Growth Performance, Haematological, Carcass and Organ Characteristics of Broiler Birds Fed Aerial Yam (Dioscorea bulbifera) Tuber Meal

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Abstract

A-48 day feeding trial was conducted to determine the effects of dietary levels of aerial yam tuber meal (AYTM) on growth performance, haematological, carcass and organ characteristics of broiler birds. Five experimental diets were formulated to include aerial yam tuber meal at 0%, 4%, 8%, 12% and 16% at the starter stage and 0%, 8%, 16%, 24% and 32% at the finisher phase for T1, T2, T3, T4 and T5 respectively. One hundred and twenty (120) day old Anak broiler chicks were used and randomly divided into five groups with each group randomly allotted to the five treatment diets in a Completely Randomized Experimental Design (CRD). Each group was further subdivided into three (3) replicates of eight birds each. The experimental starter and finisher diets were fed ad libitum. Data were collected for growth performance, haematological parameters, carcass and organ characteristics. Total body weight gain and average daily feed intake were significantly (P<0.05) better in the control diets. The haematological indices differed (P<0.05) significantly in packed cell volume (PCV) and white blood cell (WBC) counts. PCV and WBC were also higher and better for the animals fed the control diets relative to the other treatments. The carcass and organ characteristics showed no significance (P>0.05) difference among the treatment groups. Aerial yam tuber meal showed a good promise when included in the diets of broiler starter and finisher up to 32% without a harmful effect on growth performance, haematological and carcass and organ characteristics of broilers. It can be therefore recommended as a cheaper alternative to maize in broiler feeding.

Key words: *aerial yam, growth performance, hematology, carcass and organ characteristic, broiler chicken, alternative feed stuff.*

INTRODUCTION

Poultry are mainly fed with conventional resources like maize, guinea corn, sorghum, millet, wheat, soybeans, groundnut cake, fishmeal etc which are in great competition between man, poultry and various industries. Intensive approach to broiler production would however entail the use of alternative readily available resources other than the conventional ones to enhance the production of meat at affordable price (Jiwuba *et al*., 2016). It is in light of the above that aerial yam, relatively unexploited tuber, is being assayed for its feed value in broiler production.

Aerial yam *(Discorea bulbifera)* belongs to *Discoreae species* and known with diverse names; potato yam, cheeky yam, bulbils bearing yam, bitter yam, brotwurzel, karotoffel-yam (Germany) Gaithi, Inhame (Hindu), Adu (Igbo speaking regions in Nigeria), criollo (Venezuela) De Aire (Colombia) and papa Cimarrona (Mexico). *Dioscorea bulbifera* is one of the economically most important specie of yam and distinguished from all other *Dioscorea* species by having specialized aerial bulbils on the base of petioles (Marthin, 1974). The *Dioscorea bulbifera* are extensively known in West Africa, Carribean Islands, South East Asia, South Pacific and West Indies (Abara, 2011). *Dioscorea bulbifera* yam is used as food and it is a good source of calories and minerals such as iron, calcium and phosphorous (Tindall, 1983). Proximate and nutrient composition analysis reported by Abara (2011) revealed 2.89% crude fibre, 6.35% crude protein, 0.49% fat, 82.50% charbohydrate, 2.77% ash, 54.60 mg/100 calcium, 139.00 mg/100 magnesium, 440.00 mg/100 g, potassium, 550.00 mg/100 g, sodium, 5.90 mg/100 g iron, 150.00 mg/100 g phosphorus, 1.52 mg/100 g zinc, 4.00 ppm manganese and 359.81 kcal/100 g energy on dry matter basis. The yam is eaten boiled, roasted and rarely pounded as "fufu" (Ezeocha *et al.,* 2015) and however are poorly acceptable by people, hence a promising alternative source of energy for livestock and poultry. The leaves and bulbils of *Dioscorea bulbifera* are used for traditional medicine in some areas (Coursey, 1967). It contains compound that are similar to female hormones which are helpful for female disorders (Adewole *et al*., 2011), natural steroid called dehydro-epiandrosterone (DHEA) that is said to rejuvenate and give vigor to love making, considered to be a liver cleaner and sometimes called one of the best natural relievers of jaundice, and nausea (Farquer, 1996). However, Princewill-Ogbonna *et al*. (2015) reported the presence of saponins, oxalate, phenols, and tannins as anti-nutrients in aerial yam (*Dioscorea bulbifera)*; which perhaps have

hindered it acceptability and utilization. Adewole *et al*. (2011) recommended soaking in water or prolong boiling as possible means of detoxifications.

The sourcing for readily and locally available feed ingredients to enhance food production stimulated this research which aimed at evaluating the effects of diets containing aerial yam tuber meal on growth performance, haematological, carcass and organ characteristics of broilers.

