Influence of Guinea hen weed (*Petiveria alliacea*) on growth performance, nutrient digestibility and blood indices of growing pullets

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Abstract

A total of 450 ISA Brown growing chicks were used to evaluate the effects of feeding diets incorporated with *Petiveria alliacea* leaf meal (PLM) and *Petiveria alliacea* root meal (PRM) on growth performance, nutrient digestibility, haematological indices and serum biochemistry. The birds were divided into 10 treatment groups of 45 growing chicks with 3 replicates of 15 chicks each. The diets contained PLM and PRM at 5 five levels of inclusion; 0 mg/kg, 1000 mg/kg, 1500 mg/kg, 2000 mg/kg and 2500 mg/kg. The experiment was arranged in a 2 × 5 factorial layout in a Completely Randomized Design. Amidst varying inclusion levels, superior (P<0.05) final live weight, weight gain and feed-gain was obtained in birds fed diets added with 1000 mg/kg of PLM. Reduced (P<0.05) Packed Cell Volume was recorded in birds fed diet containing 1500, 2500 mg/kg of PLM and 2500 mg/kg of PRM in comparison to control. When compared to birds fed control diets, least (P<0.05) haemoglobin was obtained in birds fed with 1500 mg/kg of PLM. Among varying inclusion of PLM and PRM, Red Blood Cell was reduced (P<0.05) in birds fed diets included with 2500 mg/kg of PLM and 1000 mg/kg of PRM. White Blood Cell in birds fed diets included with 2000 and 1000 mg/kg of PLM was lowered (P<0.05) to other dietary groups. Eosinophil and monocyte differentials were decreased (P<0.05) in birds fed diets added with 2500 mg/kg of PRM. Serum total protein and albumin content were superior (P<0.05) in birds fed diets containing 2500 mg/kg of PLM in comparison to 1500 mg/kg of PLM. Globulin was best (P<0.05) in birds fed diets incorporated with 2500 mg/kg of PLM across the dietary groups. Serum ALT enzyme was increased (P<0.05) in birds fed diets incorporated with 1500 mg/kg of PLM than that fed with 1000 mg/kg of PLM. When compared to birds fed diets containing 2500 mg/kg of PRM, least (P<0.05) serum uric acid was obtained in birds fed 2000 and 2500 mg/kg of PLM. It could be concluded that incorporation of PLM at 1000 mg/kg improved weight gain, feed/gain and protein efficiency ratio. Better MCV and MCHC were recorded at 1000 mg/kg of PRM while inclusion of 2500 mg/kg of PRM increased serum total protein, albumin and globulin of the growing birds.

Keywords: *Petiveria alliacea* leaf and root meal, growing pullets, performance, digestibility, serum and haematology.

Introduction

Antibiotics have been included to poultry and pig diets to maintain health and production efficiency in the last few decades (Rosen, 1995). Its usage offered possibilities to improve animal performance and increase economic output of livestock producing units. Among the common antibiotics used as growth promoters in livestock animals are virginamycin, salinomycin, neomycin, doxycycline and avilamycin, etc. (Kumar *et al*., 2010). It helps growing animals to efficiently digest their food, derive maximum benefit from it and thereby allowing them to grow as healthy birds (Wegener *et al*., 1999). Botsoglou (2002) opined that antibiotics affect birds' gut microflora and they have been used widely to prevent poultry diseases for the improvement of egg and meat production. The development of resistance by pathogenic bacteria, which can impact on public health, necessitated it removal from poultry and pig diets around the world (Dibner and Richards, 2005). Also presently being pursued is the search for alternatives in improving the health and productivity of chickens (Barreto *et al.,* 2008). Such alternatives are probiotics, prebiotics and organic acids, which are added to the feed (Huyghebaert *et al.,* 2011). Tipu *et al.* (2006) gave a detailed account of medicinal properties of different plants. He established that these plants act as antibacterial, antioxidant, anti-carcinogenic, antifungal, analgesic, insecticidal, anti-coccidial and growth promoters. The active molecules in phytogenic include many different secondary plant metabolites, resulting in a broad range of physiological effects, like secretolytic and spasmolytic, or immune-stimulative effects (Lee *et al.,* 2004). *Petiveria alliacea* is from the order- *Caryophyllales* and family- *Phytolaccaceae*. It is a species of flowering plant in the pokeweed family, *Phytolaccaceae* (Mild 2004). It is popularly known in most part of the world as guinea hen weed. Previous work on *P alliacea* revealed the presence of triterpenoids, saponins, polyphenols, coumarins, benzaldehyde, benzoic acid, flavonoids, fredelinol, pintol and allatoin, varying their concentration in the roots, stems and leaves (Kubec *et al.,* 2003). Globally its use in livestock production has not been properly harnessed. Therefore, the aim of the present study was to examine the effect of *Petiveria alliacea* leaf and root meals on growth performance, nutrient digestibility, haematological indices and serum biochemical of growing pullets.

Materials and Methods

Experimental Site

The experiment was carried out at the Poultry Unit of the Teaching and Research Farms, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria. The area is located in the humid tropical zone of South-Western Nigeria with minimum and maximum temperatures of 20.66 and 35.48^{o}C, respectively. It lies in the region 76 m above sea level and falls within latitude 7^{o}13′49.46″N and longitude 3^{o}26′11.98″E. It receives a mean precipitation of 1037 mm per annum (Google Earth, 2015).

Processing of Test Ingredients

Petiveria alliacea roots were washed, chopped into bits followed by sun drying for 14 d (≤ 90% DM) and pulverised using a laboratory mill (1-mm sieve) to obtain a product herein referred to as *Petiveria* root meal (PRM) while *Petiveria alliacea* leaves were washed, air dried under a shed (29±2^{0}C) until they are crispy to touch, while retaining their greenish colouration. The leaves were milled (1-mm sieve) using a laboratory mill to obtain a product referred to as *Petiveria* leaf meal (PLM). The entire test ingredients were stored in an air tight container at room temperature until when needed.

