM ate the most food while the birds on the diets with 30% FCPM grew the bes and had the best feed conversion ratio. Carcass characteristics and organ weights did not significantly (P>0.05) differ among dietary treatments. With the exception of serum calcium, all the haematological and serum biochemical characteristics measured were consistently significantly higher (P<0.05) in birds fed the 30% FCPM based diet, although all values were within normal range. The results showed that broilers could tolerate up to 30% of either sundried or fermented cassava peels in their diet. When the two methods of processing were compared, in terms of growth performance, the fermented cassava meal based diets clearly demonstrated superiority.

Keywords: Carcass characteristics, cassava peel, blood parameters, and broiler chickens

Introduction

Broiler production remains the quickest means of bridging the animal protein gap in Nigeria and other developing countries because of their fast growth rate and potential for rapid returns on investment. Unfortunately, inspite of the rapid increase in human population, and massive urbanization and the rise in the demand for poultry products, the poultry industry is on the decline. Among other factors, feed cost, which accounts for about 60-75% of production cost [1], and sometimes more, is the major constraint. Thus research effort towards cheap alternative feed ingredients for compounding broiler diets continue to intensify.

Cassava (Manihot spp) is a root crop widely cultivated in Nigeria and most tropical and sub-tropical regions of the World. The peel is a major by-product of the cassava processing industry in production areas, comprising about 10-15% of the whole cassava plant [2] about 35% of the tuber weight [3] and 8-10% of root dry matter [4]. The chemical composition of various parts of the plant have been reported [4, 5]. And despite current promotion and increases in production, processing and utilization of cassava for human food and industrial uses only about 5% of cassava is used for livestock feed in Nigeria [6]. For now, the peels are still being discarded as waste, though the potential for their utilization as feed ingredient has been estimated at 10% of the cassava production total of about 5.2million tonnes per annum in Nigeria [7].

Cassava peel is a major by- product of cassava tuber root processing industry. In parts of Nigeria where cassava is grown and the tubers processed, the peel is largely underutilized as a livestock feed. The major factor limiting the use of cassava and its by-products as human food and livestock feedstuff is the presence of the anti-nutritional factors, linamarin and lataustralin, a cyanogenic glucoside [8], which on hydrolysis by the enzyme, linamerase, liberates the toxic hydrocyanic acid, HCN [9]. Cassava peels are reported to contain higher HCN, protein and phytate than other parts of the tuber [10].

Various techniques to reduce the cyanide content of cassava have been extensively reviewed by [11] and include soaking, drying and fermentation and suggested the application of advanced technologies for industrial commercialization of safe cassava food/feed ingredients. This study is aimed at a comparative evaluation of growth performance, carcass characteristics and some blood parameters of broilers fed diets with sun-dried and fermented cassava peel meal based diets with a view to determining the better of the two methods and proposing safe levels of inclusion of cassava peels in the diet of broilers.

Materials and Methods

Study Area

The research was carried out in the Poultry unit of the Teaching and Research Farm, Cross River University of Technology, Obubra Campus, Cross River State, Nigeria. The area lies along longitude 8-9^{0}E and latitude 6-7^{0}N of the equator, and has an average annual rainfall and temperature of about 500-1070mm and 21-30 ^{0}C, respectively, [12].

Experimental diets

Fresh cassava peels were collected from garri producing families in Ovonum village, the University's host community. The peels were washed to get rid of sand sun-dried for five [5] days and milled to produce the sun-dried cassava peel meal (DCPM). Another portion of the fresh cassava peels were moistened, packed in air tight bags and placed on a wooden platform for three [3] days for fermentation to take place. They were then air-dried and milled to produce the fermented cassava peel meal (FCPM). Five [5] starter and Five [5] finisher diets containing either 15% or 30% DCPM or FCPM were formulated to satisfy the nutritional requirements of the two production phases as recommended by [13] and shown in Tables 1 and 2, respectively. Diet 1 (Treatment 1) had no cassava peel meal of any kind and served as the control, T_2 (15% DCPM), T_3 (15% FCPM), T_4 (30% DCPM) and T_5 (30% FCPM) in that order.

