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Growth performance, haematological and serum biochemistry of broiler chickens fed Taro Cocoyam (*Colocasia esculenta*) peel meal as feed ingredient

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***Target audience:** Animal Scientist, Feed millers, Farmers and Processors*

Abstract

Growth performance, haematology and serum biochemistry of broiler chickens fed taro cocoyam (Colocasia esculenta) peel meal (CRM) as feed ingredient was investigated using 150 one week-old Ross strain broiler birds. The birds were randomly assigned to five (5) dietary treatment groups having three (3) replicates with 10 birds per replicate in a completely randomized design (CRD). Diet I was maize based and served as control diet. The test material replaced maize at 5%, 10%, 15% and 20% in diets II, III, IV and V respectively. Water and each of the diet were offered ad-labium for a period of 56 days (8 weeks). That is the first seven days, the birds were fed commercial feed to stabilize them and thereafter place on their respective experimental diets. The result of the growth performance showed that there were significant differences (P<0.05) in the mean final live weights, mean weight gain, mean daily weight gain, mean daily feed intake and feed conversion ratio. The mean final live weights, mean weight gain g/bird and mean daily weight gain (g) followed the same trend with birds fed diets I and II are the same but statistically similar to birds fed diets III and IV but differ from birds fed diet V. Birds fed Diets III and IV are statistically similar to birds fed diet V. Daily feed intake increased (P<0.05) with the level of cocoyam peels meal in the diet. Feed conversation ratio result for diet I was comparable to broilers on diet II. The parameters evaluated under biochemistry indices showed no significant effect for alkaline phosphate and creatinine, while results for diet III in total protein, albumin and urea were comparable to the control diet. Haematological indices like Hb, PVC and MCHC were not significantly affected by the diets but diet II was similar to control diet in all the parameters evaluated. Economic analysis showed that there were significant differences in all the parameters except in feed cost/bird and price/kg live weight. Cost/kg of feed was lowest for diet V followed by diets IV, III, II, I; due to the lower cost of Taro cocoyam when compared to maize in the control diet. Cost/kg weight gain favoured diet I followed by diets II and III, lastly diet IV and V. Finally, considering the growth performance, biochemical indices (especially albumin and urea), hematological indices and feed cost analysis (especially gross margin), diet II (5%) is recommended.

***Key words:** Cocoyam Peel Meal, Broiler Chickens, Serum Biochemistry, Haematology.*

Description of problem

Poultry feeding however stands out as a major item of cost in poultry production, it accounts for 70 – 80% of cost of production (1). There is need therefore to emphasize on the utilization of agro-industrial by-products that are considered not useful for human consumption as an alternative source of energy in rations of poultry (2; 3 and 4). At present in Nigeria there are many agricultural and industrial by products that have found their usefulness in livestock feeding (5) and (6). Among the alternative/non-conventional source of energy is cocoyam peel (a residue from cocoyam chips/processing production). Taro belongs to the genus *Colocasia* and

family *Araceae*. It is an erect, herbaceous perennial that grows up to 2m in height. It is also commonly known as old cocoyam, gabi and dasheen (7; 8). Cocoyam belongs to the monocotyledonous family *Araceae* and comprises of many genera which are cultivated as food in many parts of the world. *Colocasia esculenta* (l) schott, commonly known as taro is closely related to *Xanthosoma sagittifolium* (l) schott, which is generally referred to as Tannia. These species are tropical root crops widely known as cocoyam. They are used as subsistence staples in many parts of the tropics and sub-tropics in Africa. Cocoyams are grown primarily for their edible starch corms and cormels called tubers, and secondary as a leafy vegetable (9). It has been established that blood constituents (10) are affected by feed components; assessment of blood hematological and serum chemistry can thus be used to ascertain the effect of the test ingredient in animal. Blood is the major transport system of the body and its constituents change in relation to the physiological conditions of the animals (11) and (12). Haematological study is a useful tool for the diagnosis of many diseases and investigation of the extent of damage to the blood (13) and (12) Serum biochemical analysis is used to determine the level of heart attack, liver and kidney damage (10). Therefore, the study was aimed at evaluating the growth performance, hematological, blood chemistry and the feed cost analysis using cocoyam peel meal as feed ingredient for broilers.

Materials and Methods

Location of the experiment

The experiment was carried out in the Poultry Unit of the Research and Training Farm of the Micheal Okpara University of Agriculture, Umudike, Abia State.

Processing of cocoyam peels

The cocoyam peels were collected from the Product Development Programme of the National Root Crops Research Institute Umudike, Abia State. It was sun dried on a galvanized metallic sheet for three days, milled and stored in a bag for the experiment.