Management of Experimental Birds and Diets

A total of 450 ISA Brown grower pullets were used for the experiment. They were divided into 10 treatment groups of 45 birds. Each treatment group was replicated thrice with 15 birds per replicate in a 2×5 factorial experimental design. Dried wood shavings were used as litter material. During this period, experimental feed containing 17.22 % crude protein and 2785.19 Kcal/kg (Table 1) and clean water were supplied *ad libitum*. Ten experimental diets were formulated with the inclusion of *Petiveria alliacea* leaf meal (PLM) and *Petiveria alliacea* root meal (PRM) for growing pullets. Diets 1 - 5 contained inclusion of PLM at 0 mg/kg, 1000 mg/kg, 1500 mg/kg, 2000 mg/kg and 2500 mg/kg and Diets 6 - 10 contained inclusion of PRM at 0 mg/kg, 1000 mg/kg, 1500 mg/kg, 2000 mg/kg and 2500 mg/kg.

Data Collection

Growth Performance

Records of weight gain (g/bird): (final weight - initial weight), feed intake (g/bird): (weight of feed supplied – weight of left over feed/ number of birds), mortality: (number of dead birds/total number of birds × 100), feed conversion ratio: (total feed intake/total body weight gain) were obtained and protein efficiency ratio: total body weight gain (g/bird)/total protein consumed (g/bird).

Nutrient Digestibility

A metabolism trial was conducted at day 56 of the study. Two birds per replicate were randomly selected and housed separately in appropriate metabolism cages fitted with individual feed troughs and facility for separate excreta collection. The chicks were acclimatized for 2-d prior to the commencement of 3-d collection period. Excreta collected per replicate per day was oven dried (60 °C) and used for analysis. Proximate composition of feed and dried excreta samples were analyzed for dry matter crude fibre, ether extract, ash and crude protein using standard methods of AOAC (AOAC, 2000).

Blood sample collection

At 56 d of the trial, blood sample (2.5 mL each) was collected from the brachial wing vein of one growing chick per pen (selected at random) into a bottle containing ethylene diamine tetra-acetate for the determination of haematological indices. Another set of blood sample was collected into plain bottles (without ethylene diamine tetra-acetate), centrifuged (2500×g for 15 min at 8 °C), and used for serum chemistry analysis.

Haematological Indices

Hemoglobin concentration (Hb) was estimated using the cyanmethaemoglobin method (Cannan, 1958). Packed cell volume (PCV), red blood cell (RBC), and white blood cell counts (WBC) were determined with Wintrobe haematocrit tube according to the method of Schalm *et al.* (1975). Mean Corpuscular Haemoglobin Concentration (MCHC) was calculated by dividing the haemoglobin by the Packed Cell Volume (PCV) as described by Van Beekvelt *et al.*, (2001). Mean Corpuscular Volume (MCV) was calculated by dividing Packed Cell Volume by the Red Blood Cell. MCV was reported as part of a standard complete blood count (Tonnesen *et al.,* 1986) Mean Corpuscular Haemoglobin (MCH) was reported as part of a standard complete blood count (Van Beekvelt *et al.*, 2001) and was calculated as average mass of haemoglobin per red blood cell in a sample of blood.

Serum Chemistry

Total serum protein (Varley *et al.*, 1980) and serum uric acid concentrations (Wootton, 1964) were measured according to standard procedures of Tietz (1995) and (Fossati *et al.*, 1980) respectively. Serum enzymes such as aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were determined according to Bergmeyer (1983) with the aid of commercial kits (Roche COBAS testing Kits, Roche, Basel, Switzerland). Cholesterol was determined as described by Coles (1986).

Statistical Analysis

Data were subjected to 2-way Analysis of Variance in a 2×5 factorial arrangement. Significant ($p<0.05$) differences among treatment means were determined using Duncan Multiple Range Test as contained in Statistical Analysis Software (SAS, 2000) package.

Results and Discussion

Growth performance as affected by *Petiveria* parts (PLM and PRM), inclusion levels and interaction of *Petiveria* parts and levels of inclusion of growing chicks (8-16 weeks) is presented in Table 2. The interaction between *Petiveria* part and levels of inclusion of *Petiveria* meal on growth performance of growing chicks (8-16 weeks old) was not significant ($P>0.05$) for final live weight and feed intake. Reduced weight gain and daily weight gain were obtained in birds fed diet with 2000 mg/kg of PLM, 1500 and 2000 mg/kg of PRM when compared to similar values obtained at 1000 mg/kg of PLM, 1000 and 2500 mg/kg of PRM. While superior ($P<0.05$) feed-gain was recorded in birds fed diets added with 1000 mg/kg of PLM when compared with 2000 mg/kg of PLM. Mortality percentage was higher ($P<0.05$) in birds fed diets included with 1500 mg/kg of PRM in comparison to other dietary groups.

Table 1. Gross composition (%) of experimental grower diets (8-16) weeks

	PLM (mg/kg)					PRM (mg/kg)				
Ingredients	0	1000	1500	2000	2500	0	1000	1500	2000	2500
Maize	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00
Wheat offal	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
SBM	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
GNC	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
PKC	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Bone Meal	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Oyster Shell	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Premix*	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
PLM[2]	-	+	++	+++	++++	-	-	-	-	-
PRM[2]	-	-	-	-	-	-	+	++	+++	++++
Total	100	100	100	100	100	100	100	100	100	100

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Ingredients	PLM (mg/kg) 0	1000	1500	2000	2500	PRM (mg/kg) 0	1000	1500	2000	2500
	Calculated Analysis (%)									
ME (kcal/kg)	2785.19	2785.19	2785.19	2785.19	2785.19	2785.19	2785.19	2785.19	2785.19	2785.19
CP	17.22	17.22	17.22	17.22	17.22	17.22	17.22	17.22	17.22	17.22
CF	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24
EE	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82
Ash	2.53	2.53	2.53	2.53	2.53	2.53	2.53	2.53	2.53	2.53

*Vit./Min. Premix contained Vit. A, 10 000 000iu; D_3 , 2 000 000iu ; E, 12 500iu; K, 1.30g; B_1, 1.30; B_2, 4.00g; D Calcium-Pantothenate, 1.30g; B_6, 1.30g; B_{12}, 0.01g; nicotinic acid, 15.00g; folic acid, 0.05g; biotin, 0.02g; Co, 0.20g; Cu, 5.00g; Fe, 25.00g; I, 0.06g; Mn, 48.00g; Se, 0.10g; Zn, 45.00g; choline chloride, 200.00g; BHT, 50.00g. [2]PLM:*Petivera* Leaf Meal [2]PRM: *Petivera* Root Meal. – = exclusion levels. + = 1000 mg/kg, ++ = 1500mg/kg, +++ = 2000mg/kg, ++++ = 2500mg/kg.

