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Performance and Some Blood Chemistry Indices of Broiler Chicken Served Fluted Pumpkin (*Telfaria occidentalis*) Leaves Extract Supplement

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Abstract: A 56-day experiment involving 120 day-old Anak 2000 broiler chicks was carried out in a completely randomized design to evaluate the performance, haematological parameters and serum metabolites of the broilers served Fluted Pumpkin Leaves Extract (FPLE) supplement at four days interval for 8 weeks during the late dry season. The birds were allotted to 5 treatments containing 0, 30, 60, 90 and 120 ml FPLE/litre of water. Each treatment was replicated three times. Broiler starters were fed the same starter diet, while the finishers were equally fed the same finisher diet. The FPLE was found to be rich in protein (21.31%) and ash (10.97%) most especially Ca, P, Mg and Fe and relatively low in fibre, tannin and oxalate, hence a good protein and mineral supplement for broilers during the late dry season. Feed intake, body weight gain, feed conversion ratio, water intake, cost of fed per kg live weight gain, haemoglobin, Packed Cell Volume (PCV), Red Blood Cell (RBC), White Blood Cell (WBC), Cholesterol (CH), urea, sodium and potassium of the birds served FPLE were significantly ($p<0.05$) superior to control. Haemoglobin was elevated on the birds served PFLE by 19.64-48.2% compare to control. The birds served 60 ml FPLE/litre of water had elevated Hb, PCV and RBC, while those on 120 ml had the highest value of WBC, CH and urea. Broiler starters and finishers are recommended to be served 60 and 120 ml FPLE/litre of water, respectively at 4 days interval during late dry season for improved feed intake, weight gain and blood formation.

Key words: Performance · haematology · serum biochemistry · broiler chicken · fluted pumpin leaves extract · supplement

INTRODUCTION

Rapid growth of human and livestock population which has created increased needs for food and feed in the developing countries demand that alternative feed resources must be identified and evaluated. More also, the scarcity of locally produced protein supplements for animal diets in the tropics has created a need to finding alternative feed sources. Hence, widely cultivated vegetable in the tropics and sub-tropices known as Fluted Pumpkin (FP) (*Telfaria occidentalis*) needs to be turned attention towards exploitation its leaves extract as protein and mineral supplements in poultry nutrition. Leafy vegetables supply minerals, protein and vitamins, thereby complementing the inadequacies of most feedstuffs [1]. The protein from leaves may be recovered and fed animals as solution in form of protein concentrates [2]. In Nigeria, *T. occidentalis* leaves extract is regarded as blood tonic for both the rich and the poor [3]. Adedapo *et al.* [4] used FPand sorghum bicolor extracts as potent haematnics in domestic rabbits and concluded that the rabbits served these extracts had the highest values of packed cell volume, haemoglobin, red blood and white blood cells and faster responded to therapy. The use of *T. occidentalis* leaves extract supplement in poultry nutrition is not common in our environment. The nutritive value of the leaves of FP has been evaluated chemically and are found to contain (g/100 g DM) 30.5±2.5 crude protein, 3.0±0.15 crude lipid, 8.3±50 crude fibre and 8.4±0.5 total ash [5]. The authors noted that the leaves had low level of tannic acid (4.75±0.50 mg 100 g DM) and oxalate (0.45±0.03 mg/100 g DM) but high level of phytic acid (20.5±2.10 mg/100 g DM).

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Idufueko [6] and Madubuike [7] reported that poultry meat and eggs offer considerable potential for bridging the protein gap in view of the fact that high yielding exotic poultry are easily adaptable to our environment and the technology of production is relatively simple with returns on investment appreciably high. High cost of feed in poultry industry in Nigeria is the major problem of poultry farmers [8]. Opara [9] reported that feed accounts for 70-85% of the total production cost of poultry in Nigeria. More than 50% of the Nigerian poultry farms have closed down and another 30% are forced to reduce their production capacity due to high cost and shortage of feed [10].

Blood parameters have been shown to be major indices of physiological, pathological and nutritional status of an organism and changes in the constituent compounds of blood when compared to normal values could be used to interpret the metabolic stage of an animal as well as quality of feed [11]. It is against these backgrounds that this study was conducted to determine the nutritive value of *T. occidentalis* leaves extract and evaluate its effects on the weight gain, feed and water intake, haematology and serum biochemistry indices of broiler chickens served this extract at four days interval during the late dry season (December 2003-February, 2004) as birds loose weight during this period of the year due to positive heat load.