Experimental birds, management and design:

A total of one hundred and fifty unsexed broilers of Ross strain were purchased. Few days to the arrival of the chicks, the brooder house with the pens were washed, disinfected and left to dry. The birds were brooded with kerosene stoves placed under metal hovers for seven days in a deep litter house; feed and water were supplied *ad-libitum* to the birds. Average initial weights of the chicks were determined thereafter on weekly bases. The first seven days, the birds were fed commercial feed to stabilize them and thereafter place on their respective experimental diets. Thirty chicks were randomly allotted to each of the five dietary treatments. Each treatment was replicated 3 times with 10 birds per replicate placed in deep litter pens of fresh wood shavings. Each diet was offered to triplicate group of birds from 7^{th} day - 56 days. The birds were subjected to standard broiler management. Necessary vaccinations and medication were given. The chicks were vaccinated against New castle disease in the first and third week and against Gumboro disease in the second and fourth week. An anti-stress formular (vitalyte) was given to the birds at regular interval throughout the period of the experiment.

Experimental diets

A total of five diets having percentage crude protein which ranged between 21.10-22.00% and caloric densities of 2866-2993.48kcal/kg were formulated as shown in Table 1.

Table 1: Composition of the experimental diets

Ingredients	I	II	III	IV	V
Maize	56.82	53.98	51.14	48.30	45.46
Cocoyam peel Meal	-	2.84	5.68	8.52	11.36
Soybean	23.48	23.48	23.48	23.48	23.48
Blood meal	4.00	4.00	4.00	4.00	4.00
PKC	4.00	4.00	400	4.00	4.00
Wheat offal	4.00	4.00	4.00	4.00	4.00
Fish meal	4.00	4.00	4.00	4.00	4.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25	0.25
Vitamin premix*	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100
CP %	22	21.77	21.53	21.33	21.10
CF %	3.51	3.65	3.83	4.00	4.16
ME/ kcal/kg	2993.48	2961.61	2929.73	2897.82	2866

*Vitamin-mineral premix supplied (per kg of diet): Vitamin A, 1500Iu, vitamin D3 1600Iu, riboflavin 9.0g, Biotin 0.25mg, partothenix acid 6.0mg, vitamin B12 8.0mg, Vitamin B2 2.5mg, vitamin B12 8.0mg,Nicotinic acid 8.0mg Iron 5.0mg, manganese 10mg,zinc 4.5mg. Cobalt 0.02mg, selenium 0.01mg.

Cocoyam peels meal replaced maize in the diets while blood meal, soybean meal and fish meal were used as the major protein sources. The control diet designated Diet I contained no cocoyam peels meal while diets II, III, IV and V respectively contained 5%, 10%, 15%, and 20% levels of cocoyam peels meal in replacement of maize.

Growth performance evaluation

Feed intake and weight gain were determined weekly. They were used to calculate the feed to gain ratio. Mortality if any was recorded daily. Data obtained were used to calculate the following

(a) Feed intake/bird/day (g) =

$$\frac{\text{Quantity of feed given (g)} - \text{Quantity of feed not consumed (g)}}{\text{No. of birds} \times 56 \text{ days}}$$

(b) Daily weight gain/bird (g) =

$$\frac{\text{Final live weight} - \text{Initial Live weight}}{\text{No. of birds} \times 56 \text{ days}}$$

(c) Feed conversion ratio =

$$\frac{\text{Quantity of feed consumed}}{\text{Weight gain}}$$

(d) % Mortality =

$$\frac{\text{Number of birds that died}}{\text{Number of birds Stocked}} \times \frac{100}{1}$$

Determination of blood constituents

At the 4th and 8th week of the experiment, blood samples were collected through the wing veins. The samples were collected into sets of labeled sterile bottles. One set of the bottles containing anti-coagulant were used to determine the values of haematological indices like size of red blood cell (RBC) white blood cells (WBC), haemoglobin (Hb) and packed cell volume (PCV). While the other set of bottles without anti coagulant were used to determine the biochemical indices such as total protein, albumin, serum alkaline phosphatase, serum creatinine were evaluated using the methods of (14).

Gross Margin /Economic of the Diets

–As described by (15)

- Cost/kg of feed

= Total cost of Producing 100kg of feed
100

- Cost of feed consumed = Cost/ kg of feed × Total feed consumed.
- Cost/kg weight gain
= Cost of feed consumed.
Weight gain

-Cost of production =
cost/kg weight gain × mean weight gain
- Revenue =
Price of 1kg meat ×Mean weight gain
- Gross margin =
Revenue – Cost of production.

Statistical analysis

The experimental design used was completely randomized design (CRD). The model is as shown below.

$Y_{ij} = \mu \times Ti + e_{ji}$

Where Y_{ij} = single observation

μ = the overall mean

Ti = effect of treatment / factor of interest

E_{ij} = the random error or residual error.

