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Effect of Maize and Yam peels based Diets Supplemented with Xylanase, Amylase and Protease Multi-Enzymes on Serum Biochemical and Haematological Indices of Starter Broiler Chickens

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Abstract

A study was conducted using one hundred and eighty (180) day old broiler chicks to determine the effect of maize and yam peels meal based diets supplemented with and without enzymes on the haematological and serum biochemical indices of broiler chickens at starter phase. Birds were allotted to six dietary treatments in a completely randomized design CRD in factorial arrangement. Two levels of enzyme (0g/kg diet and 50g/kg diet) and three levels of yam peels inclusion (0%, 15 % and 30 %) as a replacement for maize. Each treatment was replicated 3 times consisting of 10 chicks per replicate. The experiment lasted for 4 weeks. The results of serum biochemical indices revealed that Yam peels meal (YPM) inclusion and enzyme supplementation had no significant (P > 0.05) effect on all the parameters determined. The interaction effect of YPM inclusion and enzyme supplementation on serum biochemical indices showed significant differences (P< 0.05) on total protein, globulin, glucose and creatinine. Higher statistical values of total protein (3.70 g/dl and 3.85 g/dl) were obtained for birds fed 15% YPM treatment without enzyme (T2) and birds fed 0% YPM diet with enzyme supplementation (T4) respectively. The control diet significantly showed least (P < 0.05) value of total protein (2.85 g/dl). Birds fed 15% YPM diet without enzyme (T2) and 0% YPM with enzyme (T4) showed higher numerical values of 204.00 mg/dl and 203.53 mg/dl for glucose at comparative level. The result of haematological indices revealed that there significant differences (P < 0.05) in interaction for all the parameters obtained with level of YPM inclusion and enzyme supplementation. Birds fed 15% YPM diet without enzyme (T2) and 0% YPM with enzyme (T4) showed higher statistical values of 39.50% and 38.00% for PCV. Similar trend was observed for Haemoglobin, white blood cell, Red blood cell and Mean corpuscular haemoglobin. Close range values which suggested good health status were obtained for both serum biochemical and haematological indices across the treatments. In conclusion, interaction of yam peels meal with or without enzyme supplementation had significant improvement on starter broiler chickens and values recorded for haematological parameters were within the normal range for broiler chickens without adverse effect on health condition of the birds.

Key words: Yampeel meal; enzymes; haematological indices; serum biochemistry; broiler chickens.

Description of problem

The insufficient supply of feedstuffs at economic prices has continue to limit the production and thus, availability of animal protein in the diets of humans in the developing countries of the world. This situation has compelled animal nutritionists to intensify research into alternative feed sources to reduce cost of animal proteins. The key to abundant animal production is the availability

of cheap and balanced feed. Feed dictates how many animals you can grow and how fast they can mature for the market (1). In order to develop feeding standard is necessary to relate information on the nutritional characteristics of feed resources with the requirements for nutrients according to the purpose and rate of productivity of the animals in question. In the industrialized countries, this information has been incorporated in tables of "Feeding standards" which interpret chemical analyses of feed resources in terms of their capacity to supply the energy, amino acids, vitamins and minerals required for the particular productive purpose. These standards are steadily becoming more sophisticated with the aim of improving their effectiveness in predicting rates of performance of intensively-fed livestock and to derive least cost formulations.

Monogastric animals are the most efficient transformers of raw ingredients, rich in starches/sugars and proteins, into meat and eggs (2).

However, the usual feeding techniques of monogastric animals require the utilization of cereals and costly protein meals as the basis of the diet. In many developing countries this usually leads to direct competition with human consumption and the expenditure of foreign currencies for importation of the raw materials.

On the other hand, poultry and pig can be intensively and rapidly produced and distributed in large and small cities and can improve quite strongly and dramatically the nutritional status of populations. Therefore an effort to use locally produced by-products for monogastric species has to be considered as a major priority, even at the expense of lower rates of individual animal productivity.

One of such potential agro-industrial by-product as alternatives to maize is yam peel meal (YPM). It serve as a cheaper energy source in poultry diets (3). Yam peel meal is obtained in substantial quantities from household kitchens, commercial eateries and markets. However, information on the chemical composition of yam peel is scanty. The major challenge preventing the efficient utilization of YPM is present of anti-nutritional factors such as: Oxalate, tannin, saponin, and phytate (4). Various methods had been adopted in the past for addressing anti-nutritional factors in feed ingredients and they include: Fermentation, treatment with chemicals, boiling, sun drying and enzyme treatments. Haematological and serum biochemical values could serve as base line information for comparison in condition of nutrient deficiency. Examination of blood provide a valuable opportunity to clinically evaluate the quality of feed. There is scarcity of data showing the advantage of multi-enzyme over a single component activities. Therefore, this study is designed to assess the haematological indices and serum biochemistry and of starter broiler chickens fed maize and yam peels based diets supplemented with xylanase, amylase and protease as combined multi-enzyme.