MATERIALS AND METHODS

A total of one hundred and twenty Anak 2000 day-old broiler chicks were weighed and randomly allotted to five dietary treatments containing 0, 30, 60, 90 and 120 ml of fluted pumpkin leaves extract (FPLE) per one litre of water for A, B, C, D and E correspondingly in a Completely Randomized Design. Treatment A served as control. Each treatment was replicated three times with 8 birds per replicate. The experiment lasted for eight weeks (i.e. [4] for weeks for each phase). The broiler starters were fed the same starter diet, while broilers finishers were equally fed the same finisher diet (Table 1). The birds were served the FPLE according to the treatments per one litre of water and later water was served freely. Feed and water were served *ad-libitum*. The FPLE was served at four days interval throughout the period of the experiment. Data on feed and water intake were recorded on daily basis, while weight gain was determined on weekly basis and feed conversion ratio was calculated at the end of each phase. Other management practices such as routine vaccination, drug administration and maintenance of cleanliness within and outside the poultry pens/house were observed.

Table 1: Gross composition of broiler chicken diets

Ingredients (%)	Broiler starter diet	Broiler finisher diet
Maize	48.00	50.00
Corn bran	6.85	8.00
Palm kernel cake	5.00	8.10
Soybean meal	20.00	17.00
Groundnut cake	12.00	9.00
Fish meal (65%)	4.20	3.50
Bone meal	3.00	3.50
Vitamin and mineral premix*	0.30	0.35
Salt	0.25	0.25
Lysine	0.25	0.20
Methionine	0.15	0.10
Calculated analysis (%)		
Crude protein	23.07	21.00
Crude fibre	3.42	4.07
Lysine	1.20	0.88
Methionine	0.62	0.50
Metabolisable energy (kcal kg^{-1})	2996.00	3100.00

*To provide the following per (kg) of diet: Vit A = 10,000iu, vitamin D3 = 2000 iu, vitamin E = 5 iu, vitamin K = 2 mg, riboflavin = 4.20 mg, vitamin B 12 = 0.01 mg, pantothenic acid = 5 mg, nicotinic acid = 20 mg, folic acid = 0.5 mg, choline = 3 mg, Mg = 56 mg, Fe = 20 mg, Cu = 10 mg, Zn = 50 mg, Co = 125 mg and Iodine = 0.08 mg

Preparation of fluted pumpkin leaves extract: One kilogramme of freshly cut fluted pumpkin leaves with leaf stalks were washed, drained, chopped and pounded in a mortar with pestle. This was then squeezed and filtered with a sieve to obtain the homogenous extract of the Fluted Pumpkin Leaves (FPL). The homogenous FPLE was prepared at four days interval and served the animals fresh according to the treatments.

Collection of blood samples: Blood collection was carried out at the 8th week of the experiment. Three birds per treatment were randomly selected and bled via wing veins using sterile gauge 19 needles and syringes. About 5 ml of blood was collected into two sets of three sterilized glass tubes/bottles. For haematology, the blood samples were collected into two sets of three sterilized bottles containing Ethylene Diaminetetra-acetic Acid (EDTA). Blood samples for serum biochemical studies were collected into plain vacutainers (i.e. without anticoagulant) for serum separation. Serum was obtained

by centrifugation and the serum samples were stored in a deep freezer (at minus 10°C) until analyzed.

Analysis of blood samples: Packed Cell Volume (PCV) was determined by microhaematocrit method [12]. Haemoglobin (Hb) concentration was measured spectrophotometrically by cyanomethaemoglobin method [13] and [12] using SP6-500 UV spectrophotometer (Pye UNICAM ENGLAND). The Red Blood Cell (RBC) and white blood cell counts were estimated using haemocytometer [12]. Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin Concentration (MCHC) and Mean Corpuscular Haemoglobin (MCH) were calculated from Hb, PVC and RBC [14]. Serum Total Protein (STP) was determined by Kjedahl method as described by Kohn and Allen [15], while albumin was determined using the BCG (bromocresol green) method as described by Peters *et al.* [16]. Aspartate Transaminase (AST) and Alanine Transaminase (ALT) activities were determined using spectrophotometric method as described by Rej and Holder [17] and Holder and Rej [18], respectively.