MATERIALS AND METHODS

Experimental site

The research was carried out at the poultry unit, Federal College of Agriculture, Ishiagu, Ebonyi State. The College is situated at latitude 5.56°N and longitude 7.31°E, with an average rainfall of 1653 mm and a prevailing temperature condition of 28.50°c and relative humidity of about 80%.

Processing of aerial yam

The aerial yam used in this study was sourced from Ebonyi State. They were boiled, peeled and oven dried at 60°C to ensure maximum nutrient retention and reduction of anti-nutritional factors. They were milled to 2mm in diameter and used in the formulation of the experimental diets.

Experimental Diet

Five experimental broiler starter and finisher diets were formulated such that aerial yam tuber meal was included at 0, 4, 8, 12 and 16% for the starter phase and at 0, 8, 16, 24 and 32% for the finisher phase respectively as presented in table 1.

Table 1: composition of experimental diets

	Starter diets					Finisher diets					
Ingredients	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_5**
Maize	50.00	48.00	45.00	42.00	39.00	57.00	53.00	47.00	40.00	34.00	39.00
AYTM	0.00	4.00	8.00	12.00	16.00	0.00	8.00	16.00	24.00	32.00	16.00
Soybean	35.00	34.00	33.00	33.00	32.00	23.00	23.00	20.00	20.00	20.00	32.00
Wheat offal	7.00	6.00	6.00	5.00	5.00	13.00	12.00	10.00	9.00	7.00	5.00
Fish meal	4.00	4.00	4.00	4.00	4.00	3.00	3.00	3.00	3.00	3.00	4.00
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vit. premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
TOTAL	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

AYTM = Aerial yam tuber meal

Experimental birds and management

One hundred and twenty (120), day old Anak broiler chicks were procured from a commercial hatchery. The chicks were divided into five groups and each group randomly allotted to the five treatment diets in a Completely Randomized Experimental Design (CRD). Each group was further subdivided into three (3) replicates of eight birds each. All the birds were fed liberally throughout the duration of the experiment. During the feeding trial, heat was provided to the birds using electric bulbs. Routine poultry management practices were maintained. The feeding trial lasted forty eight (48) days.

Data Collection

The chicks were weighed before the commencement of the trial and thereafter, the weights were taken on weekly basis using a weighing scale. At the end of the experiment, the body weight changes were calculated by subtracting the initial body weight from the final body weight. The daily weight gain was determined by dividing the body weight change by the number of days the experiment lasted.

A weighed quantity of feed was served to the birds between 6.30 am and 7.30 am daily. The leftover feed per group was collected every morning, weighed and recorded. The daily feed intake of each replicate group

was determined by the difference between the quantity of feed offered and the leftover the following day. The feed conversion ratio of the birds was equally computed using the formula: average daily feed intake divided by average daily weight gain.

At the end of the feeding trial, three birds were randomly selected from each replicate. The ventral part of the left wing was carefully defeathered to locate the veins. 5 ml of blood was collected via the left wing vein of each of the representative birds using a 10ml gauge syringe and scalp vein needle and fed in to a sterile bottle containing Ethylene Diethyl Tetra Acetic acid (EDTA), as anticoagulant for haematological determination. It was placed in an ice-moist jute material to avoid Haemolysis. The blood was drowned in a heprinised capillary tube and PCV was determined by microhaematocrit method. Determination of RBC and WBC (along with DLC) were carried out according to Dacie and Lewis (1991) while MCV, MCH and MCHC were deduced according to Jain (1986) as follows:

MCV (fl) = PCVX10/RBCX10; MCH (pg) = HbX10/RBC (10^6); MCHC (%) = HbX100/PCV.

At the end of the feeding trial, three birds were randomly selected from each replicate. Live weight and slaughter weight was taken immediately after slaughter. Defeathering followed by dipping in hot water at 800 C for 10-15 minutes. Then cut-up parts and visceral organs were later weighed. Dressing percentage was calculated using the relationships:

Dressing % = Carcass weight x 100/ Live weight

The cut up parts such as the shanks, breast cuts, neck, drumsticks, thighs and wings, were weighed using electronic sensitive balance. The weights were later expressed as percentage of the dressed weight. The organs and other visceral components such as liver, gizzard and heart, were weighed also using electronic sensitive balance and the weights expressed as percentage of the live weight.

Proximate and statistical analyses

The proximate analysis of the aerial yam tuber meal and experimental diets were determined by the methods of AOAC (2000). All data collected were subjected to Analysis of Variance (ANOVA) of Completely Randomized Design of the Package for Social Sciences Window 17.0. Where treatment effect differed significantly, means were separated using Duncan Multiple New Range Test (Duncan, 1955). All statements of significance were based on 5% level.