Materials and Methods

Experimental site

The study was conducted at the Poultry unit of the Teaching and Research Farm, Taraba State University Jalingo located between latitude 2^0 – 50N and longitude 11^o – 25E in Guinea savannah zone of northern Nigeria.

Test ingredients and preparation

Yam peels were collected fresh from kitchens and yam processing centers, the peels were sun -dried for 5 - 7 days until constant dry matter was achieved and this also reduced the enzymatic and microbial reactions which could lead to spoilage of nutrient. The dried yam peels were milled in hammer mill of 2mm mesh size before compounding the feed.

Experimental diets

A total of six isonitrogenous diets were formulated for starter chicks to meet (5)

minimum nutrient requirement. The diets were formulated in such that maize was replaced with yam- peels at dietary level of 0%, 15% and 30 % without enzyme supplementation designated as T1, T2, T3, and: and in the second group of diets maize was replaced with yam-peel at dietary levels of 0%, 15% and 30% with 50g/kg enzyme supplementation designated as T4, T5 T6 respectively as presented in Table1.

Table 1: Percentage composition of broiler starter diets (0-4 weeks)

Enzyme	**0g/kg**			**50g/kg**		
YPM levels (kg)	**0**	**15**	**30**	**0**	**15**	**30**
	T1	**T2**	**T3**	**T4**	**T5**	**T6**
Ingredients:						
Maize	52.00	37.00	22.00	52.00	37.00	22.00
YPM	0.00	15.00	30.00	0.00	15.00	30.00
Soya bean meal	18.40	18.50	18.50	18.50	18.50	18.50
Groundnut cake	17.20	16.20	16.20	16.20	16.20	16.20
Fish meal	3.00	3.00	3.00	3.00	3.00	3.00
Rice offal	5.00	6.00	6.00	6.00	6.00	6.00
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00
Lime stone	1.50	1.50	1.50	1.50	1.50	1.50
DL-Methionine	0.30	0.30	0.30	0.30	0.30	0.30
L-Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Supplementation						
Enzymes (50g/100kg)	-	-	-	+	+	+
Calculated analysis:						
ME (kcal/kg)	2856.15	2794.65	2733.15	2856.15	2794.65	2733.15
Crude protein (%)	23.26	23.12	23.00	23.26	23.12	23.00
Crude fibre (%)	3.47	4.43	5.38	3.47	4.43	5.38
Ether extract (%)	4.18	3.73	3.27	4.18	3.73	3.27
Ca (%)	1.25	1.25	1.26	1.25	1.25	1.26
P (%)	0.46	0.45	0.44	0.46	0.45	0.44
L-Lysine (%)	1.13	1.09	1.05	1.13	1.09	1.05
DL-Methionine (%)	0.64	0.61	0.58	0.64	0.61	0.58

- No enzyme supplementation
+ Enzyme supplementation
YPM = yam peels meal

Table 2: Proximate composition of yam-peels meal

Constituents	Percentage (% DM)
Dry matter	87.40
Crude protein	4.38
Crude fibre	9.80
Ether extract	4.43
Ash	6.50
Nitrogen free extract	74.89
Energy (kcal/kg ME)	3,179

Design and management of experimental birds

A total number of 180 day-old broiler chicks (Marshal®) were used in the experiment. The chicks were weighed and allotted to six dietary treatment groups. Treatments were replicated three times with 10 chicks per replicate in a Completely Randomized Design. The experiment was arranged in a 2 × 3 factorial with two levels of enzyme (0g/100kg diet and 50g/100kg diet) and three levels of yam peels (0kg, 15kg and 30kg). The Birds were reared on deep litter system for four weeks (0-4 weeks). Routine vaccinations and medications were strictly followed and feed and water were provided *ad libitum*.