Sodium and potassium were determined by flame photometry [19]. Cholesterol was determined according to Roschlan *et al.* [20], while urea was determined as described by Kaplan and Szabo [21].

Proximate and chemical analyses: Proximate and chemical composition of the feeds and the FPLE were determined According to the Official Method of Analysis (AOAC) [22]. The minerals were determined by the procedures outlined by Boehringer [23] and AOAC [22]. Sodium and calcium were read with PFP7 flame photometer and phosphorus was determined with spectrotometer (spectronic21). Gross energy values were determined using the bomb calorimeter method [24], while metabolizable energy was estimated by the method outlined by Panzenga [25]. Phytate was determined by the technique of Igbedion *et al.* [26], while tannin was determined by the procedures outlined by Hagerman and Ler [27] and oxalate by the method of Talapatra and Price [28].

Statistical analysis: Data collected were subjected to Analysis Variance (ANOVA) in SPSS 10 computer programme and errors were calculated as Standard Errors of the Mean (SEM). Significant treatment means were compared using Duncan's New Multiple Range Test as outlined by Obi [29]. Significance was accepted at the 0.5 level of probability.

Table 2: Proximate chemical composition of fluted pumpkin leaf extract (FPLE) and broiler chicken diets (%DM basis)

Fraction	Fluted pumpkin leaf extract	Broiler starter diet	Broiler finisher diet
Crude protein	21.31	22.12	21.00
Crude fibre	6.41	3.50	3.48
Ether extract	5.50	3.46	3.84
Ash	10.92	7.00	6.11
Nitrogen free extract	55.56	62.92	65.57
Metabolizable energy (Kca kg^{-1})*	3121.00	3072.00	3118.00
Gross energy (kcal kg^{-1})	4420.00	-	-
Calcium	0.67	0.96	0.80
Phosphorus	0.40	0.40	0.34
Potassium	0.15	1.28	1.31
Nitrogen	3.41	3.70	3.36
Magnesium	0.43	0.26	0.21
Sodium	0.02	0.26	0.28
Zinc (mg/100 g DM)	7.50	4.8	5.10
Iron (mg/100g/DM)	18.50	1.14	1.20
Manganese (mg/100 g DM)	1.18	7.90	9.20
Phytate (mg/100 g DM)	510.51	-	-
Tannin (mg/100 g DM)	0.184	-	-
Oxalate (mg/100 g DM)	0.0034	-	-

* Determined by Pazenga [25]

RESULTS AND DISCUSSION

The proximate chemical compositions of Fluted Pumpkin Leaves Extract (FPLE), broiler starter and finisher diets are presented in Table 2. The broiler chicken diets presented here met the requirements of the birds and are in line with NRC [30] standards. The FPLE is a valuable feed supplement for broilers, especially during the late dry season of the year, being very rich in Crude Protein (CP) (21.31%), minerals (calcium, phosphorus, magnesium and iron) and relatively low in crude fibre (5.5%), oxalate and tannin. The CP value of FPLE in this study agrees with the values reported by Okoli and Mgbeogba [31] (21.8%) and Akwaowo *et al.* [32] (22.4%), but lower than the report of Ladeji *et al.* [33] (30.5%). The crude fibre (5.5%) in this study is lower than the results of Akwaowo *et al.* [32] (10.10%) and Ladeji *et al.* [33] (8.5%). The ash (10.92%) content of FPLE in the present study is in line with the findings of Ladeji *et al.* [33] and Akwaowo *et al.* [32] whose values were 8.40 and 12.60%, respectively. The values of minerals reported in the study do not corroborate with the findings of Akaowo *et al.* [32], whose values were lower. The values (mg/100 g DM) of iron (12.0), calcium (144.0) and magnesium (100) reported

Table 3: Performance characteristics of broiler chicken served Fluted Pumpkin Leaves Extracts (FPLE) and experimental diets

