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Growth and Haematological Characteristics of Broiler Starter Birds Fed Processed Taro Cocoyam (*Colocasia esculenta*) Corm Meal

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Authors' contributions

This work was carried out in collaboration between all authors. Author PCJ designed the study, wrote the protocol, and wrote the first draft of the manuscript. Authors LCE and CN managed the literature searches, analyses of the study performed the spectroscopy analysis and managed the experimental process and author CJE identified the species of plant. All authors read and approved the final manuscript.

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ABSTRACT

Aims: Broiler production fulfils important socio-economic functions, but inadequate nutrition, scarcity and high cost of feedstuffs in developing countries undermines broilers in expressing their full potential. Therefore a 28 day feeding trail was conducted to determine the growth performance and haematological parameters of broiler starter birds fed processed taro cocoyam (*Colocasia esculenta*) corm meal.
Study Design: The birds were randomly divided into 4 experimental groups with 3 replicates of 12 birds per replicate in a completely randomized design pattern.

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Place and Duration: Federal college of Agriculture, Ishiagu, Ivo, L.G.A. Ebonyi State, Nigeria between August and September, 2015.

Methodology: 144 Anak broiler starters were used for this experiment. Four dietary treatments designated as T_1, T_2, T_3 and T_4 were formulated to contain 0%, 5%, 10% and 15% levels of taro cocoyam corm meal. Other ingredients remained constant for the four diets. Feed and water were supplied *ad libitum*. Blood samples (4 ml) were drawn from the animals on the last day of the study through the wing vein and analysed for haematological indices.

Results: Results showed that final body differed ($P<0.05$) significantly and was highest for T_2 (845.82g) and lowest for T_4 (765.21 g). Similarly, total feed intake and average daily feed intake showed a significant ($P<0.05$) difference with T_3 having highest intakes relative to T_4 with the lowest intakes. Total weight gain, average daily weight and feed conversion ratio were similar ($P>0.05$). White blood cell count of birds in control group was significantly ($p<0.05$) higher and better than the treatment groups.

Conclusion: These results showed that inclusion of taro cocoyam corm meal at 10% was relatively best and supported weight gain, feed intake and haematological characteristics of the birds and therefore recommended for optimum broiler starter production.

Keywords: Cocoyam meal; proximate composition; growth performance; normal range of haematology; broiler starters and alternative energy feed source.

1. INTRODUCTION

There is a very wide gap in animal protein intake between developed and developing countries. This may be attributed to the scarcity and high cost of energy sources, especially maize. Maize is an expensive feedstuff, constituting about 48 - 60% of poultry feeds. Maize as the most used energy source is expensive and scarce, resulting to high cost of the finished feed. This has necessitated the search into nutritionally viable alternative energy sources for feeding poultry. Poultry farmers all over the world and particularly those of the developing countries consider the use of alternative plants that can be easily grown and yield at least the same per unit area as compared to maize for inclusion in poultry rations Mozafari et al. [1]. Roots and tubers including corms readily provide these alternatives.

Cocoyam is a corm and ranked third in importance after cassava and yam among the root and tuber crops Ekwe et al. [2]. It provides food to a large segment of the world population, especially in the tropics where the bulk of the crop are cultivated and consumed. It is consumed in homes, especially during periods preceding the yam harvest, which underscores its importance as a possible substitute for the crop Ekwe et al. [2]. This crop is not widely consumed in urban and city homes due to poor information about its nutritive values and conducive environment (shades) needed for its storage. Some cultivars of cocoyam are not mostly consumed by humans because of acridity and this therefore reduces the competition between man and animal for this crop. This highlights the advantage of cocoyam in reducing the high cost and thus the scarcity of feeds and feedstuffs. Cocoyam has nutritional advantages over root crops and other tubers crops Lyonga and Nzietchueng [3]. Cocoyam has high dietary energy value, highly digestible starch because of its small granules, higher crude protein with reasonable content of calcium and phosphorus, B-complex vitamins, pro vitamin A and carotenoids, when compared to most roots and tubers. However, its use in animal nutrition could be hampered by the presence of some anti-nutritional factors like saponin, tannin, phytates and oxalates which adversely affect nutrient digestion, utilization and physiological functions in broilers when not properly processed Agwunobi et al. [4]. Cooking has been reported to reduce the acridity Okaka et al. [5] and other anti-nutrients present in cocoyam. Therefore, this study evaluated the effects of processed cocoyam meal on growth performance and heamatology of broiler starter birds.

2. MATERIALS AND METHODS

The experiment was carried out at the poultry Unit of Federal College of Agriculture, Ishiagu, Ivo Local Government Area, Ebonyi state, Nigeria. The College is located at about three kilometers (3 km) away from Ishiagu main town.