Table 2. Effects of PLM and PRM inclusion on growth performance of grower chicks (8-16 weeks)

Treatment		Initial weight (g/bird)	Final weight (g/bird)	Weight gain (g/bird)	Daily weight gain (g/bird/day)	Feed intake (g/bird/day)	Feed-gain	Mortality (%)	PER
Petiveria parts	Levels of inclusion								
PLM		424.55	1019.32	594.77	6.54	101.44	15.80	38.35[a]	0.38
PRM		416.89	1027.68	610.78	6.71	100.13	15.01	29.17[b]	0.39
SEM		9.99	26.87	20.99	0.23	3.81	0.59	3.69	0.02
	0	409.35	1024.94	615.59[ab]	6.77[ab]	101.72	15.06[b]	34.44[b]	0.38[bc]
	1000	409.81	1098.82	689.01[a]	7.57[a]	97.15	12.87[c]	22.22[b]	0.45[a]
	1500	423.84	996.14	572.17[bc]	6.29[bc]	107.01	17.02[a]	55.15[a]	0.34[cd]
	2000	432.65	942.98	515.14[c]	5.66[c]	98.66	17.52[a]	26.99[b]	0.33[d]
	2500	16.24	1054.63	621.98[ab]	6.84[ab]	99.39	14.58[bc]	30.00[b]	0.40[b]
	SEM	16.24	38.55	24.88	0.27	3.97	0.67	3.84	0.02
PLM	0	421.88	1026.67	604.79[b]	6.65[b]	108.89	16.38[abcd]	51.11[b]	0.36[cde]
	1000	401.45	1026.67	728.18[a]	8.00[a]	97.54	12.19[e]	26.66[de]	0.47[a]
	1500	415.54	977.27	561.73[bc]	6.17[bc]	104.27	16.89[abc]	46.67[b]	0.34[de]
	2000	431.22	913.04	481.82[c]	5.30[c]	98.32	18.57[a]	29.54[d]	0.31[e]
	2500	452.67	1050.00	597.33[b]	6.56[b]	98.20	14.96[cde]	37.78[c]	0.39[bcd]
PRM	0	396.82	1023.21	626.39[ab]	6.88[ab]	94.56	13.74[de]	17.77[f]	0.42[abc]
	1000	418.17	1068.00	649.83[ab]	7.14[ab]	96.77	13.55[de]	17.77[f]	0.43[ab]
	1500	432.39	1015.00	582.61[bc]	6.40[bc]	109.76	17.14[ab]	63.64[a]	0.34[ed]
	2000	424.46	972.92	548.46[bc]	6.03[bc]	99.00	16.47[abcd]	24.44[def]	0.35[cde]
	2500	412.63	1059.26	646.63[ab]	7.11[ab]	100.58	14.15[cde]	22.22[ef]	0.41[abcd]
SEM		24.29	59.09	34.80	0.38	5.82	0.89	1.95	0.02
P-values									
Petiveria parts		0.61	0.81	0.49	0.49	0.72	0.20	0.01	0.32
Levels of Incl.		0.80	0.09	0.00	0.00	0.48	0.00	0.00	0.00
Petiveria parts x Levels of Inclusion		0.90	0.46	0.01	0.01	0.63	0.00	0.00	0.00

[abcde] means on the same row having different superscript were significantly ($P<0.05$) different. SEM: Standard Error of Mean. Incl.; Inclusion. PER: Protein Efficiency Ratio

Table 3 reveals the effects of *Petiveria* parts (PLM and PRM), inclusion levels and interaction of *Petiveria* parts parts and levels of inclusion on apparent nutrient digestibility of growing chicks (8-16 wks). *Petiveria* parts employed did not differ (P>0.05) on apparent nutrient digestibility. However, levels of inclusion of *Petiveria* meal affected (P<0.05) crude fibre of growing chicks. Birds fed control diets and 1000 mg/kg of *Petiveria* meal showed decreased (P<0.05) crude fibre when compared to other inclusion levels. Dry matter, ash, crude protein, crude fibre and ether extract of growing chicks (8-16 weeks) were not significantly influenced by *Petiveria* part and levels of inclusion of *Petiveria* meal.

Table 3: Effects of PLM and PRM inclusion on apparent nutrient digestibility of grower chicks (8-16 weeks)

Treatment		Dry matter (%)	Ash (%)	Crude protein (%)	Crude fibre (%)	Ether extract (%)
Petiveria parts	Levels of inclusion					
PLM		82.22	80.55	89.69	77.84	89.68
PRM		76.61	75.31	87.68	78.34	83.63
SEM		2.25	2.10	2.06	2.21	2.11
	0	75.63	80.84	87.56	73.69[b]	84.95
	1000	72.51	71.80	85.10	70.97[b]	84.64
	1500	83.10	80.27	89.29	78.05[ab]	89.85
	2000	84.46	82.08	92.23	84.47[a]	89.85
	2500	81.40	74.68	89.26	83.31[a]	84.00
	SEM	3.37	7.85	3.32	2.86	3.59
PLM	0	78.13	82.69	88.15	74.15	90.23
	1000	75.51	72.85	86.28	70.92	89.58
	1500	80.92	80.87	88.13	77.87	88.93
	2000	89.93	89.35	94.25	83.68	91.56
	2500	86.62	76.98	91.66	82.61	88.12
PRM	0	73.13	78.99	86.97	73.22	79.69
	1000	69.50	70.74	83.93	71.02	79.69
	1500	85.28	79.67	90.46	78.23	90.76
	2000	78.97	74.81	90.19	85.25	88.14
	2500	76.17	72.38	86.86	84.00	79.88
SEM		4.59	4.50	5.12	4.51	5.00
P-values						
Petiveria parts		0.06	0.07	0.51	0.85	0.06
Levels of Inclusion		0.07	0.12	0.66	0.01	0.57
Petiveria parts x Levels of Inclusion		0.11	0.20	0.95	0.20	0.51

[abc] means on the same row having different superscript were significantly different (P<0.05). SEM: Standard Error of Mean.