	Starter phase					
Parameters	A (0 ml l^{-1})	B (30 ml l^{-1})	C (60 ml l^{-1})	D (90 ml l^{-1})	E (120 ml l^{-1})	SEM
Initial body weight (g/bird)	44.00	44.01	44.00	44.02	44.01	-
Final body weight (g/bird)	535.71^{c}	528.57^{c}	576.19^{a}	562.38^{b}	530.95^{c}	3.92
Mean body weight gain (g/bird)	491.71^{c}	484.56^{d}	532.19^{a}	518.36^{b}	486.94^{cd}	1.96
Average daily weight gain (g/bird)	17.56	17.30	19.00	18.51	17.39	-
Total feed intake (g/bird)	1100.60^{b}	1099.11^{c}	1067.90^{d}	1068.91^{d}	1108.80^{a}	0.13
Average daily feed intake (g/bird)	39.30	39.25	38.13	38.17	39.59	-
Feed conversion ratio (feed/g grain)	2.24^{b}	2.27^{a}	2.01^{d}	2.06^{c}	2.28^{a}	0.006
Total water intake (ml/bird)	1823.90^{c}	1850.21^{b}	1799.00^{d}	1775.30^{e}	1887.00^{a}	0.29
Average daily water intake(ml/bird)	65.14	66.08	64.30	63.33	67.41	-
Feed water intake ratio	01:02.00	01:01.70	01:01.70	01:01.70	01:01.70	-
Mortality (%)	-	-	-	-	-	-
Cost of feed per kg live weight gain (N/kg)	92.81^{a}	94.06^{a}	83.22^{b}	85.52^{b}	94.41^{a}	1.15
Cost of FPLE (N/bird)	-	1.3	2.6	3.9	5.2	-
	Finisher phase					
Parameters	A (0 ml l^{-1})	B (30 ml l^{-1})	C (60 ml l^{-1})	D (90 ml l^{-1})	E (120 ml l^{-1})	SEM
Initial body weight (g/bird)	535.71^{c}	528.57^{c}	576.19^{a}	562.38^{b}	530.95^{c}	3.92
Final body weight (g/bird)	1720.19^{e}	1951.40^{b}	1882.09^{d}	1888.70^{c}	2133.70^{a}	1.29
Mean body weight gain (g/bird)	1184.48^{e}	1422.57^{b}	1305.90^{d}	1326.32^{c}	1602.03^{d}	1.59
Average daily weight gain (g/bird)	42.30	50.81	46.64	47.37	57.24	-
Total feed intake (g/bird)	3063.70^{d}	3031.32^{e}	3210.86^{c}	3235.60^{b}	3333.61^{a}	5.09
Average daily feed intake (g/bird)	109.41	108.46	114.67	115.55	119.05	-
Feed conversion ratio (feed/g grain)	2.59^{a}	2.13^{d}	2.46^{b}	2.44^{c}	2.02^{e}	0.001
Total water intake (ml/bird)	8835.14^{e}	8968.40^{d}	9109.86^{b}	9072.30^{c}	9174.68^{a}	0.08
Average daily water intake(ml/bird)	313.54	320.30	325.35	324.01	327.67	-
Feed water intake ratio	01:02.90	01:03.00	01:02.80	01:02.80	01:02.80	-
Mortality (%)	-	-	-	4.70	4.70	-
Cost of feed per kg live weight gain (N/kg)	100.23^{a}	82.56^{d}	95.25^{b}	94.52^{c}	80.59^{e}	0.06
Cost of FPLE (N/bird)	-	1.30	2.60	3.90	5.20	-

abcd = Means with different superscripts on the same horizontal row within each phase differ significantly ($p<0.05$), FPLE = Fluted pumpkin leaves extract, A = Oml FPLE/l of water, B = 30ml FPLE/l of H_2O, C = 60ml FPLE/l of H_2O, D = 90ml FPLE/l of H_2O and E = 120ml FPLE/l of H_2O, SEM =Standard error of means, N = Naira

by Ladeji *et al.* [33] do not concur with the present study, unlike iron (5.0) and potassium (594). Tannin and oxalate (mg/100 g DM) values is this study agree with the study of Akwaowo *et al.* [32] and Ladeji *et al.* [33], unlike phytate which has elevated value in the present study. Variations in these values could be attributed to age of cutting, variety, season of planting and agronomic practical adopted.