One hundred and forty four (144) day old anak broiler chicks were randomly divided into 4 experimental groups of 36 birds per treatment group with 3 replicates of 12 birds per replicate.

Table 1. Composition of experimental diets

Ingredients	T_1	T_2	T_3	T_4
Maize	53.00	48.00	43.00	38.00
Cocoyam meal	0.00	5.00	10.00	15.00
Soybean meal	30.00	30.00	30.00	30.00
Wheat offal	8.00	8.00	8.00	8.00
Fish meal	3.00	3.00	3.00	3.00
Blood meal	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00
Lime stone	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25
Vitamin/mineral/premix	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Total	100	100	100	100

The four treatment groups were assigned the four experimental diets in a Completely Randomized Design (CRD) for 28 days. Before the arrival of the birds, the pens were swept, washed, disinfected and allowed to dry. Wood shaving was spread on the floor and the brooder was lighted up to ensure enough heat before the arrival of the chicks. Feed and water were supplied *ad libitum*. Feed offered and refused were recorded on a daily basis. Average initial weights of the birds were taken at the beginning of the trial and weekly subsequently.

The cocoyam coms were sourced from National root crop research institute, Umudike, Abia State. They were washed thoroughly, the back removed, sliced into bits, boiled for 30 minutes and sun dried to about moisture content of 10 % then milled into cocoyam meal. Four diets (T_1, T_2, T_3 and T_4) were formulated at 0%, 5%, 10% and 15% inclusion levels of cocoyam meal respectively as presented in Table 1 above.

Blood samples (4 ml) were drawn from the birds on the last day of the study. The birds were bled through the wing vein and used for haematological studies. Haematological parameters were measured using Haematology Blood Analyzer. Mean cells haemoglobin (MCH), MCV and mean cell haemoglobin concentrations (MCHC) were calculated.

All feeds and experimental material were analyzed for proximate compositions using the method of AOAC [6]. Metabolizable energy was calculated using the formula; ME = (3.5 X Crude protein) + (8.5 x crude fat) + (3.5 x Nitrogen Free Extract) x 10.

The results were analyzed using the Special Package for Social Sciences Window 17.0. One - way analysis of variance (ANOVA) was employed to determine the means and standard error. Treatment means were compared using Duncan's new multiple range test.

3. RESULTS AND DISCUSSION

The proximate composition of the experimental diets and taro cocoyam meal is presented in Table 2. The proximate composition of taro cocoyam meal showed a high level of dry matter (DM) and metabolizable energy (ME) with very low values of ether extract (EE) and crude fibre (CF) and relatively fair values of crude protein (CP) and ash. This is in agreement with the reports of Nnabuk et al. [7] and Olajide et al. [8] for cocoyam.

The DM values of the treatment diets compared well with the control, but tended to decrease with increasing levels of the test ingredient. The crude fibre values also followed similar trend as the DM decreasing with increasing levels of taro cocoyam meal. This is evident with the low value of the CF of cocoyam meal as observed in this study: a view corroborated by Nnabuk et al. [7]. The CP values of the experimental diets are within the crude protein nutritional requirement need by broiler starter birds, thus the fear of anaemia is eliminated, since increase in RBC value is associated with high quality dietary protein Hackbath et al. [9]. The values however did not follow a specific trend. The EE values tend to decrease with increasing values of the test diet. This could be as a result of the low value of EE from the proximate analysis of taro cocoyam in this present study. This is in tandem with the report of Nnabuk et al. [7]. The ash values of the treatment diets are compared with that of control, but had a specific trend with increasing levels of the taro cocoyam meal. The NFE did not show a particular trend. The metabolizable energy values of the diets were within the recommended values for broiler starter birds. This is evident as no treatment group lost weight during the experiment. Hence, feeding inadequate energy levels may result to low body weight Ribeiro et al. [10], increased feed intake and overall poor performance of the host animal. However, the values for energy in this present study have a specific trend, decreasing with increasing levels the test diet, which could be attributed to lower energy value of cocoyam meal compared to maize.

