Original Research Article

Haematological Response of Broiler Finishers Fed Differently Processed Taro Cocoyam *Colocasia esculenta* (L) Schott

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Abstract

The study was carried out to investigate the effect of differently processed taro cocoyam (*Colocasia esculenta*) on haematological indices of broiler finishers. For the study, 126 day-old chicks were used. The birds were fed broiler starter diet for pre-experimental period of two weeks, after which they were randomly grouped into six treatments and each treatment had 3 replicates with 7 birds per replicate. The control diet was maize-based while the other treatments contained raw unpeeled, raw peeled, boiled unpeeled, boiled peeled sun-dried taro cocoyam and peels in complete replacement of maize. The experiment lasted 8 weeks. The results of the study showed no significant difference across the treatments for packed cell volume (PCV), haemoglobin (Hb), mean cell haemoglobin concentration (MCHC) and lymphocyte. The mean value of red blood cell (RBC) counts for birds on raw peeled taro cocoyam diet ($2.7 \times 10^6 \mu\text{l}^{-1}$) was significantly ($P < 0.05$) higher than those on control diet ($1.9 \times 10^6 \mu\text{l}^{-1}$). White blood cell (WBC) counts slightly varied across the treatments. There was no significant difference in total protein across the treatments. Birds on control diet had the highest numerical mean value of 4.3g/dl. In terms of cholesterol, birds on peels had the least mean value of 62.5g/dl which was significantly ($P < 0.05$) different from those on control diet (105.5g/dl). Birds on boiled unpeeled taro cocoyam had the least mean value of 142.1g/dl for glucose level which significantly ($P < 0.05$) differed from those on control diet (170.7g/dl). Taro cocoyam is thus a recommended alternative energy source for poultry.

Keywords: Broilers; energy; feeding trial; haematology; nutrition; processed; serum metabolites; taro cocoyam.

INTRODUCTION

One major concern of science of nutrition is food security, which according to FAO (2002) has been defined as a situation that exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs. Ofongo and Ologhobo (2007) maintain that enhancement of cost-effective livestock production is one important aim of research in animal production. However, the rapid growth of human population has intensified the competition between humans and livestock for grains (Mohammed and Agwunobi, 2009) such as maize, which is the major source of energy in poultry feeds (Durunna et al., 2000). High cost of feeding livestock has necessitated the need to look for alternative energy feed source for livestock, especially poultry.

It has been observed that unconventional tropical resources and their by-products which have potential use as alternative sources of feed for poultry could be utilised to reduce cost and limit dependence on maize (Apata, 2004; Iyayi and Fayoyin, 2004; Annongu et al., 2006). Taro cocoyam and its by-products are examples of such unconventional tropical sources which could be used as alternative source of feed for poultry. The average yield

of taro cocoyam in Africa has been estimated to be about 5.1t/ha as compared with 1.6t/ha for maize (Raemaekers, 2001). Taro cocoyam is less consumed by humans when compared with grains and other root and tuber crops. It has starch digestibility of about 98.8%, 1/10 starch size of that of potato (Aderolu and Sogbesan, 2010). However, Agwunobi et al. (2002) reported that taro cocoyam contained saponin, tannin, phytates and oxalates. The use of heat could, however, inactivate the anti-nutritional factors contained in it, as well as improve the nutritive value and nutrient utilisation of taro cocoyam.

This study therefore investigated the effect of feeding processed taro cocoyam on haematological indices and serum metabolites of broiler finishers.

MATERIALS AND METHODS

Site of the experiment

The experiment was carried out at the Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria. The location of the study is $7^{\circ}27'N$ and $3^{\circ}45'E$ at altitude 200-300 m above sea level with a mean temperature of 25-29 °C and average annual rainfall of 1250 mm.

Purchase and processing of feed ingredient

Feed ingredients such as maize were purchased from a reputable feed mill in Ibadan, while cocoyam tuber (*Colocasia esculenta*) used for the study was purchased from the open market in Gbongan, Osun State and properly cleaned to remove exterior impurities. Thereafter, they were divided into four equal parts, one part was not peeled but sliced into chips of about 5 mm thickness and sun-dried for 3 days. The 2nd part was peeled, sliced and sun-dried; the 3rd part was not peeled but boiled and sun-dried; the 4th part was peeled, boiled, sliced and sun-dried while raw peels which formed the 5th part was sun-dried. The boiling took about 30 minutes and the dried chips were milled separately and used in ration formulation.