The Final Body Weight (FBW), Weight Gain (WG), Feed Intake (FI), Total Water Intake (TWI), Feed Conversion Ratio (FCR) and Cost of Feed per Kilogramme Live Weight Gain (CFPKLWG) were significantly ($p<0.05$)different among the treatments (Table 3). At starter phase the best WG (532.19 g/bird) was observed on the birds served 60 ml FPLE/litre of water compared to control and 120 ml FPLE/L H_2O (486.94-491.719 g/bird), but at finisher's phase, the birds served 120 ml FPLE had the best result for FBW (2133.70 g/bird) unlike control (1720.19 g/bird). This indicates that broiler starters tolerated lower concentration of FPLE, while broiler

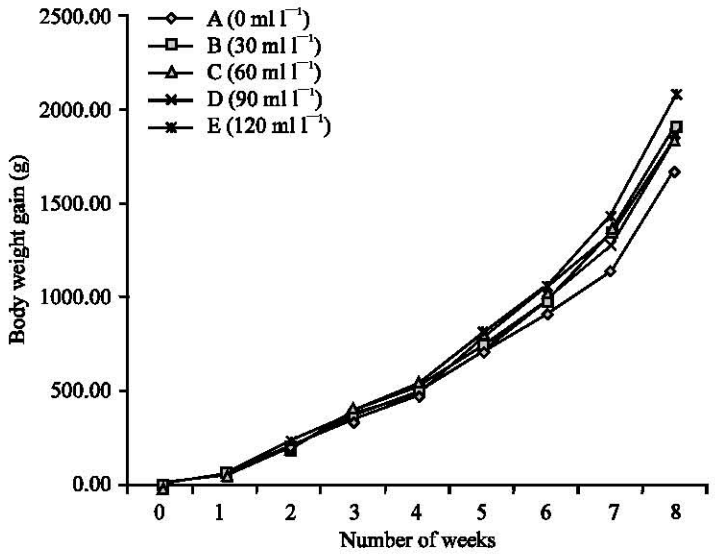

Fig. 1: Effect of fluted pumpkin leaves extract on body weight gain of broiler checked

finishers tolerated higher concentration. This is likely due to their better developed organs. In both phases, the highest F1 was recorded on the birds served 120 ml FPLE/litre H_2O. This could be as a result of availability of minerals which improved feed intake. Oluyemi and Roberts [34] reported that both micro and macro elements improve F1 in poultry. The TWI was similarly highest at this concentration in both phases. The TWI here agrees with the report of Oluyemi and Roberts [34]. The WG for birds served 60 ml FPLE/litre H_2O (532.19 g/bird) and those in control (491.71 g/bird) corroborate with the report of Nworgu and Egbunike [35] (259.0-586.0 g/bird) and at finisher's phase the WG (1184.48-1602.03 g/bird) agrees with the values reported by Esonu *et al.* [36] (982.0-1405.0 g/bird). The FCR for broiler starters is lower (better) than that reported by Odunsi *et al.* [37] (2.59-2.88) when the authors fed broiler chicks wild sunflower leaves meal, while the FCR at finisher phase was better than the record of Esonu *et al.* [36] (3.60-4.66). The CFPKWG for broiler starters is not in harmony with the result of Nowrgu *et al.* [38] (N53.39-N54.96 /kg)), while such parameter is in agreement with these authors (94.92-N106.36 /kg) at finisher phase. Variation at starters phase for FCR was as a result of poor weight gain in this study compared to Nworgu *et al.* [38] (671.2-746.0 g/bird) when the birds were fed full fat soybean and soybean meal. Mortality recorded was as a result of coccidiosis infection. Figure 1 shows the weight gain curves of the birds in each treatment. It reveals that birds served FPLE gained more weight than those in control.