Table 1: Proximate Composition of Experimental Diets

Treatments	C.P%	EE%	C.F%	ASH%	NFE%	Moisture%
T1	12.25	10.50	4.25	3.00	64.00	15.80
T2	9.50	10.50	8.00	3.00	71.00	16.80
T3	13.25	11.50	10.75	5.00	65.00	18.80
T4	14.00	8.00	13.00	5.00	68.00	19.60
T5	11.25	6.50	6.50	6.00	72.00	18.00

Experimental Animals and their Management

One hundred and fifty (150) day old Fedan broiler chicks were purchased from a reputable local distributor and randomly assigned to five (5) treatment groups of three replicates each. Each replicate had ten (10) birds, totaling thirty (30) birds per treatment. The birds were reared on deep litter pens. Water and feed were administered *ad libitum* for the eight weeks (56 days) of the experiment. Appropriate vaccinations and prophylactic medications were also administered as and when due. Mortality was also recorded.

Data on daily feed intake and weekly live weight were obtained. At the end of the feeding trial, one bird was selected from each replicate for blood analyses and carcass studies.

Blood Samples and Analyses

10mls of blood were collected from each bird per replicate at the 8th week. Of this amount, 5ml were collected in sterile-labeled bijou sample bottles containing Ethylene diamine tetra acetic acid (EDTA) for haematological analysis, the remainder 5ml were collected in anti-coagulant free sample bottles allowed to clot and centrifuged to separate the serum for the determination of biochemical parameters. Erythrocyte counts (RBC) and leucocyte counts (WBC) were carried out in an improved Neubaeur haemocytometer (Marienfeld, Germany) using a modified Yokoyama diluting fluid. Basic erythrocyte indices - mean cell haemoglobin concentration (MCHC), mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) - were computed from haemoglobin values and erythrocyte counts. Computerized method employing System KX-2IN^{TM} Automated Hematology Analyzer was used in blood analysis, the KX-2IN is an ideal hematology analyzer for a clinical satellite laboratory or research testing. Spectrophotometric method was used for biochemical analysis as described by Svobodova *et al*., (2003). While the plasma electrolytes were determined using corning 400 flame photometer. Other metals was determined using (a back) Model 200A flame of the Atomic Absorption Spectrophotometer (AAS).

Total protein level, plasma glucose, and serum albumin determinations were carried out using the methods described by [12]. The plasma electrolytes - sodium, magnesium and potassium - were determined by flame photometry using a Corning 400 photometer (Fiscientico, Zurich). Plasma magnesium was determined by flame emission spectrophotometry using a Flame Atomic Spectrophotometer, model 200A [13]. Plasma chloride was assessed using the titrimetric method described by [14], while plasma phosphorus was determined by spectrophotometry (Fiske and Subbarow 1956)

Design and Statistical Analyses

Data obtained were subjected to one-way analysis of variance (ANOVA) using the SAS statistical package [14], in a completely randomized design. Where significant treatment effects were observed, means were separated using the Duncan multiple range test of the same software.

Results

Growth performance and Carcass Characteristics

A summary of the growth performance and carcass characteristics is presented in Table 4. Average daily feed intake wwas least in the control diet compared to the diets containing cassava peel meals. Birds fed the sun-dried cassava peel meal (SDCPM) consumed more feed than those on diets with fermented cassava peel meals (FCPM). As the level of SDCPM in the diet increased from 15 to 30%, feed intake increased significantly (P<0.05). On the contrary, there was a significant (P<0.05) decrease in feed intake as the level of FCPM increased from 15 to 30% in the diet. At the 15% level of inclusion, there was no significant difference in feed intake between birds fed either the DCPM and FCPM, but at the 30% level of inclusion, feed intake decreased significantly(P<0.05)with birds on the FCPM diet consuming less.

Average final live weight and daily gain was superior in birds receiving the FCPM diets. Generally, the average final live weight, shrunk with and daily weight gain were not significantly (P>0.05) affected by the dietary treatments. Similarly, the shrunk weight dressed with carcass cuts and abdominal fat pad weights did not show any trends and did not differ significantly (P>0.05) among the treatments. However, feed conversion ratio was highest with birds receiving diets containing 30% FCPM and lowest for birds on 15% FCPM, and this difference was significant (P<0.05).

Haematological and Serum biochemical parameter

Haematological and serum biochemical parameters measured are shown in table 5. With the exception of calcium, all the parameters were consistently highest (P<0.05) with the birds fed the 30% FCPM based diet. In most cases, the lowest values were obtained from birds on the control diet, with no cassava peel meal inclusion.

Discussion

Feed intake significantly increased as cassava peel meal was included in the diet, although the birds with 30% FCPM ate less than the other treatment groups. In all, the inclusion of cassava peel meal in the diets improved the general performance of the birds, with the best results in terms of growth and feed conversion ratio, recorded from birds on the 30% FCPM inclusion.