Management of experimental birds and feeding procedure

For the feeding trial, 126 Shaver broiler 1-day-old chicks (mixed sexes) from Tuns Farm, Osogbo, Nigeria, were used. The birds were subjected to standard brooding and fed a common basal broiler starter diet for pre-experimental period of 2 weeks during which necessary vaccinations were administered. At the beginning of the 3rd week, birds were weighed and randomly allotted in group of 21 to each of the six experimental diets with 3 replicates in each treatment of 7 birds per replicate. The trial had six treatments, maize-based diet served as the control while the other 5 treatments contained raw unpeeled, raw peeled, boiled unpeeled, boiled peeled sun-dried taro cocoyam and peels which replaced maize at 100% level. The birds were fed *ad libitum* and clean cool water was supplied to the birds regularly. The feeding trial lasted 8 weeks.

Haematological analysis

At 8 weeks of age, the blood samples for haematological analysis were collected through jugular veins of two birds of similar weights from each replicate into sterilised glass tubes containing ethylene tetra acetic (EDTA), while the sample for serum analysis was collected into tubes containing no EDTA, and the samples were later analysed. Haematological indicators (such as white blood cell counts, red blood cell counts, packed cell volume, and haemoglobin) of the birds were determined using the methods of Wintrobe microhaematocrit and cyanomethaemoglobin, respectively Ghai (1993). The concentrations of total protein, total cholesterol and total glucose were determined by using commercial clinical kits.

Statistical analysis

Data obtained were subjected to one way analysis of

variance (ANOVA), while significant means were separated using Duncan multiple range test. Proximate analyses of the experimental diets were carried out using A.O.A.C. (1990).

RESULTS

The percentage of experimental diets, proximate composition of experimental diets, haematological indices and serum metabolites of broilers fed experimental diets are as shown in Tables 1, 2, 3 and 4. PCV, Hb, MCHC and lymphocyte did not significantly vary across the treatments. Birds on raw peeled taro cocoyam based diet had the highest mean value of $2.7 \times 10^6 \mu\text{l}^{-1}$ for RBC counts, which significantly ($P < 0.05$) differed from those on control diet ($1.9 \times 10^6 \mu\text{l}^{-1}$). WBC counts of birds on raw peeled taro cocoyam based diet had the highest mean value of $28.1 \times 10^3/\text{mm}^3$ while those on raw unpeeled taro cocoyam had the least mean value of $24.0 \times 10^3/\text{mm}^3$. There was a general increase in the white blood cell (WBC) counts, except for those birds on diet containing raw unpeeled sun-dried taro (T2).

Table 1: Percentage composition of experimental diets

Ingredients (%)	T1	T2	T3	T4	T5	T6
Maize	60.00	-	-	-	-	-
Cocoyam	-	60.00	60.00	60.00	60.00	60.00
Soybean meal	30.00	30.00	30.00	30.00	30.00	30.00
Fish meal (72%)	1.00	1.00	1.00	1.00	1.00	1.00
Wheat meal	4.00	4.00	4.00	4.00	4.00	4.00
Palm oil	0.90	0.90	0.90	0.90	0.90	0.90
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00
Oyster shell	1.00	1.00	1.00	1.00	1.00	1.00
Common Salt	0.25	0.25	0.25	0.25	0.25	0.25
Broiler Premix	0.25	0.25	0.25	0.25	0.25	0.25
Lysine (%)	0.05	0.05	0.05	0.05	0.05	0.05
Metionine (%)	0.05	0.05	0.05	0.05	0.05	0.05
Determined						
crude protein (%)	20.3	19.8	18.1	20.1	20.1	18.9
ME (MJ/kg)	12.31	13.22	13.22	13.22	13.22	13.22

+ Broiler vitamin premix supplied the following vitamins and trace elements per kg diet: vit A (7812.5 IU), vit D₃ (1562.5 IU), vit E (25.0 mg), vit K₃ (1.25 mg), vit B₁ (1.8 mg), vit B₂ (3.44 mg), niacin (34.4 mg), calcium pantothenate (7.19 mg), vit B₃ (3.1 mg), vit B₁₂ (0.02 mg), choline chloride (312.5 mg), folic acid (0.6 mg), biotin (0.1 mg), manganese (75 mg), iron (62.5 mg), zinc (50.0 mg), copper (5.3 mg), iodine (0.9 mg), cobalt (0.2 mg), selenium (0.1 mg), antioxidant (75 mg)

ME =Metabolisable energy

T1 = control diet

T2 = raw unpeeled diet

T3 = raw peeled diet

T4 = boiled unpeeled diet

T5 = boiled peeled diet

T6 = peels

Table 2: Proximate composition of experimental diets (g/100g DM)