The Haemoglobin (Hb), Packed Cell Volume (PCV), Red Blood Cell (RBC), White Blood Cell (WBC) and Mean Corpuscular Volume (MCV) were highly significant ($p<0.05$) and increased in the birds served FPLE compare to control (Table 4). The best Hb (10.0%), PCV (41.50%) and WBC (3.39x 10^6/l) were recorded on the birds served 60 ml/FPLE, while the least of these parameters (7.66, 28.00 and 2.35 x 10^6 /l, respectively) was recorded in control. This indicates that FPLE helps in blood formation, mostly at 60 ml/litre of H_2O, due to availability of protein, iron, calcium, magnesium, potassium and phosphorus as the birds ate more feed when they were served with FPLE. This is likely one of the reasons in Nigeria why anaemic patients, pregnant women, men and children are advised by medical personnels to take FPLE mixed with milk or honey or sole. The values of Hb, PCV, MCHC in this study are in harmony with the reports of Iheukwumene and Herbert [39] whose values were 6.0-13.0%, 29.0-38.0% and 33.0-35.0 pg, respectively. Islam *et al.* [40] reported that commercial and local chicken reared in Sylhet region in Bangladesh had Hb value of 7.06-9.37%, PCV value of 26.56-34.60% and MCV value of 84.27-163.56 fl and the values of these parameters are in line with the report of this study. The Hb, PCV, MCV, MCHC and RBC reported in the present study agree with that reported by MVM [41] for chicken whose values were 9-13%, 30-40%, 127 fl, 29% and 3.0x10^6 /l, respectively. Awotwi [42] reported that PCV of local and commercial chickens in Ghana varied from 32.88-33.20 and 31.30-35.60%, respectively, while Nworgu *et al.* [43] reported PCV of 28-30.0% for cockerel chicks fed cocoa pod husk meal.

The Total Serum Protein (TSP), albumin, cholesterol (CH), urea, Alamine Transaminase (ALT), Aspartate Transaminase (AST), sodium and potassium were

Table 4: Haematological parameters of broilers served Fluted Pumpkin Leaves Extract (FPLE) supplement

	Treatments					
Parameters	A (0 ml l^{-1})	B (30 ml l^{-1})	C (60 ml l^{-1})	D (90 ml l^{-1})	E (120 ml l^{-1})	SEM
Haemoglobin (gm%)	7.66^{e}	9.59^{b}	10.00^{a}	8.59^{d}	8.92^{c}	0.01
Packed cell volume (%)	28.00^{d}	36.50^{b}	41.50^{a}	33.50^{c}	36.50^{b}	0.02
Red blood cell (x10^{6}/l)	2.35^{d}	2.83^{c}	3.30^{a}	2.38^{d}	3.23^{b}	0.01
White blood cell (x10^{6}/l)	2.17^{d}	2.30^{c}	2.92^{b}	2.08^{e}	3.48^{a}	0.01
Mean corpuscular/cell volume (fl)	119.40^{d}	128.97^{b}	122.41^{c}	140.75^{a}	97.85^{e}	0.05
Mean cell haemoglobin (pg/cell)	32.59^{c}	33.88^{b}	29.49^{d}	36.09^{a}	23.91^{e}	0.02
Mean cell haemoglobin concentration (%)	27.35^{a}	26.27^{b}	24.09^{e}	25.64^{c}	24.34^{d}	0.02

Table 5: Serum metabolite indices of broiler chicken served fluted pumpkin leaves extract (FPLE) supplement

	Treatments					
Parameters	A (O ml l^{-1})	B (30 ml l^{-1})	C (60 ml l^{-1})	D (90 ml l^{-1})	E (120 ml l^{-1})	SEM
Total serum protein (g dl^{-1})	3.50^{b}	3.70^{a}	3.50^{b}	3.60^{ab}	3.10^{c}	0.06
Albumin (g dl^{-1})	2.10^{b}	2.40^{a}	2.40^{a}	2.30^{ab}	2.00^{b}	0.09
Globulin (g dl^{-1})	1.40^{a}	1.30^{ab}	1.10^{b}	1.30^{ab}	1.10^{b}	0.01
Albumin globulin ratio	1.50^{c}	1.80^{b}	2.20^{a}	1.80^{b}	1.80^{b}	0.09
Cholesterol (mg dl^{-1})	143.10^{b}	147.00^{b}	150.12^{b}	158.10^{ab}	163.00^{a}	0.61
Urea (mg dl^{-1})	14.00^{c}	12.01^{d}	10.01^{e}	17.00^{b}	19.00^{a}	0.35
Alanine transaminase (iu l^{-1})	23.50	23.50	23.00	24.00	24.84	0.26
Aspartate transaminase (iu l^{-1})	19.00^{b}	19.00^{b}	17.00^{c}	21.11^{a}	19.00^{b}	0.32
Sodium (mmol l^{-1})	103.10^{e}	112.00^{d}	121.00^{b}	117.00^{c}	131.00^{a}	1.10
Potassium (mmol l^{-1})	4.40^{b}	4.80^{a}	5.10^{a}	5.20^{a}	5.30^{a}	0.06