Although reports of studies in the use of cassava peels in broiler diets is inconsistent, the observations in this study agrees with those of [16-19] has reported that sun-drying is more effective at eradicating cyanide than oven drying because with this method the cyanide is in contact with Linamase for a long period. Earlier, [20] had reported that sun-drying alone can eliminate almost 90% of initial cyanide content. Fermentation has also been reported to reduce the cyanide content of cassava products [21-23], reported that samples that have been peeled, fermented and sun-dried had higher water holding capacity and digestible fiber. In this study, the fermentation of the cassava peels, may have improved the utilization of nutrients, and counteracted the negative effect of cyanide and brought about the overall performance of the broiler chickens.

With the exception of calcium, all the other blood parameters measured were consistently highest in the birds fed the 30% FCPM. The values obtained in this study were within the normal range for avian species [24] and posed no health impediment to the birds. The results in this study shows that the animals did not suffer from the synthesis of red blood cells (erythrogenesis) nor did they suffer from leukocytosis.

Conclusion and Applications

This study has shown that broilers could conveniently tolerate up to 30% cassava peel meal in their diets whether sun-dried or fermented without any adverse effect on the health of the birds. And that the birds fed the fermented cassava peel meal based diets gave the better performance. It is also possible that substantial cost savings in production can be made with the use of this ingredient in broiler diet.

Table 2: Gross Composition of Experimental Broiler Starter Diet

Ingredients	Treatments				
	T1 (0%CPM)	**T2 (15%DCPM)**	**T3 (15%FEPM)**	**T4 (30%DCPM)**	**T5 30%(FCPM)**
Maize	47.99	21.43	21.43	4.77	4.77
Soybean	34.10	37.67	37.67	39.33	39.33
Wheat offal	10.00	10.00	10.00	10.00	10.00
Cassava Peel Meal	-	15.00	15.00	30.00	30.00
Fish meal	3.50	3.50	3.50	3.50	3.50
Bone meal	3.00	3.00	3.00	3.00	3.00
Palm oil	-	8.00	8.00	8.00	8.00
Nacl	0.30	0.30	0.30	0.30	0.30
*Vitamin/mineral Premix	0.50	0.50	0.50	0.50	0.50
Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00
Calculated Nutrients					
Crude Protein (%)	23.44	23.60	23.58	23.50	23.48
Crude Fibre (%)	4.39	5.36	5.29	6.43	6.43
Metabolisable Energy(Kcal/kg)	3060.19	3193.57	3193.57	3014.99	3014.99
Calcium (%)	1.41	1.89	1.89	1.90	1.90
Phosphorus (%)	0.48	0.43	0.43	0.39	0.39

*To provide: Vit. A, 10,000 I.U, Vit.D3,2000 I.U, Vit.E,51.U, Vit.k, 2mg; Riboflavim, 4.2mg; Vit.B12, 0.01mg; Pantothenic acid, 5mg; Nicotinic acid, 20mg; Folic acid, 0.5mg; chlorine, 3mg; Mg, 56mg; fe, 20mg; Cu, 10mg; Zn, 50mg; Co, 125mg

Table 3: Gross Composition of Experimental Broiler Finisher Diets

Ingredients	**Treatments**				
	T1 (0%CPM)	**T2 (15%DCPM)**	**T3 (15%FEPM)**	**T4 (30%DCPM)**	**T5 30%(FCPM)**
Maize	40.997	23.43	23.99	6.97	6.97
Soybean	33.103	35.11	35.11	37.13	37.13
Wheat offal	10.00	10.00	10.00	10.00	10.00
Cassava Peel Meal	-	15.00	15.00	30.00	30.00
Fish meal	3.50	3.50	3.50	3.50	3.50
Bone meal	3.00	3.00	3.00	3.00	3.00
Palm oil	-	8.00	8.00	8.00	8.00
Nacl	0.30	0.30	0.30	0.30	0.30
*Vitamin/mineral Premix	0.50	0.50	0.50	0.50	0.50

Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00
Calculated Nutrients					
Crude Protein (%)	20.43	20.56	20.58	20.72	20.56
Crude Fiber (%)	4.15	5.25	5.25	6.35	6.35
Metabolisable Energy(Kcal/kg)	3150.71	3200.95	3200.95	3017.89	3017.95
Calcium (%)	1.27	1.27	1.27	1.27	1.27
Phosphorus (%)	0.92	0.88	0.88	0.85	0.85