Effects of *Petiveria* parts (PLM and PRM), inclusion levels of *Petiveria* parts and interaction of *Petiveria* parts and levels of inclusion on haematological indices of growing chicks (8-16 weeks) is shown in Table 4. Lymphocyte was influenced ($P<0.05$) by *Petiveria* part and levels of inclusion of *Petiveria* parts of growing chicks (8-16 weeks old). Birds fed diets included with 1500 and 2500 mg/kg of PLM and 2500 mg/kg of PRM showed decreased ($P<0.05$) PCV than other inclusion levels. Reduced ($P<0.05$) haemoglobin was recorded in birds fed diets added with 1500 mg/kg of PLM and 2500 mg/kg of PRM in comparison to those on control diets and 1000 mg/kg of PLM. When compared with other varying inclusion of PLM and PRM, least ($P<0.05$) RBC was recorded in birds fed diets with 2500 mg/kg of PLM and 1000 mg/kg of PRM. White Blood Cell (WBC) was lowered ($P<0.05$) in birds fed diets incorporated with 2000 mg/kg of PLM and 1000mg/kg of PRM when compared to other dietary group. When compared with 1500 mg/kg of PRM, heterophil was elevated ($P<0.05$) in PLM of the same inclusion rate. Eosinophil was better ($P<0.05$) in birds fed diets containing 2500 mg/kg of PLM and 1000 mg/kg of PRM when compared to 1000, 1500 mg/kg of PLM and 1500 mg/kg of PRM. But basophil was increased ($P<0.05$) in birds fed diets included with 1500 and 2000 mg/kg of PRM than in 2500 mg/kg of PRM. Monocyte (3.00%) was elevated ($P<0.05$) in birds fed diets of 2500 mg/kg inclusion of PLM than those fed diets with 2500 mg/kg of PRM (0.50%).

Table 4. Effects of PLM and PRM inclusion on haematological indices of grower chicks (8-16 weeks)

Treatment		PCV (%)	Hb (g/dl)	RBC ($\times10^{12}$/l)	WBC ($\times10^{9}$/l)	HET (%)	LYM (%)	EOS (%)	BAS (%)	MON (%)	MCV (fl)	MCH (Pg)	MCHC (g/dl)
Petiveria parts	Levels of inclusion												
PLM		25.30	8.86	2.54	11.79	29.90	66.70	0.60	1.10	1.70	99.75	30.65^{b}	31.09
PRM		26.80	8.52	2.43	12.25	32.90	64.30	0.50	1.00	1.30	112.19	40.35^{a}	29.95
SEM		1.29	0.42	0.08	0.39	1.12	1.75	0.16	0.16	0.24	8.07	2.77	1.13
	0	31.25^{a}	10.58^{a}	2.70	13.15	30.75	66.25	0.25^{bc}	0.75^{b}	2.00	117.28^{a}	39.68^{b}	33.83
	1000	27.50^{ab}	9.40^{ab}	2.48	11.35	29.75	67.50	0.75^{ab}	0.50^{b}	1.50	140.98^{a}	48.30^{a}	31.73
	1500	24.00^{b}	7.33^{c}	2.53	11.58	35.75	61.50	0.00^{c}	1.50^{a}	1.25	77.18^{b}	29.43^{c}	30.05
	2000	27.75^{ab}	8.58^{bc}	2.48	11.45	30.50	65.75	1.00^{a}	1.75^{a}	1.00	121.68^{a}	37.63^{b}	29.13
	2500	19.75^{c}	7.58^{c}	2.25	12.58	30.25	66.50	0.75^{ab}	0.75^{b}	1.75	72.75^{b}	22.48^{c}	27.88
	SEM	1.31	0.47	0.11	0.57	1.65	2.80	0.17	0.17	0.33	8.26	2.79	1.65
PLM	0	32.00^{a}	11.00^{a}	2.75^{a}	13.05^{a}	25.50^{d}	70.50	0.50^{c}	1.00^{c}	2.50^{b}	116.35^{bc}	40.00^{b}	34.40^{a}
	1000	29.00^{ab}	10.00^{abc}	2.80^{a}	12.25^{ab}	26.50^{cd}	71.00	0.00^{d}	0.50^{d}	2.00^{c}	101.10^{cd}	34.90^{bcd}	34.60^{a}
	1500	19.50^{c}	6.00^{f}	2.50^{ab}	10.95^{abc}	35.50^{a}	63.50	0.00^{d}	1.00^{c}	0.00^{g}	85.00^{de}	26.35^{e}	30.65^{ab}
	2000	27.50^{ab}	8.90^{bcd}	2.55^{ab}	9.90^{c}	30.00^{abcd}	66.50	1.00^{b}	1.50^{b}	1.00^{e}	109.50^{c}	35.60^{bc}	32.45^{a}
	2500	18.50^{c}	8.40^{cd}	2.10^{b}	12.80^{a}	32.00^{abc}	62.00	1.50^{a}	1.50^{b}	3.00^{a}	86.80^{de}	16.50^{f}	23.35^{c}
PRM	0	30.50^{ab}	10.15^{ab}	2.65^{a}	13.25^{a}	36.00^{a}	62.00	0.00^{d}	0.50^{d}	1.50^{d}	118.20^{bc}	39.35^{bc}	33.25^{a}
	1000	26.00^{b}	8.80^{bcd}	2.15^{b}	10.45^{bc}	33.00^{ab}	64.00	1.50^{a}	0.50^{d}	1.00^{e}	180.85^{a}	61.70^{a}	28.85^{ab}
	1500	28.50^{ab}	8.65^{bcd}	2.55^{ab}	12.20^{ab}	36.00^{e}	59.50	0.00^{d}	2.00^{a}	2.50^{b}	69.35^{ef}	32.60^{cde}	29.45^{ab}
	2000	28.00^{ab}	8.25^{de}	2.40^{ab}	13.00^{a}	31.00^{abcd}	65.00	1.00^{b}	2.00^{a}	1.00^{e}	133.85^{b}	39.65^{b}	25.80^{bc}
	2500	21.00^{c}	6.750^{ef}	2.40^{ab}	12.35^{ab}	28.50^{bcd}	71.00	0.00^{b}	0.00^{e}	0.50^{f}	58.70^{f}	28.45^{de}	32.40^{a}