RESULTS AND DISCUSSION

The proximate composition of the experimental diets and aerial yam tuber meal is presented in table 2 and table 3. The proximate composition of the aerial yam tuber meal (AYTM) is comparable with the earlier reports by Abara (2011) and Princewill-Ogbonna and Ibeji (2015) for the same crop. The dry matter, crude protein and crude fibre contents of the test diets compared with the control diet and are in agreement with the crude protein and energy requirement for broiler birds as stated by NRC (1994).

Table 2: proximate composition of experiment diets (starter phase)

	Starter diets				
Parameters (%)	**T1**	**T2**	**T3**	**T4**	**T5**
Dry matter	94.94	94.86	93.21	93.07	94.92
Crude protein	22.69	22.48	22.66	22.77	22.11
Crude fibre	3.18	3.37	3.78	3.57	3.23
Ash	8.79	9.84	9.33	9.47	7.27
Ether extract	4.92	6.53	5.25	6.31	5.09
Nitrogen free extract	48.36	48.13	48.06	47.97	47.96
Metabolisable Energy (Kcal/kg)	3411.8	3302.9	3302.0	3268.6	3186.5

Table 3: proximate composition of experiment diets and aerial yam tuber meal (finisher phase)

	Finisher diets					
Parameters (%)	**T1**	**T2**	**T3**	**T4**	**T5**	**AYTM**
Dry matter	92.70	90.61	91.80	89.83	90.67	90.82
Crude protein	19.99	19.99	19.14	19.36	19.35	5.76
Crude fibre	4.81	4.30	4.15	4.20	4.18	1.97
Ash	6.99	7.23	7.50	7.55	7.57	3.25
Ether extract	3.55	3.61	3.66	3.66	3.64	1.05
Nitrogen free extract	55.44	55.48	55.35	55.06	54.93	79.82
Metabolisable Energy (Kcal/kg)	2,939.0	2,948.3	2953.25	2,950.8	2,944.2	3,133.15

The performance of broiler birds fed the aerial yam tuber meal is presented in Table 4. The results indicated that birds fed diet with 0% aerial yam tuber meal gained higher weight than birds fed AYTM diets. Average daily weight gain in the 0% group was numerically better than other treatment groups. This confirmed the observations made by Ayuk and Essien (2009), Turner *et al.* (1976), Agwunobi (1999), Tamir and Tsega (2009) that increasing inclusion level of roots, corms or tuber in broiler diets did not have any significant effect on daily body weight gain and feed conversion ratio (FCR). However, the slight reduction in growth rate as AYRM increase may have been due to the presence of unidentified inhibitors of digestive and / or metabolic processes as suggested by Gerspacio (1978). This observation could be generally traced to increasing palatability of the control feed which enhances its acceptability and utilization. The negative effect of the anti-nutritional factors and phytochemical compounds present in aerial yam on the birds could also be responsible for decreasing performance. Aerial yam has been implicated by the presence of phenol, saponin oxalate and tannin (Princewill-Ogbonna *et al*. 2015). Aerial yam popularly known as bitter yam is generally bitter in taste (Nwosu, 2014), therefore, the inclusion of AYRM in the diets could have resulted in reduced palatability and thus reduce feed intake of the broiler diets. Omekam (1994) observed that unpalatability nature of a feedstuff will consequently prevent chicks from consuming adequate quantity of the feed. There was a significant decrease in the average daily feed intake of the birds fed AYTM diets than birds that are fed the control diet. This explained the higher feed intake of birds fed the control diet than the other diets.

Table 4: growth performance of broilers fed aerial yam tuber meal

Parameters (%)	**T_1**	**T_2**	**T_3**	**T_4**	**T5**	**SEM**
Initial body weight (g)	70.50	65.00	66.00	68.21	69.00	4.70
Final body weight (g)	2285.00[a]	2180.00[a]	2030.0[b]	2050.00[b]	1984.39[b]	31.62
Total weight gain (g)	2191.50[a]	2115.00[a]	1964.00[b]	1981.79[b]	1915.39[b]	24.11
Daily weight gain (g)	45.66	44.06	40.92	41.29	39.90	3.41
Total feed intake (g)	3162.57	3010.03	2908.78	2878.33	2792.50	22.85
Daily feed intake (g)	65.89[a]	62.71[b]	60.60[b]	59.97[b]	58.18[b]	3.79
Feed conversion ratio (g)	1.44	1.42	1.48	1.45	1.46	0.03

a. b. Means within the same row with different superscripts are significantly different ($p<0.05$)