Data Collection

At 28th day of age, blood samples were drawn via wing vein of 3 birds per treatments that is one from each replicates. 2m1 of blood was collected into a clean syringe and kept in plane bottle for serum biochemical analyses and another 2ml in a heparinized tube for haematological analyses. For serum analyses, the blood samples were allowed to clot and refrigerated for 6 hours before being spun in a centrifuge at 900 rpm for 20 minutes. The separated serum were stored in the freezer at -2°C prior to analysis. Blood samples obtained from the experimental birds were analyzed for serum metabolites such as serum total protein, albumin, globulin, creatinine, uric acid and cholesterol. In the blood samples for haematology, parameters determined include: Packed Cell Volume (PCV), White Blood Cell (WBC), Haemoglobin (Hb), Red Blood Cell (RBC), Mean Corpscular Haemoglobin Concentration (MCHC), Mean Corpscular Haemoglobin (MCH) and Mean Cell Volume (MCV).

Statistical Analysis

Data collected were subjected to analysis of variance using SPSS software. Where significant differences exist, means were separated using Duncan's New Multiple Range Test (DNMRT) (6).

Results and Discussion

The proximate composition of the test ingredient (Yam peels meal) is presented in Table 2. YPM had slightly lower value of 87.40% for dry matter content at comparative level to a value of 89.25% reported by (4). Similar value of 4.38% was recorded for crude protein compared to the value of 4.89% reported by (7). This value recorded for crude protein was lower compared to higher values of 9.12% and 12.17% reported in the literature (4, 8). This observable variation could be attributed to different in the sources of the Yam peel. Very close value of 9.80 was obtained for crude fibre at comparative level to 8.38 reported by (8). Value of 4.43% obtained for ether extract in this study is in close range to value of 3.34% reported in the literature (7). Values of 6.50% and 74.89% recorded for Ash and NFE were similar to 6.80% and 74.71% respectively reported in the literature (8). Gross energy content of the YPM recorded 3,179 kcal/kg. This observation for gross energy of the YPM corroborated the value of 3,000 reported in the literature (8) and it is an indication that YPM can compete favourably with maize in energy content.

The results showing the main effect of yam peels meal and enzyme supplementation

on serum biochemical indices of starter broiler chickens is presented in Table 3. Yam peels meal (YPM) inclusion as a replacement for maize had no significant ($P > 0.05$) influence on all the parameter determined. Numerically the total protein, albumin, globulin, creatinine and uric acid revealed similar values across dietary treatments. Values ranged from 3.35g/dl – 3.38g/dl, 1.63g/dl – 1.73g/dl, 1.50g/dl – 1.75g/dl, 0.25mg/dl – 0.30mg/dl and 6.23mg/dl – 6.44mg/dl for total protein, albumin, globulin, creatinine and uric acid respectively. Values recorded for glucose ranged from 186.05mg/dl – 193.02mg/dl with birds fed 0% YPM showed highest numerical value of 193.02 mg/dl. Similar trend was observed for cholesterol with birds fed 0% YPM recorded slightly higher value of 119.91 mg/dl as against 118.68 mg/dl and 118.07 mg/dl recorded for 15% and 30% YPM replacement levels. Akinmutimi and Onen (4) reported similar ranged values of 2.80 – 3.40g/dl, 1.25 – 2.20g/dl and 8.0 – 9.16mg/dl for total protein, albumin and uric acid respectively. The values obtained for parameters across dietary treatments as shown in this study revealed adequacy of the diet and safety of dietary treatments.

Enzyme supplementation followed the same trend with YPM. The result showed no significant ($P > 0.05$) effect of enzyme supplementation on the parameters determined. Enzyme supplementation showed higher similar values of 192.17 mg/dl and 185.24 mg/dl for glucose. The observations in this study suggested availability and adequacy of soluble carbohydrates across dietary treatments. This could be possibly attributed to the ability of enzyme in enhancing break down of polysaccharide as additional energy source (9).