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Treatment	PCV (%)	Hb (g/dl)	RBC ($\times10^{12}$/l)	WBC ($\times10^{9}$/l)	HET (%)	LYM (%)	EOS (%)	BAS (%)	MON (%)	MCV (fl)	MCH (Pg)	MCHC (g/dl)
SEM	1.50	0.50	0.14	0.69	1.81	3.78	0.03	0.06	0.09	6.12	2.05	1.76
P-values												
Petiveria parts	0.23	0.44	0.30	0.39	0.05	0.35	0.62	0.58	0.26	0.16	0.00	0.46
Levels of Incl.	0.00	0.00	0.15	0.15	0.09	0.61	0.03	0.00	0.40	0.00	0.00	0.16
Petiveria parts x Levels of Incl	0.00	0.00	0.04	0.03	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00

[abide] Means on the same row having different superscript were significantly ($P<0.05$) different. SEM: Standard Error of Mean, Incl; Inclusion, PCV: Packed Cell Volume, Hb; haemoglobin, RBC: Red Blood Cell, WBC: White Blood Cell, HET: Heterophil

Table 5 reveals the effects of *Petiveria* parts (PLM and PRM), inclusion levels and interaction of *Petiveria* parts and levels of inclusion on serum biochemical of growing chicks (8-16 weeks old). Interactive between *Petiveria* part and levels of inclusion of *Petiveria* parts on serum biochemical of growing chicks (8-16 weeks old) did not differ (P>0.05) on glucose, aspartate transaminase and cholesterol. Serum total protein in birds fed diets of 2500 mg/kg inclusion of PLM was elevated (P<0.05) when compared to control, 1500 and 2000 mg/kg of PLM and 2000 mg/kg of PRM. More so, serum albumin was similar (P>0.05) in birds fed diets containing 1000 and 2500 mg/kg of PLM, however increased (P<0.05) than those fed with 1500 mg/kg of PLM and 2000 mg/kg of PRM. Amidst varying inclusion of PLM and PRM, birds fed diets containing 2500 mg/kg of PLM had elevated (P<0.05) serum globulin. Birds fed diets incorporated with 1500 mg/kg of PLM and 1500, 2000 and 2500 mg/kg of PRM showed similar (P>0.05) serum ALT, however least (P<0.05) when compared to other inclusion levels.

Table 5. Effects of PLM and PRM inclusion on serum biochemical of grower chicks (8-16 weeks)

Treatment		Total Protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	Glucose (mg/dl)	AST (u/l)	ALT (u/l)	Uric acid (mg/dl)	CHOL (mg/dl)	TRG (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	VLDL (mg/dl)
Petiveria Parts	Levels of inclusion												
PLM		4.87	2.70	2.17	121.10	46.80^{b}	23.30	2.23^{b}	81.60	72.40	48.90	18.22	14.30
PRM		4.61	2.67	1.94	120.40	53.90^{a}	25.10	2.60^{a}	83.90	73.30	49.20	18.28	14.72
SEM		0.28	0.15	0.15	3.02	1.26	0.87	0.10	2.41	3.26	1.82	0.79	0.68
	0	4.10^{b}	2.40^{b}	1.70^{b}	124.50	52.75	22.25^{b}	2.63^{a}	84.50	65.00	55.50^{a}	16.00^{b}	12.85
	1000	5.05^{ab}	2.88^{ab}	2.18^{ab}	123.5	47.75	22.25^{b}	2.28^{ab}	85.25	74.50	51.25^{ab}	17.00^{b}	13.95
	1500	4.50^{b}	2.43^{b}	2.08^{b}	116.50	51.00	27.25^{a}	2.60^{a}	84.75	78.75	50.25^{ab}	18.75^{ab}	15.75
	2000	4.03^{b}	2.43^{b}	1.60^{b}	116.25	52.25	25.25^{ab}	2.13^{b}	74.75	77.50	41.50^{c}	17.75^{b}	15.50
	2500	6.03^{a}	3.30^{a}	2.73^{a}	123.00	48.00	24.00^{ab}	2.45^{ab}	84.50	68.50	46.75^{bc}	21.75^{a}	14.50
	SEM	0.348	0.195	0.162	4.797	2.455	1.21	0.154	3.584	4.548	2.253	0.976	0.957
PLM	0	3.75^{de}	2.15^{de}	1.60^{d}	130.00	48.00^{abc}	22.50^{bc}	2.85^{ab}	86.00	62.00^{d}	60.00^{a}	13.60^{e}	12.10^{c}
	1000	5.60^{b}	3.35^{ab}	2.25^{b}	127.50	44.50^{bc}	20.50^{c}	2.05^{cd}	77.50	69.50^{bcd}	47.50^{bc}	16.10^{cde}	13.30^{c}
	1500	3.55^{e}	1.80^{e}	1.75^{cd}	111.00	48.00^{abc}	29.00^{a}	2.35^{cd}	90.00	97.00^{a}	52.00^{abc}	18.60^{bc}	19.40^{a}
	2000	4.20^{cde}	2.60^{cd}	1.60^{d}	117.50	50.00^{abc}	22.00^{bc}	1.95^{d}	73.00	72.50^{bcd}	38.00^{d}	20.50^{ab}	14.50^{bc}
	2500	7.25^{a}	3.60^{a}	3.65^{a}	119.50	43.50^{c}	22.50^{bc}	1.95^{d}	81.50	61.00^{d}	47.00^{bcd}	22.30^{a}	12.20^{c}
PRM	0	4.45^{cde}	2.65^{cd}	1.80^{cd}	119.00	57.50^{a}	22.00^{bc}	2.40^{cd}	83.00	68.00^{cd}	51.00^{abc}	18.40^{bc}	13.60^{c}
	1000	4.50^{cd}	2.40^{d}	2.10^{bc}	119.50	51.00^{abc}	24.00^{bc}	2.50^{bc}	93.00	79.50^{bc}	55.00^{ab}	17.90^{bcd}	14.60^{bc}
	1500	5.45^{b}	3.05^{bc}	2.40^{b}	122.00	54.00^{ab}	25.50^{ab}	2.85^{ab}	79.50	60.50^{d}	48.50^{bc}	18.90^{bc}	12.10^{c}
	2000	3.85^{de}	2.25^{de}	1.60^{d}	115.00	54.50^{a}	28.50^{a}	2.30^{cd}	76.50	82.50^{b}	45.00^{cd}	15.00^{de}	16.50^{b}
	2500	4.80^{bc}	3.00^{bc}	1.80^{cd}	126.50	52.50^{abc}	25.50^{ab}	2.95^{a}	87.50	76.00^{bc}	46.50^{bcd}	21.20^{ab}	16.80^{b}