*To provide: Vit. A, 10,000 I.U, Vit.D3, 2000 I.U, Vit. E, 51.U, Vit. k, 2mg; Riboflavim, 4.2mg; Vit.B12, 0.01mg; Pantothenic acid, 5mg; Nicotinic acid, 20mg; Folic acid, 0.5mg; chlorine, 3mg; Mg, 56mg; fe, 20mg; Cu, 10mg; Zn, 50mg; Co, 125mg

Table 4: Performance of Broiler Chickens fed Sun-dried and fermented cassava peel meal bas diets

Parameters	Treatments					
	T1 (0%CPM)	**T2 (15%DCPM)**	**T3 (15%FCPM)**	**T4(30%DCPM)**	**T5 (30%FCPM)**	**SEM**
Average initial live weight(g)	50	50	50	50	50	0.00
Av. Final live weight (g)	2167.5	2267.2	2047.5	2284.2	2305.0	106.77
Av. daily weight gain	37.81	39.59	35.66	39.89	40.26	1.52
Av. daily feed intake (g)	96.53^{d}	107.24^{b}	106.89^{b}	109.03^{a}	102.53^{c}	2.06
Av. shrunk live weight, SLW (g)	2066.5	2166.6	2200.0	2266.6	2100.0	36.51
Av. Dressed weight (g)	1566.6	1433.3	1466.6	1683.3	1600.0	79.93
Dressed percentage (%)	75.81	66.15	66.66	74.26	76.19	3.44
Feed Conversion ratio	2.60^{b}	2.71^{b}	2.99^{a}	2.73^{b}	2.55^{b}	0.08
Thigh/shank weight (%SLW)	30.61	24.57	24.24	25.73	27.78	1.93
Breast/wing weight (%SLW)	37.88	29.15	29.55	35.28	35.71	1.53
Back weight(%SLW)	16.97	11.15	13.64	13.96	14.29	1.09
Heart weight (%SLW)	0.46	0.57	0.55	0.45	0.62	0.05
Intestine weight (%SLW)	5.92	5.12	5.16	6.33	6.39	0.68
Liver weight (%SLW)	2.42	1.65	1.94	2.25	2.87	0.24
Gizzard weight (% SLW)	2.46	2.45	2.74	2.59	2.49	0.20
Kidney weight (%SWL)	0.11	0.11	0.09	0.12	0.17	0.02
Abdominal fat pad weight (%SLW)	2.42	1.38	1.97	1.94	2.51	0.39

^{abc} means on the same row with the different superscripts are significantly different ($P<0.05$)

Table 5: Haematological and serum biochemical characteristics of broilers fed sundried and fermented cassava peel based diets.

Parameters	Treatments					
	T1 (0%CPM)	**T2 (15%DCPM)**	**T3 (15%FCPM)**	**T4 (30%DCPM)**	**T5 (30%FCPM)**	**SEM**
PVC (%)	22.30^{c}	25.30^{b}	22.80^{c}	25.30^{b}	30.00^{a}	1.69
Hb (g/dl)	7.30^{c}	8.50^{b}	7.50^{c}	8.60^{b}	10.16^{a}	0.67
PBC (X10^2/L)	2.10^{c}	2.26^{b}	2.36^{b}	2.50^{b}	3.10^{a}	0.18
WBC (x10^9/L)	1.96^{c}	2.70^{b}	2.30^{b}	2.60^{b}	3.16^{a}	0.27
Total serum protein (g/dl)	4.19^{c}	5.36^{b}	4.06^{c}	3.85^{d}	6.05^{a}	0.73
Albumin (g/dl)	2.76^{b}	3.54^{ab}	2.68^{b}	2.64^{b}	3.99^{a}	0.46
Globulin(g/dl)	1.42^{b}	1.82^{b}	1.38^{b}	1.31^{b}	2.06^{a}	0.25
GOT (H/L)	17.00^{c}	14.00^{d}	24.33^{ab}	21.00^{b}	25.67^{a}	3.05
PAT (H/L)	13.67^{d}	26.33^{c}	35.67^{b}	31.00^{bc}	37.00^{a}	4.12
Creatinine (mg/dl)	1.69^{b}	1.69^{b}	1.88^{b}	1.97^{b}	2.30^{a}	0.16
Urea (mg / dl)	39.67^{c}	39.50^{c}	42.50^{b}	45.67^{ab}	46.60^{a}	1.71
Calcium (mg/dl)	11.87^{b}	11.64^{b}	11.81^{b}	12.01^{a}	11.89^{b}	0.12

^{abc} Means on the same row with different superscripts are significantly different ($P<0.05$).

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