The interaction effect of YPM as a replacement for maize and enzyme supplementation in diets of starter broiler chickens is presented in Table 4. Total protein, globulin, glucose and creatinine were significant different ($P < 0.05$) with YPM inclusion and enzyme supplementation. Higher values of 3.70 g/dl and 3.85g/dl were obtained for total protein in the birds fed 15% YPM without enzyme (T2) and birds fed 0% YPM with enzyme supplementation (T4) respectively. The control diet had the least value of 2.85 g/dl for total protein compared to others across the treatment. The values of 2.85 g/dl – 3.85 g/dl obtained for total protein in this study fall within the normal range of 2.80 g/dl – 3.40 g/dl reported by (4) when broiler chickens were fed diets containing YPM as replacement for maize. Inclusion of YPM and enzyme supplementation showed higher statistical values for globulin at comparative level to the control diet. Birds fed control diet had the least value of 1.15 g/dl for globulin compared to others. Birds fed 15% YPM without enzyme (T2) and those fed 0% YPM with enzyme (T4) showed higher values of 204.00 mg/dl and 203.53 mg/dl for glucose respectively. Dietary treatments had significantly ($P < 0.05$) influenced creatinine values. This observation was at variance with the report of (4) who reported no Significant ($P > 0.05$) influence on creatinine when broiler chickens were fed varying levels of YPM as replacement for maize. The values range from 0.15mg/dl – 0.45mg/dl for creatinine in this study fell within 0.9 mg/dl – 2.0 mg/dl reported by (10). High level creatinine values is an indication of muscle wastage and imply that animal is surviving at the expense of the body reserve which result to weight loss (11). Though, no significantly ($P > 0.05$) influenced by dietary treatments across the treatments. Values range from 6.04 mg/dl – 6.85 mg/dl was recorded for uric acid in this study. This is in contrast with values 8.00 mg/dl – 9.16 mg/dl reported by (4). Absorption and utilization of dietary protein by birds is determined through uric acid and low level of uric is an indication of better utilization of

diet. Improved values Albumin, globulin and uric acid indicate the adequacy of protein quality, quantity and degree of protein utilization (12).

Table 3: Main effects of yam peels meal and enzyme supplementation on serum biochemical indices of starter broiler chickens (0 – 4 weeks)

Parameter	Yam Peels Meal				Enzyme		
	0 %	15 %	30 %	SEM	0g	50g	SEM
Total protein (g/dl)	3.35	3.43	3.38	0.11	3.37	3.40	0.09
Albumin (g/dl)	1.73	1.68	1.63	0.06	1.65	1.70	0.05
Globulin (g/dl)	1.63	1.50	1.75	0.16	1.55	1.70	0.13
Glucose (mg/dl)	193.02	186.05	187.05	4.37	192.17	185.24	3.57
Creatinine (mg/dl)	0.30	0.30	0.25	0.02	0.27	0.30	0.02
Uric acid (mg/dl)	6.39	6.44	6.23	0.15	6.55	6.17	0.12
Cholesterol (mg/dl)	119.91	118.68	118.07	1.15	119.31	118.46	0.94

Table 4: Interaction effect of yam peels meal and enzyme supplementation on serum biochemical indices of starter broiler chickens (0 – 4 weeks)

Enzyme	Without Enzyme (0g)			With Enzyme (50g)			
Yam Peels Meal	0%	15%	30%	0%	15%	30%	
Parameters	T1	T2	T3	T4	T5	T6	SEM
Total protein (g/dl)	2.85^{d}	3.70^{ab}	3.55^{abc}	3.85^{a}	3.15^{cd}	3.20^{bcd}	0.16
Albumin (g/dl)	1.70	1.75	1.50	1.75	1.60	1.75	0.08
Globulin (g/dl)	1.15^{b}	1.45^{ab}	2.05^{a}	2.10^{a}	1.55^{ab}	1.45^{ab}	0.22
Glucose (mg/dl)	182.50^{bc}	204.00^{a}	190.00^{ab}	203.53^{a}	168.10^{c}	184.10^{abc}	6.18
Creatinine (mg/dl)	0.15^{b}	0.40^{a}	0.25^{b}	0.45^{a}	0.20^{b}	0.25^{b}	0.03
Uric acid (mg/dl)	6.45	6.85	6.36	6.35	6.04	6.12	0.21
Cholesterol (mg/dl)	119.30	120.00	118.63	120.52	117.35	117.50	1.62

^{abc} Mean on the same row having different superscripts were significantly ($P<0.05$) different.

The results showing the main effect of yam peels meal and enzyme supplementation on haematological parameters of starter broiler chickens is presented in Table 5. The result of haematological indices revealed a significant ($P < 0.05$) variation for packed cell volume, red blood cell and mean corpuscular haemoglobin concentration (MCHC) with level of YPM inclusion. Birds fed 0% and 15% YPM showed similar statistical values of 30.75% and 32.50% for PCV. Values recorded for red blood cell followed similar trend with PCV in which 0% YPM and 15% YPM showed higher statistical values of 3.78×10^{6}/L and 3.93×10^{6}/L compared to least value of 3.53×10^{6}/L recorded for birds on 30% YPM replacement level. Result recorded for MCHC showed higher similar statistical values for birds fed 0% and 30% YPM. Haemoglobin, white blood cell, mean corpuscular haemoglobin and mean corpuscular volume though not significantly ($P > 0.05$) influenced by dietary treatments showed normal values for healthy chickens. This observation was

supported by (13) who reported ranged values of 27.67 – 30.00% and 3.10 – 5.67 $\times 10^9$/l for broiler chickens fed enzyme supplemented diets.