Nutrients	T1	T2	T3	T4	T5	T6
Dry matter	90.5	90.1	89.9	89.7	90.0	90.2
Crude protein	20.3	19.8	18.1	20.1	20.1	18.9
Crude fiber	7.1	8.9	7.7	8.6	7.7	9.6
Ether extract	4.1	3.5	3.9	3.6	4.0	3.7
Ash	7.0	8.3	7.2	9.2	8.1	9.3
Nitrogen free extract	52.0	49.5	62.9	48.9	50.1	53.6

T1 = control diet

T2 = raw unpeeled diet

T3 = raw peeled diet

T4 = boiled unpeeled diet

T5 = boiled peeled diet

T6 = peels

The glucose concentrations of birds on boiled unpeeled taro cocoyam based diet with the least mean value of 142.1 g/dl significantly ($P < 0.05$) differed from those on control diet with mean value of 170.7g/dl. Total serum protein did not vary across the treatments, although birds on control diet had the highest numerical mean value of 4.3g/dl while those on boiled unpeeled taro cocoyam based diet had the least numerical mean value of 3.5g/dl. Value of cholesterol for birds on taro cocoyam peel based diet (62.5g/dl) significantly ($P < 0.05$) differed from those on other treatments, meanwhile, birds on raw peeled taro cocoyam based diet had the highest numerical mean value (109.7 g/dl).

Table 4: Serum metabolites of broilers fed experimental diets

Indicators	T1	T2	T3	T4	T5	T6	SEM
Total protein (g/dl)	4.3	3.7	3.7	3.5	3.9	3.8	0.3
Cholesterol (g/dl)	105.5 ^a	76.4 ^{ab}	109.7 ^a	101.4 ^a	94.4 ^{ab}	62.5 ^c	3.6
Glucose (g/dl)	170.7 ^a	169.6 ^a	176.6 ^a	142.1 ^b	170.1 ^a	186.0 ^a	3.3

Means with different superscripts on the same row are significantly ($p < 0.05$) different

T1 = control diet

T2 = raw unpeeled diet

T3 = raw peeled diet

T4 = boiled unpeeled diet

T5 = boiled peeled diet

T6 = peels

DISCUSSION

Blood is a complex fluid containing large variety of dissolved suspended inorganic and organic substances (Stewart, 1991). Its various functions are made possible by individual and collective action of its constituents, which are the haematological and biochemical components (Ahamefule et al., 2006). Haematological and biochemical blood components have been found to be influenced by the quantity and quality of feed (e.g., Akinmutimi, 2004). Biochemical components are sensitive to elements of toxicity in feeds and their concentrations in the blood could be used to monitor protein quality of feeds (Ahamefule et al., 2006).

Table 3: Haematological indices of broilers fed experimental diets

Indicators	T1	T2	T3	T4	T5	T6	Normal Range*	SEM
RBC $\times 10^6 \mu\text{l}^{-1}$	1.9 ^{bc}	1.7 ^c	2.7 ^a	1.7 ^c	1.5 ^c	2.2 ^b	2.9 - 4.1	0.1
WBC $\times 10^3/\text{mm}^3$	24.5 ^{ab}	24.0 ^b	28.1 ^a	26.5 ^{ab}	26.3 ^a	27.3 ^{ab}	9.7 - 31.0	0.7
PCV (%)	30.3	29.3	31.0	30.3	29.7	27.7	26.0 - 45.2	0.7
Hb (g/dl)	10.5	9.8	10.3	10.1	10.0	9.3	7.5 - 13.1	0.2
MCV (fl)	174.1 ^b	176.6 ^b	116.5 ^a	177.3 ^b	197.4 ^d	126.2 ^c	100.0 - 128.0	2.0
MCH (pg)	58.1 ^{ab}	58.8 ^{ab}	38.6 ^c	58.9 ^{ab}	66.2 ^d	42.6 ^c	25.3 - 33.4	3.1
MCHC (gl ⁻¹)	33.4	29.6	33.3	33.4	33.6	33.7	25.3 - 32.5	0.9
Lymphocyte (%)	63.0	65.7	68.3	63.3	65.3	65.7	43.9 - 67.7	1.2

* Mitruka and Rawnsley (1977)

Means with different superscripts on the same row are significantly ($p < 0.05$) different

T1 = control diet

T2 = raw unpeeled diet

T3 = raw peeled diet

T4 = boiled unpeeled diet

T5 = boiled peeled diet

T6 = peels

RBC = red blood cell; WBC white blood cell; PCV = packed cell volume; Hb = haemoglobin; MCV = mean cell volume; MCH = mean cellular haemoglobin content; MCHC = mean cell haemoglobin concentration

Haematological components of blood are also valuable in monitoring feed toxicity, especially with feed constituents that affect the formation of blood (Oyawoye and Ogunkunle, 1998). Haematological indicators commonly used in nutritional studies include red blood cell counts (RBC), white blood cell counts (WBC), mean cell haemoglobin concentration (MCHC), mean cell volume (MCV) and packed cell volume (PCV) (Adeyemi et al., 2000; Olorode and Longe, 2000; Aletor and Egberongbe, 1992).