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Treatment	Total Protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	Glucose (mg/dl)	AST (u/l)	ALT (u/l)	Uric acid (mg/dl)	CHOL (mg/dl)	TRG (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	VLDL (mg/dl)
SEM	0.27	0.16	0.12	6.97	2.91	1.40	0.14	4.78	4.21	2.93	1.05	0.84
P-values												
Petiveria parts	0.46	0.87	0.23	0.88	0.00	0.11	0.01	0.49	0.85	0.89	0.95	0.67
Levels of Inclusion	0.01	0.02	0.23	0.62	0.24	0.03	0.09	0.24	0.29	0.00	0.00	0.33
Petiveria parts x Levels of Inclusion	0.00	0.00	0.00	0.70	0.06	0.00	0.00	0.14	0.00	0.03	0.00	0.00

[abcde] means on the same row having different superscript were significantly different (P<0.05). SEM: Standard Error of Mean. AST: Aspartate transaminase, ALT: Alanine Transaminase, CHOL: Cholesterol, TRG: Triglyceride. HDL: High Density Lipoprotein, LDL: Low Density Lipoprotein, VLDL: Very Low Density Lipoprotein

Superior weight gain, feed intake, feed to gain, and protein efficiency ratio achieved in birds fed diets included with 1000 mg/kg of PLM could be adduced to synergistic effects among complex active molecules existing in phytobiotics (Gauthier, 2002) at this level. It could also be attributed to the presence of antioxidants and antibacterial effects of PLM in the intestine (Nascimeto *et al.,* 2000). The result from this experiment was in line with the findings of Wheeler (2006) who fed herbal medicines to broiler chicken and observed better FCR values at the end of the trial. Buchanan *et al*. (2008) stated that broiler chicken fed diets incorporated with plant extract blends had minimum feed conversion ratio, increase weight gain and maximum breast yield. The protein efficiency was better at 1000 mg/kg of PLM which means that protein at this rate was better utilized. Tannins is said to form complexes with protein, cellulose, hemicellulose, lignin and starch and interfere with their optimum utilization in the digestive tract (Ranjhan, 1999).

Packed Cell Volume and Haemoglobin were reduced at 1500 mg/kg of PLM and 2500 mg/kg of PRM, an indication that the oxygen carrying capacity is low suggesting anaemia. This report was in line with the findings of Moses (1999) who explained anaemia as a reduction in haemoglobin accompanied by fall in red blood cell count and packed cell volume. Onyeyilli *et al*. (1992) reported that reduction in RBC, Hb and PCV is an indication of either the destruction of RBC or their decreased production, which may lead to anaemia. Furthermore, an increase in the count of RBC, Hb and PCV is suggestive of polycythemia and positive erythopoisis (Okpuzor *et al*., 2009). Hence, Hb values obtained ($2.1\text{-}2.75\times10^{12}$l) in this experiment were elevated than the range of $2\text{-}4\times10^{6}$ reported by Mitruka and Rawnsley, (1977). White blood cell recorded was higher than the reported range of ($9\text{-}56\times10^{3}$) reported by (Aeillo *et al.,* 1998). Reports about WBC counts have pointed out that increased count of WBC is supposed to be helpful in boosting immune system (Adedapo *et al*., 2007), a decreased count of WBC shows the suppression of leucocytes and their production from bone marrow (Odesanmi *et al*., 2010). Traces of monocytes, eosinophils and basophils have been reported to be an indication of infections (Frandson, 1974). The differences in the WBC differentials could be attributed to several factors including physiological (Alodan and Mashaly, 1999), environmental conditions (Graczyk *et al*., 2003) and diets (Odunsi *et al.,* 2002) have been reported to be responsible for variation in haematological parameters. Mean Corpuscular Volume was better than the reference range of 60.0fl - 65.7fl (Ayoola *et al*., 2010). Indicating there is no regenerative anaemia/blood destruction. Observed Mean Corpuscular Haemoglobin was higher than the range of 19.29Pg - 23.20Pg reported by Ayoola *et al*., (2010). Obtained Mean Corpuscular Haemoglobin Concentration was within the reference range of 31.90 - 35.52% reported by Ameen *et al.* (2007) indicating sufficient iron in the blood/mild non-regenerative anaemia apart from those fed diets containing 2500 mg/kg of PLM; 1000, 1500 and 2000 mg/kg of PRM were depressed.

Anonymous (1980) opined that changes in protein reserve in animal as indicated by serum total protein to be associated with alteration in the albumin fraction. The observed total protein values fell within the reference range of (3.25g/dl to 7.61g/dl) reported by Rajurker *et al.* (2009), Albumin levels which is an indicator of the synthetic activity of the liver (Black, 1996) was within the reference range of (1.25- 2.20 g/dl) as observed by (Akinmutimi and Onen 2008) and globulin (2.13g/dl-3.02g/dl) reported by (Adeyemo, 2008). Nonetheless, employment of PRM and PLM at varying inclusion showed reduced serum AST and ALT levels. Serum enzyme concentrations were reported to exist at low concentration in a normal healthy animal but increased under stressful conditions, hepatotoxic situation, and inhibition of protein synthesis (Grunwaldt *et al.,* 2005). Obtained serum ALT values were less than 32 to 62µl/ml reported by Fasina *et al.* (2004). Increased concentration of liver enzymes has been reported in situations of liver abnormalities, stress and disease condition (Ewuola *et al.*, 2008). Rosa *et al.* (2001) reported impaired carbohydrate, and lipid metabolism in animals with increased liver enzymes. Serum uric acid was less than (3.68 mg/dl to 3.77 mg/dl) reported by (Sogunle *et al.*, 2007). Oduguwa and Ogunmodede (1995) reported high serum uric acid concentrations due to inefficient protein utilization. High serum uric acid concentration has been reported to be typical of animals fed with nutritionally imbalanced dietary amino acids (Szabo *et al.,* 2005). An indicant that the protein content in the diets was not challenged (Eggum 1970).

