Performance characteristics and physiological response of broiler chickens at finisher stage to oral supplementation with fluted pumpkin, *Telfairia occidentalis* leaf extract

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Abstract

The performance characteristics and physiological response of broiler chickens to oral supplementation with *Telfairia occidentalis* leaf extract (TOLE) at finisher stage were investigated. One hundred and twenty unsexed broilers of Arbor Acre strain at 28-day-old were randomly divided into four treatment groups of oral supplementation each with three replicates. The treatment groups are: T_1=Water (control), T_2=Vitalyte, T_3=15% TOLE, and T_4=30% TOLE. The experiment lasted for 70 days, during which data collection was carried out and blood obtained for analysis at the 70th day. Results revealed that average body weight gain, average daily feed intake, and feed conversion ratio were significantly ($P<0.05$) affected by oral TOLE while percentage crop and gizzard weight were not significantly ($P>0.05$) affected by oral TOLE. Measured blood parameters of the groups on TOLE were significantly ($P<0.05$) higher than those on vitalyte and control group. Hemoglobin concentration, packed cell volume and red blood cell counts revealed that broilers on oral TOLE had better values when compared to those on vitalyte and control. Meanwhile, white blood cell count was not affected significantly ($P>0.05$) by the oral supplementations. Apart from creatinine, uric acid and globulin, other serum metabolites investigated were significantly ($P<0.05$) affected by TOLE inclusions. No mortality was recorded during the experiment. Oral supplementation of TOLE compared well with conventional vitamin supplement based on measured parameters, 30% supplementation can be used as vitamin supplement in broiler chicken at finisher phase.

Keywords: blood parameters, broilers, oral supplementation, performance characteristics, *Telfairia occidentalis*, vitalyte

Introduction

Vegetables and other leafy plants are known to be rich in protein, essential fatty acids and most especially in vitamins and minerals which make them to be a good potential source of these nutrients to livestock and human populations at a reasonably cheaper rate (Farinu et al., 1992). However, their incorporation is still at a relatively low rate in view of the huge dependence on vitamin mineral premixes which are tested and well adopted sources of these micro nutrients to the livestock.

Ruminant animals by virtue of their grazing behavior derive most of their nutritional requirements from the green pastures. However, this is not possible with non-ruminants especially in poultry production where chickens are being kept intensively hence the need for provision of balanced diet both quantitatively and qualitatively.

Broilers are meat type chicken genetically developed to mature within few weeks of life (7 to 10 weeks), depending on the level of production and management practices. Nevertheless, good feeding regime is highly required for the actualization of this genetic potential of broilers (Madubuike, 1992; Oluyemi and Roberts, 2000). Meanwhile, prominent among the factors limiting broilers production in Nigeria is the feed cost which carries 70% of the total cost of production (Alimi et al., 2006) and poor marketing opportunities. Scientists have started looking inward to reducing feed cost by exploiting materials that are locally available as feed raw materials and medications.

Broilers have access to vitamins and minerals through feed and oral supplementation right from the day of hatch through the starter phase subsequently as anti-stress before, during and or after important operations such as vaccination, deworming, transportation and also during heat stress. Vitamins are organic substances that play vital roles in the daily metabolic processes in animals, deficiency of which can lead to poor productivity or premature death of such animal. Although, they are needed in minute quantity, and their importance cannot be over emphasized. Members are vitamins A, D, E and K otherwise known as water soluble vitamins and vitamin B complex and vitamin C which are classified as fat soluble vitamins.

However, the high cost of common wettable and premixes form of commercially available vitamins supplement in Nigeria have necessitated the need to exploit leafy vegetables, herbs and other parts of locally available plants as substitutes for these synthetic products as a way of reducing the cost of production. *Telfairia occidentalis* otherwise known as fluted pumpkin is native to the tropical rainforest of West Africa with the largest diversity in Southeastern Nigeria (Fasuyi and Nonyerem, 2007). Asiegbu (1988) reported that "*Telfairia* species are rich sources of iron and essential fatty acids and also in amino acids and are very high in minerals and vitamin contents", while Akoroda (1990) reported "*T. occidentalis* contains 21-37% of crude protein, 14% ash, 13% fat and 13% crude fibre". Fasuyi and Nonyerem (2007) reported "traces of some anti-nutritional factors notably phytates and oxalates".