In this study, the proximate composition of the experimental diet (Table 2) showed that the dietary crude protein of maize based diet and that of boiled peeled and unpeeled taro cocoyam based diets are similar, about 20.00% which is similar to 20.00% requirement for poultry finishers (Atteh, 2002). Crude protein contents of diets contained raw unpeeled taro cocoyam and raw peeled taro cocoyam were lesser, being 19.80% and 18.10%, respectively. Crude fibre content in all the treatment diets was higher than the control diet. The haematology of broiler finishers fed taro cocoyam meal based diet is presented in Table 3. The effect of experimental diets on WBC, RBC, MCV and MCH were statistically ($P < 0.05$) significant. The PCV of broiler finishers varied from 27.67% to 31.00%, which did not follow a specific pattern across the treatments, but were within the normal range of 26.00 – 45.20% for normal adult chicken as reported by Mitruka and Rawnsley (1977). This thus implies that the feed value of the diets was adequate and the replacement of maize with taro cocoyam meal in the experimental diet did not reduce its nutritional quality.

Haemoglobin concentration in this study ranged between 9.33g/dl and 10.33g/dl. This was also within the reference values of 7.50g/dl and 13.10g/dl for normal adult chicken (Mitruka and Rawnsley, 1977). It thus means that replacing maize with taro cocoyam meal did not suppress intake and impair dietary availability that could cause anemic conditions. The significant ($P < 0.05$) difference in WBC counts did not follow a specific trend except for those on raw unpeeled taro cocoyam diet with least value of $24.00 \times 10^3 \text{ mm}^3$. However, the mean values of $24.00 \times 10^3 \text{ mm}^3$ and $28.00 \times 10^3 \text{ mm}^3$ obtained for WBC counts were within the reference values of $9.76 \times 10^3 \text{ mm}^3$ and $31.00 \times 10^3 \text{ mm}^3$ (Mitruka and Rawnsley, 1977). It could be inferred from this that taro cocoyam meal did not seem to have the possibility of predisposing infections in broiler finishers, nor interfere with haemopoietic process.

The cholesterol analysis (Table 4) showed that the level of protein produced in the five treatments compared favourably with the control diet. The overall result showed that birds on boiled taro cocoyam based diet compared favourably with those fed maize based diet. This improvement could be attributed to the effect of heat on taro cocoyam, which is in agreement with the study carried out by Mohammed and Agwunobi (2009), who reported that higher feed

consumption and weight gain in birds fed boiled taro cocoyam was due to heat treatment of boiling. Agwunobi et al. (2002) earlier reported that boiling was more effective in reducing the level of anti-nutritional factors contained in taro cocoyam than sun drying alone. Also, Ogun et al. (1989) reported that cooking caused significant reduction in feed toxicants. Onu and Madubuike (2006) reported also that cooking of cocoyam resulted in better protein efficiency ratio.

The mean weight gain of birds on raw unpeeled sun-dried taro cocoyam (1110.00 g), those on raw peeled sun-dried taro cocoyam (1126.70 g), and peels (836.70 g) were significantly ($P < 0.05$) lower than those on the control diet (1850.00 g). Those on boiled unpeeled sun-dried and boiled peeled sun-dried taro cocoyam with mean values of 1513.30 g and 1613.30 g, respectively, were statistically similar to the control diet. Final weight gain had similar trends across the treatments. Higher values of feed intake were achieved in diets containing boiled unpeeled sun-dried taro cocoyam (73.50 g), boiled peeled sun-dried taro cocoyam (70.30 g) and peels (69.80 g). Feed conversion ratio was higher in the treatment diets, with highest value obtained in diet containing peels with a mean value of 4.70.

Maize cost about \$0.35 (about ₦ 56.00) per kilogram, while cocoyam cost about \$ 0.23 (about ₦ 38.00) per kilogram.

CONCLUSION

Boiling of taro cocoyam has resulted in a significant improvement over the raw taro cocoyam in most of the indicators measured. This suggests that boiled taro cocoyam could replace maize in broiler feed without any detrimental effect to the health of the birds, while replacing maize with raw taro cocoyam in broiler finisher feed should be discouraged. Taro cocoyam is a recommended alternative energy source for poultry.

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