Enzyme supplementation had significant ($P < 0.05$) effect on MCHC as summarized in the result presented. 50g/100kg diet revealed higher value of 33.60 g/dl compared to 32.69 g/dl recorded for 0g /kg enzyme supplementation. Observations in this study suggested adequacy of the diets and good health status of the birds. Haematological parameters are used to determine the health status of animal and stress due to environment, nutrition and pathological factors (14).

The interaction effect of YPM and enzyme supplementation on haematological parameters of starter broiler chickens is presented in Table 6. Observations from the table showed that there were significant ($P < 0.05$) effect of dietary treatments on all the parameters determined. The result did not follow a particular pattern though birds fed 50g enzyme supplementation (T4, T5 and T6) showed decreased numerical values for PCV, Hb, WBC and RBC with increased levels of YPM. Birds fed 0% YPM with 50g enzyme (T4) recorded higher statistical values across the parameters determined. Similar trend was observed for birds on 15% YPM with 0g enzyme (T2) with the exception of MCHC. Numerically, birds fed 30% YPM with 50g enzyme (T6) revealed least ($P < 0.05$) value of 2.70×10^3/L and 3.20×10^6/L for WBC and RBC respectively. Values range of 23.00% – 39.00% recorded for PCV in this study were comparable to the values of 22.00% – 35.00% reported by (15). The observation in this study revealed ranged value of 7.80 – 12.65 for Hb which fall within the normal range for healthy birds (16). White blood cell as observed in this study fall within the normal range for healthy chicken. Low WBC indicate allergic condition while elevated value (Leucocytosis) indicate the existence of infection usually with bacteria (17). (18) reported 2 - 4 $\times 10^6$ /L for RBC which is in line with results obtained in this study (3.20 $\times10^6$/L – 4.25 $\times10^6$/L). Research evidence has shown that Hb, PCV and RBC were within the normal range. This may be due to bone marrow of the birds which were functioning properly. High PCV in the blood usually indicates present of toxic factors which has adverse effect on blood formation. Hb and PCV are descriptors of function and concentration of RBC (19). MCH and MCHC found to be within the normal range reported by (20) and this could be an indication that there were no negative interactions between the energy and protein levels in the diets. Thus, the diets were nutritionally adequate with YPM replacement for maize and supplementation with enzyme.

Table 5: Effects of yam peels meal and enzyme supplementation on haematological parameters of starter broiler chickens (0 – 4 weeks)

Parameter	Yam Peels Meal				Enzyme		
	0 %	15 %	30 %	SEM	0g	50g	SEM
Packed cell volume (%)	30.75^{ab}	32.50^{a}	26.50^{b}	1.68	31.00	28.83	1.37
Haemoglobin (g/dl)	10.25	10.45	8.93	0.52	10.07	9.67	0.42
White blood cell ($\times10^3$/L)	3.53	3.50	3.08	0.16	3.52	3.22	0.13
Red blood cell ($\times10^6$/L)	3.78^{ab}	3.93^{a}	3.53^{b}	0.11	3.80	3.68	0.09
Mean corpuscular haemoglobin (pg)	26.43	26.38	25.31	0.70	26.16	25.92	0.57
Mean cell haemoglobin concentration (g/dl)	33.25^{ab}	32.41^{b}	33.78^{a}	0.30	32.69^{b}	33.60^{a}	0.25
Mean cell volume (fl)	79.48	81.83	74.95	2.44	80.36	77.15	1.99

^{ab} Mean on the same row having different superscripts were significantly ($P<0.05$) different.