References

Adedapo, A.A., Abatan, M.O and Olorunsogo, O.O. 2007. Effects of some plants of the Spurge family on the haematological and biochemical parameters of rats. Veterinary Archive, 77: 29-38.

Adeyemo, G.O. 2008. Effects of cottonseed cake based diets on haemotology and serum biochemistry of egg-type chickens. International J. Poultry Sci. 7(1):23–27.

Aiello, S.E. and Mays, M. 1998. The Merck-Veterinary Manual, 8th edition. Merck and Company.

Akinmutimi, A.H. and Onen, G.E. 2008. The response of broiler finisher birds fed graded levels of yam peel meal in place of maize–based diets. International J. Poultry Sci. 7(5):474–479.

Alodan, M.A and Mashaly, M.M. 1999. Effect of induced moulting in laying hens on production and immune parameters. J. Poultry Sci. 78: 171-177.

Ameen, S.A., Adedeji, O.S., Akingbade, A.A., Olayeni, T.B., Ojedapo, L.O and Aderinola, O.A. 2007. The effects of different feeding regimes on haemological parameters and immune status of commercial broilers in derived savannah zone of Nigeria. Proceedings of the 32nd Annual Conference of the Nigerian Society for Animal Production (NSAP), pp.176–178.

AOAC, 2000. Official method of analysis of AOAC International, 17th ed. Assoc. Off. Anal. Chem. Washington, DC., US.

Ayoola, M.O., Alabi, M.O., Sokunbi, O.A., Adewumi, A.A., Essien, A., Aderemi, F.A., Lawal, T.E. 2010. Physiological response of broiler starter chickens to oral supplementation with *Telfairia occidentalis* leaf extract. proceedings of the 35th Annual Conference of the Nigerian Society for Animal Production (NSAP) pp126-128.

Barreto, M.S.R.., Menten, J.F.M., Racanicci, A.M.C., Pereira P.W.Z and Rizzo. P.V. 2008. Plant extracts used as growth promoters in broilers. Brazillian J. Poultry Sci. 10: 109-115.

Bergmeyer, H.U., 1983. Methods of enzymatic analysis. Vol. III. Enzymes 1: oxidoreductase, transferase. verlay chemie, deerfteld beach, FL, pp. 126–510.

Black, D.D. 1996. Gastrointestinal, hepatobiliary and nutritional physiology. Lippincott-raven, Philadelphia, PA, pp. 223-227.

Botsoglou, N.A., Florou-paner, P., Christaki, E., Fletouris, D.J. and Spais, A.B. 2002. Effect of dietary oregano essential oil on performance of chickens and on iron-induced lipid oxidation of breast, thigh and abdominal fat tissues. British Poul. Sci. 43: 223-230. broiler chicks. International J Poultry Sci, 9: 244-246.

Buchanan, N.P., Hott, J.M., Cutlip, S.E., Rack, A.L., Asamer, A and Moritz, J.S. 2008. The effects of a natural antibiotic alternative and a natural growth promoter feed additive on broiler performance and carcass quality. J. Applied Poult. Research, 17: 202-210.

Cannan, R.K., 1958. In: fifth, I. (Ed.), Book of Clinical Practical Chemistry. Vol. CBS.

Coles, E.H. 1986. Veterinary clinical pathology, 4th Ed. Coles, E. H. (ed), W.B. Saunder Company, Philadelphia, USA.

De Sousa, J.R., Demuner, A.J., Pinheiro, J.A., Bretmair E., Cassels, B.K. 1990. Dibenzyl Trisulphate and Trans-N-methyl-4-methoxyproline from Petivera alliacea: Phytochemistry 29: 3653-3655.

Dibner, J.J. and Richards, J.D. 2005. Antibiotic growth promoters in agriculture: History and mode of action. Poultry Sci, 84: 634-643.

Duncan, D.B., 2000. Multiple Range and Multiple F-test Biometric. 11: 1-24.

Eggum, B.O. 1970. Blood urea measurement as a technique for assessing protein quality. British J. Nutr. 24: 983-988.

Ewuola, E.O., Ogunlade, J.T., Gbore, F.A and Egbunike, G.N., 2008. Serum biochemistry and organ traits of growing rabbits fed fusarium verticilloides cultured maize-base diet. In: Proceedings of the 33rd Annual Conference NSAP, Ogun State, Nigeria, pp. 199–203.

Fasina, O.E., Ologhobo, A.D., Adeniran, G.A., Ayoade, G.O., Adeyemi, O.A., Olayode, G. and Olubanjo, O.O. 2004. Toxicological assessment of *Venonia amygdaliana* leaf meal in nutrition of starter broiler chicks. Nigerian J. Animal Prod. 31(1):3 11.

Fossati, P., Principe L. and Berti G.1980. Use of 3,5 dichloro-2-hdroybenzene sulfonic acid and 4- amino-phenazone chromogenic system in direct enzymatic assay of uric acid in serum and urine. Clinical Chemistry; 26(2); 227-231.

Frandson, R.D 1974. Anatomy and Physiology of Farm Animals. Lea & febiger, Philadelphia. 494p gallopavo). Acta Vet. Hung. 53: 397–409.

Gauthier, R. 2002. (XVIII Congreso Lantioamericano de Avicultura) (2002) Poultry Therapeutics: New alternatives.

Goodlad, R.A, Levi, S., Lee, C.Y., Mandir, N., Hodgson, H and Wright, N.A. 1991. Morphometry and cell proliferation in endoscopic biopsies: evaluation of a technique. Gastro-enterology, 1235–1241.

Google, 2015. retrived September 2015. www.google.com.

Graczyk, S., Pliszczak-Krol, A., Kotonski, B., Willzek, J. and Chmielak. Z. 2003. Examination of Haematological and Metabolic changes mechanisms of Acute Stress in Turkeys. Electronic J. Polish Agric. and University Veterinary Medicine, 6:1-10.

Grunwaldt, E.G., Guevara, J.C., Estevez, O.R., Vicente, A., Rousselle, H., Alcunten, N., Aguerregaray, D., Stasi, C.R., 2005. Biochemical and haematological measurements in beef cattle in Mendoza plain rangelands (Argentina). Tropical Anim. Health Prod. 37: 527–540.

Hampson, D.J. 1986. Alteration in piglet small intestine structure at weaning. Resource Vet Sci.