This study therefore investigated the effect of *T. occidentalis* leaf extract (TOLE) administered orally on the production performance, body characteristics and blood parameters of broiler chickens at finisher stage.

Materials and methods

Extraction

T. occidentalis leaves were harvested fresh from maturing stems and rinsed in distilled water to remove dirt and sand. Five kilograms of dirt-free leaves were shred thoroughly squeezed in twenty liters of distilled water to ensure maximum extraction as described by Siamba et al. (2007). The resulting green extract was then sieved to remove the leaf remnants and other solutes. The extract was later stored in an air tight container and refrigerated prior to use.

Experimental birds and management

The experiment was carried out at the poultry unit of the teaching and research farm, Faculty of Agriculture, Bowen University, Iwo, Nigeria. Environmental temperature range of 15-28 ^{0}C and mean annual rainfall of 1,400 mm, subject to climate change. One hundred and twenty 28-day-old unsexed Arbor Acre broilers were randomly allotted into four treatment groups of thirty birds each with three replicates (n=10) in a completely randomized design. The treatment groups are: T_1=Water; T_2=Vitalyte, T_3=15% inclusion of TOLE; T_4=30% inclusion of TOLE. T_1 served as the control while T_2 with vitalyte represented the common commercial vitamins supplement available for poultry. The birds were reared on deep litter, provided with insulating materials on the floor and at a spacing of 650 cm^2 per bird (Oluyemi and Roberts, 2000). Birds were allowed to adjust for seven days, routine management practices in terms of medication and vaccination were strictly observed while feed and experimental TOLE, water and vitalyte were given to the birds ad libitum.

Data collection

Collection of data started after 7 days of acclimation. Data for daily feed intake and weekly body weight gain were collected for 70 days. Average body weight gain, feed conversion ratio (FCR) and efficiency of feed utilization (EFU) were later calculated. Blood samples were collected from three birds per treatment through their wing web veins at 70th day. Samples meant for hematology were collected into bottles treated with ethylene diamine tetra acetic acid (EDTA), an anticoagulant. Hematological parameters measured were hemoglobin concentration (Hb), packed cell volume (PCV), red blood counts (RBC), white blood counts (WBC), erythrocyte indices such as mean cell volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC). Serum metabolites measured were total protein (TP), glucose, albumin, globulin, creatinine, bilirubin, uric acid, cholesterol, calcium and iron concentrations. At the 10th week of age, three birds were randomly picked from each treatment group and the live weight (final body weight, FBW), gizzard percentage, liver percentage, spleen percentage, heart percentage and abdominal fat percentage were determined and expressed as percentage live weight.

Statistical analysis

Data collected were subjected to a one way analysis of variance (ANOVA) using the fixed effect model. Duncan multiple range test was used to test for the significance of variance ($P<0.05$) for all recorded and calculated data between different treatments using SAS 1999 version 12.

$Y_{ij}=\mu+T_i+e_{ij}$

Where Y_{ij}=individual observation

μ=general mean

T_i=fixed effect of treatment (i=1…..4)

e_{ij}=expected error

Results

Table 1 gave the performance characteristics of broiler chicken at finisher stage on oral treatment supplementation. Parameters measured were average daily feed intake (ADFI), initial body weight (IBW), average body weight gain (ABWG), feed conversion ratio (FCR), efficiency of feed utilization (EFU) and percentage mortality. Oral supplementation with TOLE and vitalyte had significant ($P<0.05$) effect on the ADFI. The range was from 158.55 g (T_1) to 164.27 g (T_3). No significant ($P>0.05$) difference was observed between the mean ADFI of T_2 and T_4, but they are significantly different ($P<0.05$) from T_3 and T_1 while T_1 and T_3 also differed significantly ($P<0.05$). Birds on T_1 had the lowest feed intake followed by T_4, T_2 and T_3. The initial body weight was similar in all treatment groups prior to the administration of TOLE and vitalyte.