The haematological parameters of broiler birds fed diets containing aerial yam tuber meal are presented in Table 5. The haemoglobin (Hb), red blood cell (RBC), mean corpuscular haemoglobin concentration (MCHC) mean corpuscular haemoglobin (MCH) and mean corpuscular volume (MCV) were not ($P>0.05$)

influenced by the treatment diets while packed cell volume (PCV) and white blood cell counts (WBC) were significantly (P<0.05) affected. All the haematological parameters evaluated however fell within the normal range for apparently healthy broiler as reported by Mitruka and Rawnsley (1977) indicating that the diets were nutritionally adequate in providing a sound plane of nutrition for the birds. The non significance and within normal range of Hb, RBC, MCHC, MCH and MCV gave a clear indication of absence anemia. This further indicated that, all the birds had higher tendency to resist respiratory stress, owing to the fact that, the Hb, which is carried on the RBC, is the oxygen carrying pigment as earlier observed by Muhammad and Oloyede (2009). PCV is used as an index of toxicity and its reduction in blood concentration usually suggests the presence of toxic factor like haemaglutinin which has adverse effect on blood formation (Jiwuba *et al*., 2016). Though the PCV values obtained for all the treatment groups in this study fell within the reported values for apparent healthy broiler according to (Mitruka and Rawnsley, 1977), the AYTM generally promoted lower PCV values when compared to the control, indicating the presence of anti nutritional factors in the AYTM diets relative to control. Hydrogen cyanide abounds in *Dioscorea bulbifera* species (Anhwange *et al*., 2011) which has been found to affect blood formation in animals.

The slight decrease in WBC counts of birds fed the AYTM suggest possible immune suppression since the WBCs are known to be the key actors in immune responses as they form the first line of defense against invading microorganism and the lowering of WBC values usually indicates fall in immune strength (Sembulinggam and Prema, 2010). The observed decrease in the WBC observed in the study is agreement with the results of Princewill-Ogbonna *et al*. (2015) who studied the haematological and histopathological parameters of rats fed with Aerial yam (*Dioscorea bulbifera*).

Table 5: haematological parameters of broilers fed aerial yam tuber meal

Parameters	**T_1**	**T_2**	**T_3**	**T_4**	**T5**	**SEM**
Packed cell volume (%)	32.5^a	29.0^b	28.0^b	29.5^b	27.5^b	0.35
Haemoglobin (g/dl)	10.90	9.70	9.60	10.00	9.60	0.12
Red blood cell ($X10^{12/L}$)	3.66	3.67	3.28	3.53	3.19	0.15
MCHC (%)	32.53	29.44	28.28	29.89	28.72	0.09
Mean corpuscular haemoglobin (pg)	30.03	26.55	29.33	28.68	30.14	0.89
Mean corpuscular volume (fl)	89.55	79.38	85.54	84.76	87.91	2.78
White blood cell ($X10^{12/L}$)	16.8^a	12.40^b	12.00^b	11.60^b	10.13^b	0.40

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

The carcass and organ characteristics are summarized in Table 6. The non-significant difference (P>0.05) in the carcass and organ weights investigated could also mean that the diets were safe for the broiler feed production.

Table 6: carcass and organ characteristics of broilers fed aerial yam tuber meal

Parameters	T_1	T_2	T_3	T_4	T_5	SEM
Live weight (g)	2285.00[a]	2180.00[b]	2030.00[b]	2050.00[b]	1984.39[b]	31.62
Dressed carcass weight (g)	1905.00	1772.50	1626.50	1645.00	1560.00	26.72
Dressing percentage (%)	83.37	81.31	80.12	80.24	78.61	3.93
Thigh (% DW)	23.58	22.82	24.09	20.49	19.15	1.03
Drumstick (%DW)	17.71	16.32	15.67	15.21	16.69	0.43
Breast cut (%DW)	37.46	32.40	29.50	33.18	30.47	1.29
Wing (%DW)	13.99	12.56	10.65	11.19	12.15	0.26
Shank (%LW)	3.48	4.92	3.97	3.53	4.08	0.20
Neck (%LW)	3.84	3.39	4.53	4.22	4.29	0.20
Liver (%LW)	1.53	1.95	2.33	2.11	1.89	0.14
Heart (%LW)	0.38	0.49	0.33	0.48	0.52	0.04
Gizzard (%LW)	2.78	2.42	2.82	2.78	2.73	0.13

a. [b.] Means within the same row with different superscripts are significantly different ($p<0.05$)

%DW = Percentage dressed weight %LW = percentage live weight

Conclusion

It could be concluded that aerial yam tuber meal could be included up to 32% of without any detrimental effects on growth performance and haematolgy, carcass and organ weights. It can be therefore recommended as a cheaper alternative to maize in broiler feeding.

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