Huyghebaert, G., Ducatelle, R and Immerseel, F.V. 2011. An update on alternatives to antimicrobial growth promoters for broilers. The Veterinary J. 187: 182–188.

Kececi, T and Col, R. 2011. Haematology and biochemical values of the blood of pheasants (*Phasianus colchicus*) of different ages. Turkish J. Veterinary and Animal Sci. 35(3): 149-156.

Kubec, R. Kim, S, Musah R.A 2003. The lachrymatory principle of *Petivera alliacea*- Part II. Phytochemical chemistry 63: 37-40

Kumar, S., Saradamma, K.C. and Radhakrishna, P.M. 2010. Effects of garlic active based growth promoter on growth performance and specific pathogenic intestinal microbial counts of broiler chicks. International J. Poultry Sci. 9: 244-246.

Lee, K.W., Everts, H, Kappert, H.J and Beynen. A.C. 2004. Growth performance of broiler chickens fed a carboxymethyl cellulose containing diet with supplemental carvacrol and/or cinnamaldehyde. International J. Poultry Sci. 3: 619–622.

Mild, C. 2004. Smelly Weed Is Strong Medicine.

Mitruka, B.M. and Rawnsley, H. 1977. Clinical biochemistry and haematological reference values in normal experimental animals. 1st edition, Masson Publishing Inc. New York, USA. pp.54-55.

Moses, R. 1999. Repaglinide in combination therapy with metformin in Type 2 diabetes. Experimental and Clinical Endocrinology and Diabetes 107(Suppl 4):S136–9.

Odesanmi, S.O., Lawal, R.A and Ojokuku, S.A. 2010. Haematological effects of ethanolic fruit extract of *Tetrapleura tetraptera* in male dutch white rabbits. Research J. Med. Plant, 1-5.

Oduguwa, O.O., Ogunmodede, B.K., 1995. Comparative growth response of three commercial vitamins and trace minerals premixes for rearing broiler chicks at the starter and finisher phases. Pertanika J. Tropical Agric. 19: 81–87.

Odunsi, A.A., Ogunleke, M.O., Alagbe, O.S. and Ajani, T.O. 2002. Effects of feeding *Gliricidia sepium* leaf meal on the performance and egg quality of layers. International J. Poultry Sci. 1: 26-28.

Okpuzor, J., Okochi, V.I. Ogbunugafor, H.A. Ogbonnia, S.T., Fagbayi, Obidiegwu, C. 2009. Estimation of cholesterol level in different brands of vegetable oils. Pakistan J. Nutrition, 8: 57-62.

Onyeyilli, P.A., Egwu, G.O., Jike, G.I., Pepple, D.O. and Ohaegbulem, J.O. 1992. Seasonal variation on haematological indices in the grey-breasted guinea fowls. Nigeria J. Animal Prod. 18: 101-107.

Nascimento, E.R. 2000. Micoplasmoses aviárias. In Berchieri Junior A, Macari M, Doença das aves. Campinas: Facta, pp. 217-224.

Rajurker, S., Rekhe, D. S., Maini, S. and Ravikanth, K. 2009. Acute toxicity studies of polyherbal formulation (Methiorep premix). Veterinary World 12(2)58-59.

Ranjhan, S.K, Falvey L, Chantalakhana C. 1999. Dairy feeding system. In: Smallholder dairying in the tropics. pp. 117-132.

Rosa, C.A., Miazzo, R., Magnoli, C., Salvano, M., Chriac, S.M., Ferrero, S., 2001. Evaluation of the efficacy of bentonite from the South Argentina to ameliorate the toxic effects of aflatoxin in broilers Poultry Sci. 80: 139–144.

Rosen, G.D. 1995. Antibacterials in poultry and pig nutrition, in: Wallace, R. J. and Chesson, A. (Eds). Biotechnology in Animal Feeds and Feeding, pp. 143-172 (Weinheim, Germany).

SAS, 2010. Institute Inc. SAS Technical report package 2234 SAS/STAT software. The GEMOD procedure. release 6.09. SAS Institute Inc. Cary, NC.USA.

Schalm, O.W., Jain, N.C and Qureshi, M.Q., 1975. Veterinary haematology third ed.. Lea and Fibinger, Philadilphia, PA, US.

Sogunle, O.M., Fanimo, A.O., Abiola, S.S. and Bamgbose A.M. 2007. Growth response, body temperature and blood constituents of pullet chicks fed cassava peel meal supplemented with cashew nut reject meal. Nigerian J. Animal Prod. 34(1):32-44.

Szabo, A., Mezes, M., Horn, P., Suto, Z., Bazar, G and Ramvari, R., 2005. Developmental dynamics of some blood biochemical parameters in the growing turkey (Meleagris).

Tietz, N.W. 1995. Clinical guide to laboratory test, 3rd Edition. W.b Sanders company, Philadephia. Pp518-519.

Tipu, M.A, Akhtar M.S, Anjum M.I, Raja, M.L. 2006. New dimension of medicinal plants as animal feed, Pakistan Vet. Journal, 26: 144-148.

Tonnesen, H., Hejberg, L., Frobenius, S and Anderson, J. 1986. Erythtrocyte mean cell volume correlation to drinking pattern in heavy alcoholics Acta. Medical Scandinavica 21995) 515. toxic effects of aflatoxin in broilers. Poultry Sci. 80: 139–144.

Van Beekvelt, M.C.P., Colier W.N.J.M, Wevers R.A. and. Van Engelen B.G.M, 2001. Performance of near-infrared spectroscopy in measuring local O2 consumption and blood flow in skeletal muscle. Journal App Physiology, 90: 511-519.

Varley, H., Gowenlock, A.H and Bell, M. 1980. The Plasma Proteins. In: practical Clinical Biochemistry, Vol. I5th edition. William Heinemann Medical Books Ltd, London, 535–595.

Wegener, H.C., Aerestrup, F.M., Gerner-Smidt, P and F. Bager. 1999. Transfer of antibiotic resistant bacteria from animals to man. Acta Veterinaria Scandinavica, 92: 51-57.

Wheeler, G.E., 2006. Use of a herbal supplement to reduce the effects of stress in intensively reared chickens, Indian J. Indigenous Med. 11: 78-83.

Wootton, I.D.P., 1964. Micro-analysis in Medical Biochemistry 4th ed. J. and A. Churchill, London, UK, 86–95.