abcde: Means with different superscripts on the same horizontal row differ significantly ($p<0.05$)

significantly ($p<0.05$) improved on the birds served FPLE compared to control (Table 5). The values of urea, sodium and potassium in this study are higher than the report of Iheukwumene and Herbert [39], while results of Nworgu [8] for TSP (6.50-6.77 g dl^{-1}) and urea (21.01-24.00 mg dl^{-1}) are higher than reported in the present study. However, the values of sodium, potassium, ALT and AST in this study are in line with the submission of Nworgu [8] when broilers were fed mimosa leaf meal. The value of CH reported by Aderemi [44] (100.30-108.21 mg dl^{-1}) and Nworgu [8] (93.33-116.67 mg dl^{-1}) is lower than reported in this study. Variations in CH could be attributed to breed of chicken, nutritional pattern, type of feed, environmental factors and the test ingredient used. The CH in this study agrees with the values reported by Sturkie *et al.* [45] (100-150 mg dl^{-1}). Highest value of CH for birds severed 90-120 ml FPLE in this study could be attributed to low fibre content of the FPLE which could not have a binding effect on the bile acids excreting such and thus resulted in higher level of serum cholesterol. When the scenario above is on, recycling of bile acid is increased thereby synthesis of more bile acid from CH is not stimulated resulting again in higher level of CH. This is in agreement with the findings of Ezeagu *et al.* [46]. Matawalli *et al.* [47] conducted experiment on the effect of methanolic leaf extent of *Adansonia digitata* on serum lipid levels in normal and ethanol fed rats and reported that the extract lowered the lipid levels in rat fed with alcohol and adduced/concluded that the possible hypolipiaemic effect could be attributed to the presence of saponins and fibre in the extract, which has been shown to bind to serum lipids especially CH, thereby easing their excretion from circulation. Sturike *et al.* [45] noted that an increase in the CH level of the feed of an animal, consequently would lead to an increase in the CH level of the blood of the animal and the authors reported that the value of CH in chicken varies from 100-150 mg dl^{-1}. Higher values of CH depicts hyperlipeamia indicating that the patient is likely to have heart disease. The TSP in study was maintained by slight increase of albumin fraction with corresponding decrease in globulin fraction. Harper [48] highlighted that increased in serum globulin in infected animal is expected since this fraction of protein is the principal site of the circulating antibodies

(immunoglobulins). Egyum [49] and Iyayi and Tewe [50] reported that serum urea and TSP depend on both the quality and the quantity of the protein supplied in the diet. Higher level of urea for the birds fed 120 ml FPLE/litre of H_2O could be attributed to the presence of some anti-nutritional factors which might have lowered the quality of the protein indicating imbalance of amino acids in the diet which caused elevated blood urea concentration [51]. However, kidney malformation may raise the level of blood urea. The values of ALT and AST in this study are similar to the reports of Nworgu [8]. Positive correlation between ALT and growth performance, protein quality and quantity of the diet was reported by Balogun [52]. Higher values of sodium and potassium reported in the birds served FPLE reveals that FPLE are rich in these minerals. Value of potassium reported here is similar to the values reported by Nworgu [8] (3.87-4.37 mmol l^{-1}), while value of sodium is higher than the submission of Iheukuwemene and Herbert [39].

CONCLUSIONS

The FPLE is rich in protein and minerals and low in fibre, tannin and oxalate. The FPLE is a valuable protein and mineral supplement for broiler chicken during the dry season in the tropics, as it encouraged feed and water intake, weight gain and blood formation. Birds severed FPLE had increased weight gain, Hb, PCV, RBC, serum sodium and potassium which were 10.52-35.25, 12.14-30.55, 19.64-48.21, 1.28-41.28, 8.63-26.06 and 9.09-20.45%, respectively with respect to control in 8 weeks. Broiler finishers tolerated higher concentration of the FPLE than broiler starters. Hence, 60 and 120 ml FPLE/litre of water are recommended for broiler starters and finishers, respectively.

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