Data analysis

Data collected were subjected to analysis of variance (ANOVA) as described by (16) and significant means were separated using (17).

Results and discussion

Table 2 reveals the growth performance of broilers fed difference levels of taro cocoyam peels meal. There were significant differences ($P<0.05$) in the mean final live weights, mean weight gain g/bird, mean daily weight gain (g), mean daily feed intake(g) and feed conversion ratio. Mean final live weights, mean weight gain g/bird and mean daily weight gain (g) followed the same trend with birds fed diets I and II are the same but statistically similar to birds fed diets III and IV but differ from birds fed diet V. Birds fed Diets III and IV are statistically similar to birds fed diet V. The significantly higher values obtain in birds fed diets I and II than diet IV and progressive decrease in weight of birds fed diets III, IV and V in the mean final live weight and mean daily weight gain g/bird could be attributed to the effect of anti-nutritional factors such as hydrogen cyanide. Hydrogen cyanide has been reported to cause marked weight reduction in the growth of broiler birds as a result of using methionine which ought to have been used for growth to detoxify hydrogen cyanide (18; 19 and 20). Also, trysin inhibitor has been reported to cause poor weight gain as a result of inhibitory effects on proteolytic enzymes (19; 21 and 22).

Table 2: Growth performance of broilers fed difference levels taro cocoyam peels meals based diets.

Parameters	I	II	III	IV	V	SEM
Initial live wt (g)	100	100	100	100	100	-
Final live wt (g)	2019.67^{a}	2025.33^{a}	1920.00^{ab}	1893.33^{ab}	1850.00^{b}	39.59
Total weight gain g/bird	1919.70^{a}	1925.03^{a}	1820.00^{ab}	1793.33^{ab}	1750.00^{b}	39.60
Daily Weight gain (g)	34.29^{a}	34.38^{a}	32.50^{ab}	32.02^{ab}	31.25^{b}	0.70
Feed intake g/bird	2526.17	2871.67	2917.17	2115.67	3175.00	143.11
Daily feed intake (g)	45.08^{b}	51.27^{ab}	52.09^{ab}	54.45^{a}	56.72^{a}	2.55
Feed conversation ratio	1.34^{c}	1.51^{bc}	1.60^{abc}	1.71^{ab}	1.86^{a}	0.08

Means within the same row with different superscripts (a-e) are significantly ($P<0.05$) different.
SEM: Standard Error of Mean.

The resultant effect is poor digestibility of protein and loss of amino acid and hence poor growth. Oxalate on the other hands combines with minerals such as calcium and phosphorus making them unavailable for metabolic processes (23). The mean final live weight value obtained for birds fed diets I to V falls within the normal range for broiler Chickens marketed at 9 weeks (24; 22). The increase in mean daily feed intake as the quantity of taro cocoyam peels meal increased in the diets may be attributed to the decrease in the energy level of the diets as cocoyam peel meal increases. Feed conversion ratio increased as the quantity of cocoyam peels meal increased in the diets. The higher the feed conversion ratio, the poorer the diet (25) hence diet I is a superior diet followed by diets II and III.

Table 3 reveals biochemical indices of broiler chicken fed cocoyam peels meal (CPM) based diets. There were significant differences ($P<0.05$) in all the parameters measured except alkaline phosphatase and creatinine. The total protein value for birds fed diet I was statistically similar to those fed diets II, III and 1V but differ significantly ($P<0.05$) from diet V. There was downward decrease in the value of total protein from diet 1 to diet V making diet I having the highest value while diet V had the least value. The downward decrease could be attributed to the effect of anti nutritional factors and it suggests poor quality protein for the test feedstuff (26).

Table 3: Biochemical indices of broiler chicken fed cocoyam peels meal based diets.

Parameter	I	II	III	IV	V	SEM
Total protein (g/l)	6.37^{a}	5.10^{a}	5.00^{a}	4.6^{ab}	3.0^{b}	0.807
Albumin (g/l)	2.76^{a}	2.20^{ab}	2.10^{b}	1.80^{b}	1.80^{b}	0.182
Urea (mg/dl)	3.80^{c}	4.90^{bc}	6.50^{b}	9.17^{a}	9.43^{a}	0.808
Creatinine(mg/dl)	0.20	0.15	0.10	0.10	0.20	0.018
Alkaline phosphate (u/l)	126.50	135.50	123.50	119.00	115.00	8.077

Mean within the same row bearing different superscripts (a-c) are significantly ($P< 0.05$) different.
SEM: Standard Error of Mean.