The final body weight (FBW) and average body weight gain (ABWG) were significantly ($P<0.05$) affected by oral supplementation of TOLE, values followed the same trend in each of the parameters. For FBW, T_1 birds had the least value followed by T_2, T_3 and T_5 with the highest. The range was from 2.19 kg (T_1) to 2.55 kg (T_4). For ABWG, the range was from 1.54 kg (T_1) to 1.89 kg (T_4). Consequently T_1 group had the highest FCR value of 3.60 while T_4 had the lowest of 2.99 with EFU of 0.33 (33%) better than other treatment groups. Meanwhile, no mortality was recorded throughout the trial period.

Table 2 shows the gross composition of the feed (broiler finisher) given to the experimental birds. The feed was compounded to meet the nutrient requirement as recommended by NRC (1994) for broilers chicken.

Table 3 described the effect of oral supplementations on the hematological and serum blood parameters measured at day 70 of age. Hemoglobin concentration was significantly ($P<0.05$) affected by the vitalyte and TOLE inclusions. Birds on T_4 had the highest value of 7.80 $g*dL^{-1}$ while those on control (T_1) had the lowest value 6.10 $g*dL^{-1}$. No significant ($P>0.05$) difference was noted between T_2 and T_3 but they differed significantly ($P<0.05$) from T_1 and T_4. PCV (%) and RBC of birds were significantly ($P<0.05$) affected by treatment sand values followed the same pattern as hemoglobin. The oral inclusions had no significant ($P>0.05$) on the white blood cell

(WBC) and the mean cell volume (MCV). Meanwhile, mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) of birds were significantly affected by oral treatments. MCH increased from 27.16 pg of the control group (T_1) to 30.16 pg (T_4) and MCHC followed the same pattern, increased significantly ($P<0.05$) with the TOLE inclusion.

Serum creatinine, uric acid and globulin were not affected significantly ($P>0.05$) by the inclusions. However, total protein, albumin, cholesterol, calcium and glucose values were significantly ($P<0.05$) affected and their values were increasing from the control group (T_1) with increased concentration of TOLE ($T_2>T_3>T_4$).

Table 1. Performance characteristics of broiler treated with oral supplementation of TOLE and Vitalyte for 70 days

	Treatments				
Parameters	T_1	T_2	T_3	T_4	SEM
ADFI (g)	158.55^{c}	162.15^{b}	164.27^{a}	161.85^{b}	2.5
IBW (kg)	0.65	0.66	0.65	0.66	0.02
FBW (kg)	2.19^{d}	2.26^{c}	2.3^{b}	2.55^{a}	0.02
ABWG (kg)	1.54^{d}	1.6^{c}	1.65^{b}	1.89^{a}	0.01
FCR	3.6	3.54	3.48	2.99	
EFU	0.27	0.28	0.28	0.33	
Mortality (%)	0	0	0	0	

^{abcd}Means along the same row with different superscripts are significantly ($P<0.05$) different using Duncan's test as post hoc analysis; SEM - Standard Error of Means; ADFI - Average Daily Feed Intake; IBW - Initial Body Weight; FBW - Final Body Weight; ABWG - Average Body Weight Gain; FCR - Feed Conversion Ratio.

Table 2. Gross composition of the broiler finisher diet

Ingredients	%
Maize	49.3
Brewers dry grain	11
Wheat offal	5
Ground nut cake	11
Soybean meal	14.5
Fish meal 72%	1.5
Oyster shell	1
Bone meal	2
*Broilers premix	2.5
Salt	2
Methionine	0.1
Lysine	0.1
Total	100

[a]Calculated values; Metabolizable Energy (ME)=2800.5 kcal*kg^{-1}; Crudeprotein (CP)=20.1%; Crude Fibre (CF)=4.98%; Ether Extract (EE)=5.5%

[b]Premix to provide the followings per kg of feed: Vitamin A-500 iu, Vit. D3 - 1,200 mg, Vit. E - 11 mg, Vit. K3 - 2 mg, Riboflavin - 20 mg, Nicotinic acid -10 mg, Panthothenic acid - 7 mg, Cobalamin - 0.08 mg, Choline chloride - 900 mg, Folic acid - 1.5 mg, Biotin - 1.5 mg , Iron – 25 mg, Manganese - 80 mg, Copper - 2 mg, Zinc – 50 mg, Cobalt - 1.2 mg and Selenium - 0.1 mg.