The growth performance of the broiler starter birds fed dietary levels of processed taro cocoyam corm meal is presented in Table 3. Final weight, total feed intake and average daily feed intake were significantly (P<0.05) influenced by the test diets while average total body weight gain, average daily weight gain and feed conversion ratio were similar (P>0.05) across the treatment groups. T_2 had the highest (845.82 g) final body weight while T_4 had the lowest (765.21 g). The higher and better (P<0.05) final body weight of T_2 over T_4 could be attributed to better feed intake and feed conversion ratio of T_2 relative to T_4. The lowest final body weight, average total weight and average daily weight gain recorded in birds fed T_4 (15% cocoyam meal) could be attributed to the presence of anti nutritional factors present in taro cocoyam, which may have limited the utilization of nutrients by the birds. Agwunobi et al. [4] reported the presence of saponin, tannin, phytates and oxalates in taro cocoyam. The total feed intake differed (P<0.05) significantly with T_2 and T_3 being (P>0.05) similar, but however differed (P<0.05) from T_1 and T_4. The average daily feed intake followed similar pattern with the total with intake. T_2 and T_3 have the highest numerical value over the period of the experiment; this can be attributed to the acceptability of the diets or other factors. Birds are known to eat more when diets are acceptable and coarse than when they are finely ground Leeson [11]. Also the significant increase on average daily feed intake may be in part, due to the relative decrease in energy level of the diet. This observation agrees with report of Oruwari et al. [12], who indicated that feed intake decreased with increase in energy level. It also corroborates the scientific evidence that birds eat to satisfy their energy requirement Tewe and Egbuike [13]. However, significant (p<0.05) decreased in total feed intake and average daily feed intake of birds on diets T_1 and T_4 could be due to the levels of antinutritional factors present in the diets and the dusty nature of the feed with increasing levels of taro cocoyam corm meal.

The haematology of broiler starter birds fed dietary levels of processed cocoyam corm meal is presented in Table 4. The values for packed cell volume (PCV), haemoglobin (Hg), red blood cell (RBC), Mean corpuscular volume (MCV),

Table 2. Proximate composition of experimental diets and taro cocoyam meal (% DM)

Parameters	T_1	T_2	T_3	T_4	Taro cocoyam meal
Dry matter (%)	92.27	92.18	92.04	91.22	90.28
Crude fibre (%)	5.55	4.82	4.21	3.53	3.09
Crude protein (%)	20.76	21.42	21.85	21.54	9.38
Ether extract (%)	5.87	5.32	4.92	3.52	1.14
Ash (%)	6.35	6.92	7.85	8.15	3.84
Nitrogen free extract (%)	53.74	53.70	53.21	54.48	72.83
Metabolizable energy (Kcal/kg)	3106.45	3051.40	3045.30	2959.90	2974.25

Table 3. Growth performance of broiler starter birds fed dietary levels of processed cocoyam (*Colocasia esculenta*) corm meal

Parameters	T_1	T_2	T_3	T_4	SEM	P-value
Average initial body weight (g)	57.55	56.14	59.30	58.30	4.02	0.692
Final body weight (g)	797.44^{ab}	845.82^{a}	822.31^{ab}	765.21^{b}	25.61	0.000
Average total body weight gain (g)	739.89	789.68	763.01	706.91	19.42	0.522
Average daily weight gain (g)	26.42	28.20	27.25	25.25	2.71	0.106
Total feed intake (g)	1460^{b}	1527^{a}	1538^{a}	1378^{b}	20.49	0.000
Average daily feed intake (g)	52.14^{b}	54.54^{a}	54.93^{a}	49.21^{b}	4.99	0.000
Feed conversion ratio	2.00	1.93	2.01	1.95	0.34	0.002

$^{a, b}$ Means within the same row with different superscripts are significantly different (P < 0.05)

Table 4. Haematology of broiler starter birds fed dietary levels of processed cocoyam (*Colocasia esculenta*) corm meal

Parameters	T_1	T_2	T_3	T_4	SEM	*Normal range*	P-value
Packed cell volume (%)	29.33	30.33	31.67	31.33	3.49	26.0 - 45.2	0.008
Haemoglobin (gldl)	9.83	10.17	10.73	10.63	1.57	7.5-13.1	0.081
Red blood cell ($x10^6/mm^3$)	3.97	4.07	3.53	3.63	0.59	2.9-4.1	0.443
White blood cell ($x10^{12/1}mm^{3)}$)	21.20^a	18.40^b	18.80^{ab}	16.80^b	2.57	9.7-31.0	0.103
Mean corpuscular volume (fl)	74.82	74.75	83.57	86.82	6.32	100.0- 128.0	0.130
Mean corpuscular hemoglobin (Pg)	25.12	25.05	30.46	29.44	3.01	25.3-33.4	0.062
Mean corpuscular hemoglobin conc. (%)	29.48	29.51	30.11	30.17	3.07	25.3-32.5	0.001

a, b Means within the same row with different superscripts are significantly different (P < 0.05)

mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were similar (P>0.05) among the treatments. However, MCV among the treatment group is below the normal range reported by Mitruka and Rawnsley [14] for healthy adult birds. The lower values obtained in this study could be attributed to the age of the birds. Similarly, the MCH for the birds on the control diet were slightly below the normal range as reported by Adejumo and Ologhobo [15]. The lower value of MCH observed in the control could be attributed to the lower concentrations of erythrocyte parameters such as PCV, RBC and haemoglobin concentration observed in T_1. The white blood cell (WBC) was significantly (P<0.05) affected by the treatment diets. Haematological parameters are used to monitor feed toxicity, especially with feed constituents that affect blood formation and functions. The PCV values, although similar (P>0.05) for broiler starters varied from 29.33% to 31.33% in this study, which followed a specific pattern across the treatments and were within the normal range of 26.00 – 45.20% for normal chicken as reported by Mitruka and Rawnsley [14]. This implies that the nutritional content of the diets were adequate and the replacement of maize with cocoyam meal in the experimental diets did not reduce its nutritional quality. The significant (*P*<0.05) difference in WBC counts followed a particular trend, decreasing with increasing levels of test ingredient. The result of the present study is in disagreement with the findings of Adejumo and Ologhobo [15] who stated increase in WBC to finisher broilers fed taro cocoyam meal. However, the values obtained for WBC counts were within the reference values reported by Mitruka and Rawnsley [14]. The decrease in the WBC with increasing levels of the test ingredient could possibly be due to the presence of antinutritional factors, which were not tolerable by the starter broiler birds at the early stage of live.

4. CONCLUSION

The result of this study showed that processed taro cocoyam meal could replace maize in broiler diet up to 10% without having detrimental effects on feed intake, growth performance and haematological indices in broiler starters. Further studies to examine the impact of processed taro cocoyam on nutrient intake and digestibility, growth performance and meat quality in broiler finishers are suggested.

ETHICS APPROVAL

This paper followed all the guidelines for the care and use of laboratory animal model of the Federal College of Agriculture, Ishiagu, Ebonyi State, Nigeria.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Mozafari O, Ghaziand S, Moeini MM. The effects of different levels of edible potato (*Solanum tubresum*) replacing maize on performance, serum metabolite and immune system of broiler chicks. Anim Sci App Ira J. 2013;3:588-583.
2. Ekwe KC, Nwosu KI, Ekwe CC, Nwachukwu I. Examining the under exploited values of cocoyams for enhanced household food security, nutrition and economy in Nigeria. ISHS ACTA Horticulturae 806; 2012.
3. Lyonga SN, Nzietchueng S. Cocoyam and African food crisis. In "Proc. of the 3rd Triennial Symp., Int. Soc. Trop. Root Crops. African Branch, Owerri- Imo State, Nigeria; 1986.

4. Agwunobi LN, Awukam PO, Cora OO, Isika MA. Studies on the use of *Colocasia esculenta* (taro cocoyam) in the diets of weaned pigs. Trop Anim H Prod. 2002;34: 241-247.
5. Okaka JC, Akobundu ENT, Okaka ANC. Human nutrition-an integrated approach. ESUT Publications, Enugu, Nigeria. 1992; 108.
6. AOAC. Association of Official Analytical Chemists. Official Method of Analysis, Washington, D.C. Chapter. 1995;4:17-34.
7. Nnabuk OE, Emmanuel E, Eno EE, Richard AU. Industrial potential of two varieties of Cocoyam in bread making. e-Journal of Chemistry. 2012;9: 451-464.
8. Olajide R, Ainsoyinu AO, Babayemi OJ, Omojola AB, Abu AO, Afolabi KD. Effect of processing on energy values, nutrient and anti nutrient components of wild cocoyam (*Colocasia esculenta* (L) Schott) corm. Pak J. Nutri. 2011;10:29-34.
9. Hackbath H, Buron V, Schimansley G. Strain difference in inbred rats: Influence of strain and diet on haematological traits. Lab Anim. 1983;17:7–12.
10. Ribeiro PAP, Matos Jr JB, Lara LJC, Araujo LF, Albuquerque R, Baiao NC. Effect of dietary energy concentration on performance parameters and egg quality of white leghorn laying hens. Braz J Pltry Sci. 2014;16:381-388.
11. Leeson S. Is feed efficiency still a useful measure of broiler performance? Department of Animal and Poultry Science, University of Guelp, Ministry of Agriculture, Food and Rural Affairs Canada; 2000.
12. Oruwari BM, Aniebo AO, Nkanta DM. Effect of replacing maize with cassava brewers, dried yeast blend (cassava yeast) on performance of broiler chicks and feed cost in southern Nigeria. Nig J Anim Prod. 1996;30:169-178.
13. Tewe OO, Egbuike GN. Utilization of cassava in non-ruminant livestock feeds. Cassava as livestock feed in Africa. Proceeding of the IITA/ILCA/University of Ibadan workshop on the potential utilization of cassava as livestock feed in Africa. Nigeria. 1992;10:28-38.
14. Mitruka BM, Rawnsley HM. Chemical, biochemical and haematological references values in normal experimental animal, Mason publishing, USA Inc. N.V. 1977;88-142.
15. Adejumo IO, Ologhobo AD. Haematological response of broiler finishers fed differently processed taro cocoyam *Colocasia esculenta* (L) Schott. Agricultura Tropica et Subtropica. 2012; 45(3):112-116.

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