The albumin value of diets I and II were statistically similar ($P>0.05$) but diet I differs significantly ($P<0.05$) from diets III, IV and V. The high value of albumin in diet I implies good clotting ability of blood and hence prevention of hemorrhage (23). The urea value ranges from 3.80mg/dl in diet I to 9.43mg/dl in diet V making diet V to have the highest value and diet I the least. The progressive increase in the value as the quantity of the test feedstuff increase suggest the poor quality of the test ingredient since the higher the urea value the poorer the feed (27; 22). Based on the above result, diet I proved to be superior to others but, this is followed by diet II and III.

Table 4 reveals haematological indices of broiler chickens fed cocoyam peels meal based diets. There were significant differences in all the parameters considered ($P<0.05$) except for PVC, HB and MCHC which the inclusion levels could not influence. Never the less with the exception of Red blood cell in diet V, they all fall within the normal range for broiler chicken as reported by (28). The low value of Red blood cell in diet V could be attributed to the accumulated effect of anti-nutritional factors in the test material. This implies that the bird placed on that diet is prone to anemia (19). The high level of the White Blood Cell both in diets IV and V suggest invasion of foreign body and hence were produced to fight against them (29). From the above, it seems diet I, II and III compared favourable with one another in the hematological parameters.

Table 4: **Haematological indices of broilers fed cocoyam peels meal based diets**

Parameter	I	II	III	IV	V	SEM
RBC(×106 /cm3)	2.64a	2.62a	2.39ab	2.09bc	1.84c	0.098
WBC(×103 /cm3)	9.00b	14.15ab	16.00ab	27.86a	28.27a	4.25
Hb(g/100ml)	9.10	9.15	8.35	7.55	7.25	0.58
PVC (%)	26.00	27.00	25.20	24.00	24.40	1.46
MCV (%)	98.54b	112.42b	119.76ab	115.34ab	132.28a	6.152
MCH (%)	34.48b	34.98b	34.50ab	36.30ab	39.39a	1.35
MCHC (%)	33.19	33.18	33.30	31.47	31.65	1.429

Mean within the same row bearing different superscripts (a-c) are significantly (P< 0.05) different.
SEM: Standard Error of Mean.

Table 5 reveals the economics of broiler chickens fed difference levels of taro cocoyam peels meal based diets. The values were significantly different (P<0.05) for all the parameters evaluated, except in feed cost/bird (₦) and price/kg live weight (₦). Cost/kg of feed favored diet V followed by diets IV, III, II, I; this is due to the lower cost of the test ingredient when compared to maize in the control diet. Cost/kg weight gain, diet I had the lowest values that was statistically similar to diets II and III but differ significantly (P<0.05) for diet IV and V. The low cost/kg weight gain for diets I, II, III could be attributed to good efficiency of converting feed to meat.

Table 5: The economics of broilers fed different levels of taro cocoyam peels meal based diets.

Parameter	I	II	III	IV	V	SEM
Total feed intake	2526.17	2871.67	2005.17	3049.00	3175.00	-
Cost/kg of feed(₦)	73.12^{a}	71.32^{b}	69.56^{c}	67.74^{d}	65.94^{e}	-
Feed cost/ bird(₦)	184.75	202.88	204.93	206.38	209.25	10.24
Cost/kg weight gain(₦)	96.274^{b}	106.50^{ab}	111.30^{ab}	115.83^{a}	119.790^{a}	5.52
Price/kg live Weight(₦)	400	400	400	400	400	-
Revenue(₦)	768.00^{a}	770.66^{a}	728.00^{ab}	717.33^{ab}	700.00^{b}	15.82
Gross margin(₦)	583.25^{a}	565.74^{ab}	525.12^{bc}	510.95^{bc}	490.75^{c}	16.88

Mean within the same row bearing different superscripts (a-c) are significantly (P< 0.05) different.
SEM: Standard Error of Mean.

Revenue values showed that diet II, had the highest value, which was significantly higher (P<0.05) than diet V value. It is statistically the same with diets I, III and IV but differ (P<0.05) with diet V. Diet II was favoured as for revenue value due to good weight gain. Gross margin followed a pattern of which diet1 gave the highest value followed by diets II, III, IV and V. This shows the superiority of diet I among others, since the higher the gross margin the better the diet (30). Finally broiler chickens fed diet II was not inferior to the broiler chickens fed control diet (0%), in the parameter evaluated in Table 5 hence, they are statistically similar.

Conclusion and Applications

1. Growth performance and feed cost analysis shows that the result obtained in diet II (5% inclusion of CPM) was also comparable to the control diet therefore, will help reduce cost of feed

in areas where cocoyam peels are in abundant or an industrial waste.

2. Biochemical and Hematological indices evaluated shows that broiler chickens fed 5% was comparable with the control diet and was within the normal range therefore, produced no negative effect in the broiler chickens.
3. Finally diet II (5%) did not produce any detrimental effect on the broiler chickens evaluated under growth performance, biochemical and hematological indices therefore, 5% inclusion is recommended.

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