Table 3. Haematological and serum parameters of broiler treated with oral supplementation of TOLE and Vitalyte at 70th day

Treatments	T_1	T_2	T_3	T_4	SEM
Haematological parameters					
Packed cell volume (PCV) (%)	30.9^{c}	32.4^{b}	32.6^{b}	33.41^{a}	0.8
Heamoglobin (Hb) (g*dL^{-1})	9.1^{c}	9.2^{b}	10.3^{b}	10.8^{a}	0.4
Red blood cell (RBC) (10^{6}*µL^{-1})	3.35^{d}	3.45^{c}	3.52^{b}	3.58^{a}	0.05
White blood cell (WBC) (10^{6}*µL^{-1})	1,180	1,180.5	1,190	1,181	11
Mean cell volume (MCV) (fL)	92.23	94.2	92.61	93.32	2
Mean corpuscular haemoglobin (MCH) (pg)	27.16^{b}	27.67^{b}	29.26^{a}	30.16^{a}	1
Mean corpuscular haemoglobin (MCHC) concentration (%)	2.94^{b}	2.83^{b}	3.16^{a}	3.23^{a}	0.15
Serum biochemistry parameters					
Glucose (mg∗dL^{-1})	133.65^{c}	135.55^{b}	137.75^{a}	138.3^{a}	1.5
Calcium (mg∗dL^{-1})	14.5^{b}	14.9^{b}	15.5^{a}	15.6^{a}	0.5
Globulin (g*dL^{-1})	2.7	2.75	2.75	2.7	0.6
Albumin (g∗dL^{-1})	2.80^{d}	2.9^{c}	3.1^{b}	3.55^{a}	0.08
Total protein (g∗dL^{-1})	5.50^{c}	5.65^{b}	5.85^{b}	6.25^{a}	0.51
Cholesterol (mg∗dL^{-1})	49.03^{c}	51^{b}	54.6^{ab}	55.25^{a}	1
Uric acid (mg∗dL^{-1})	2.04	2	1.98	2.01	0.05
Creatinine (mg∗dL^{-1})	2.2	2.21	2.21	2.2	0.05

^{abcd}Means along the same row with different superscripts are significantly (P<0.05) different using Duncan's test as post hoc analysis.

Table 4. Gut morphology of broiler treated with oral supplementation of TOLE and vitalyte at 70th day (percentage of live weight)

	Treatments				
Parameters	T_1	T_2	T_3	T_4	SEM
FBW (kg)	2.19^{d}	2.26^{c}	2.3^{b}	2.55^{a}	0.02
Gizzard (%)	3.46^{c}	3.45^{c}	3.66^{b}	3.84^{a}	0.05
Liver (%)	1.93^{d}	2.15^{c}	2.23^{b}	2.55^{a}	0.05
Heart (%)	0.45^{d}	0.46^{c}	0.56^{b}	0.72^{a}	0.02
Spleen (%)	0.13^{c}	0.16^{b}	0.17^{b}	0.19^{a}	0.01
Abdominal fat (%)	1.05^{d}	1.1^{c}	1.13^{b}	1.17^{a}	0.01

^{abcd} Means along the same row with different superscripts are significantly ($P<0.05$) different using Duncan's test as post hoc analysis; SEM - Standard Error of Means; FBW - Final Body Weight.

In Table 4, the visceral organ weights of experimental broiler on oral supplementations was presented. Parameters measured were FBW, gizzard percentage, liver percentage, heart percentage, spleen percentage and abdominal fat percentage all expressed as percentage of live weight. Supplementation with TOLE and vitalyte had significant ($P<0.05$) effect on the weight of these internal organs in the same trend, with birds on TOLE having higher values. For gizzard, liver and abdominal fat, oral TOLE had significant ($P<0.05$) effect on their weights with the least values from T_1 and the highest from T_4. The trend was $T_4>T_3>T_2>T_1$. For spleen percentage, no significant different ($P>0.05$) was observed between the treatment means of T_2 and T_3 but they differed significantly ($P<0.05$) from T_4 and T_1 while T_4 and T_1 also differed significantly ($P<0.05$) from each other. The range was from 0.13% (T_1) to 0.19% (T_4).

Discussion

Higher ADFI recorded with oral TOLE supplementation confirmed that TOLE can be used to improve the feed intake of broiler probably due to its laxative effect. Increase ADFI with TOLE could also be as a result of availability of minerals present in the leaf (Agatemor, 2006). This corroborates the report of Oluyemi and Roberts (2000), that "availability of both macro and micro elements in poultry diet improved feed intake". However, the higher feed intake with TOLE supplementation may be responsible for the better growth rate recorded by birds on oral TOLE. This is in agreement with the report of Fasuyi and Nonyerem (2007) that "the growth stimulating factor in *Telfairia occidentalis* may be traced to its well-balanced amino acid profile and its rich contents of minerals, vitamins and essential fatty acids" also reported by Agatemor

(2006). Fasuyi and Nonyerem (2007) reported that “nitrogen digestibility and protein efficiency ratio were higher with *Telfairia occidentalis* leaf meal in broiler starter diets”.

The result of the organ weight suggested that TOLE is likely to have hypertrophic influence on these organs. This could probably be due to higher physiological activities by these organs triggered by the presence of anti-nutritional factors present in TOLE and their concomitant effects (Fasuyi and Nonyerem, 2007; Ibitoye et al., 2012).

The result of treatments on hematological blood profile of birds, suggested that TOLE have erythropoietic effect on the blood profile of the chickens and this agrees with the report of Agatemor (2006) that “*T. occidentalis* is very rich in iron which is an important component of hemoglobin of the red blood cells that are transporter of oxygen and carbon-dioxide at cellular level”. In the same line, chemical composition of *T. occidentalis* had been shown to include proteins, fat, vitamin A, thiamine, riboflavin, nicotinamide, vitamin C and minerals such as zinc, iron, calcium and magnesium. The amino acid profile of *T. occidentalis* had also been shown to be very rich and includes alanine, aspartate, glycine, glutamine, histidine, lysine, methionine, tryptophan, cystine, leucine, arginine, serine, threonine, phenylalanine, valine, tyrosine and isoleucine (Fasuyi, 2006). Some of these constituents are well-established haemopoietic factors that have direct influence on the production of blood in the bone marrow.

The result of the hematological blood profile obtained in this research is however inconsistent with the report of Fasuyi and Nonyerem (2007), when birds were fed with the dietary preparation of the sun-dried leaves of the *T. occidentalis* plant. The result obtained with the sun-dried leaves might be due to the denaturing of the active ingredients especially proteins in the leaves during exposure to sunlight. The oral inclusions did not affect the WBC and this suggests that the health status of the birds in term of infection was not negatively affected. Meanwhile, the result of MCV, MCH, and MCHC implies that the amount of hemoglobin by weight in average RBC of the birds was increasing with the TOLE inclusion. However, values obtained fell within the ranges for normal chickens as reported by Mitruka and Rawnsley (1977), Jain (1986) and Awotwi (1990).

Result for serum creatinine, globulin and uric acid suggested that vitalyte and TOLE inclusions had no negative effect on the protein metabolism and energy-protein balance of the birds and there was no tissue breakdown within the system of experimental birds. However, total protein, albumin, cholesterol calcium and glucose values were significantly ($P<0.05$) affected and their values were increasing from the control group to T_4 indicating that TOLE is having higher vitamins and minerals profile even than the synthetic vitalyte. However, increase in value of cholesterol with TOLE supplementation could be attributed to low fibre content of TOLE. This could have resulted in low binding effect on the bile acids excreting, thereby increased higher level of serum cholesterol. This is in agreement with the findings of Ezeagu et al. (2000), Matawalli et al. (2004) and Nworgu et al. (2007). Higher values of cholesterol depicts hyperlipidemia (a likely indicator of heart diseases), which can also accumulate in the meat and potentially the body of those that consume it.

Conclusion

From the above findings, oral supplementation of *Telfairia occidentalis* leaf extract (TOLE) can be used to stimulate body growth in broilers chickens at finisher stage and also to improve the relative organ weight of the chickens without adverse effect on the birds and with better efficiency of feed utilization. The increase in the Hb concentration with a simultaneous increase in the proportion of RBC and PCV suggested that inclusion of TOLE as oral vitamins supplement can be done to improve the nutritional status of the birds and can thus be adopted as substitute for synthetic vitamin products. Therefore, locally available leafy vegetables like *T. occidentalis* will serve as a cheap source of vitamins in livestock management. However, 30% inclusion rate of TOLE in drinkable water can be tolerated in broiler production.

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