Table 6: Interaction effects of yam peels meal and enzyme supplementation on haematological parameters of starter broiler chickens (0 – 4 weeks)

Enzyme	Without Enzyme (0g)			With Enzyme (50g)			
Yam Peels Meal	0%	15%	30%	0%	15%	30%	
Parameters	T1	T2	T3	T4	T5	T6	SEM
Packed cell volume (%)	23.50^{b}	39.50^{a}	30.00^{b}	38.00^{a}	25.50^{b}	23.00^{b}	2.38
Haemoglobin (g/dl)	7.80^{b}	12.45^{a}	9.95^{b}	12.65^{a}	8.45^{b}	7.90^{b}	0.73
White blood cell (×10^{3}/L)	2.95^{bc}	4.15^{a}	3.45^{ab}	4.10^{a}	2.85^{bc}	2.70^{c}	0.22
Red blood cell (×10^{6}/L)	3.30^{c}	4.25^{a}	3.85^{ab}	4.25^{a}	3.60^{bc}	3.20^{c}	0.16
Mean corpuscular haemoglobin (pg)	23.35^{b}	29.28^{a}	25.85^{b}	29.51^{a}	23.48^{b}	24.77^{b}	0.99
Mean cell haemoglobin concentration (g/dl)	33.22^{a}	31.69^{b}	33.17^{a}	33.28^{a}	33.14^{a}	34.39^{a}	0.43
Mean cell volume (fl)	70.31^{b}	92.83^{a}	77.94^{b}	88.66^{a}	70.83^{b}	71.96^{b}	3.45

^{abc} Mean on the same row having different superscripts were significantly (P<0.05) different.

Conclusions and Recommendations

It was concluded that:

i. Inclusion of yam peels meal as a partial replacement for maize in the ration of starter broiler chickens had no significant main effect on serum biochemical indices of the birds.
ii. Yam peels meal with enzyme supplementation showed significant interaction influence on total protein, globulin, glucose and creatinine of starter broiler chickens.
iii. Inclusion of yam peels meal as a replacement for maize with enzyme supplementation had significant influence on haematological parameters of starter broiler chickens.
iv. Inclusion of yam peels meal at 0% level of replacement for maize with enzyme supplementation (T4) had higher significant values for total protein, globulin and glucose which suggest better nutrient utilization without health impairment.

References

1. Aduku, A. O. (1993). Tropical feedstuff – analysis. Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Samaru, Zaria, Nigeria.
2. FAO (1986). Better utilization of crop residues and by-products in animal feeding: research guidelines.
3. Adeyemo, A. I. and Borrie, O. F. (2002). Response of giant snail (*Archachina marginata*) to graded levels of yam peel meal base diet. *Journal Nigeria Society of Animal Prod*uction. 12: 42-51.
4. 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 diet. *International Journal of Poultry Science*, 7: 474-477.
5. N. R. C. (1994). Nutritional Research Council Nutrient Requirement of poultry 9th edition. Revised edition National Academy of Science. Washington D. C. pp 235.
6. SPSS (2012). Statistical package for social sciences, version 21. USA IBM Corporation.
7. Omole, A. J., Okpezi, C. N., Fayenuwo, J. A. and Olorungbohunmi, T. O. (2013). Effects of partial replacement of maize with yam peel (*Discorea rotundata*) in diet of juvenile snails (*Archachatina marginata*). African Journal of

Agricultural Research. 8(16): 1361 – 1364.

8. Lawal, M. O., Eniola, O., Amos, A. O., Jattodayo, K. A., Fadimu, B. O. and Babatunde, R. O. (2017). Performance characteristics of broiler chickens fed diets supplemented with yam peel (*Dioscorea cayanensis*) as a partial replacement for maize. *Journal of forestry research and management.* 14 (1) 49 – 60.
9. Mandel, A. B., Yadav, A. S., Johri, T. S. and Pathak, N. N. (2004). Nutrition and disease management of poultry. International book distribution CO. Lucknow. India, pp 12 – 370.
10. Oyeyemi, M. O., Ekanade, A. O. and Ogunsemoyin, A. (2014). Haematology, Serum chemistry and Hormonal assay of Yankasa ewe fed concentrate supplementation. Procceding of 39th Annual Conference of Nigerian Society of Animal Production held at Babcock University Ilishan-Remo. March 16th – 19th 2014.Pp 68 – 71.
11. Ross, J. G., Halliday, W. G. and Jones, R. M. (1978). Haematological and blood chemistry comparison value for clinical pathology. *Poultry Veterinary* 102: 29-39.
12. Okorie, K. C., Nkwocha, G. A. and Ndubuisi, E. C. (2011). Implications of feeding varying dietary levels of cassava leaf meal on finisher broiler: Performance carcass, haematological and serological profiles. *Global research journal of science*. 1: 58-66, ISBN: 2276-8300.
13. Oladipo, M.F., Onimisi, P.A. and Bawa, G.S. 2015. Response of broiler chicken fed kaura variety of sorghum (*Sorghum bicolor*) based diets supplemented with enzyme. *Nigerian Journal of Animal Science.* 15(1): 75-82.
14 Afolabi, S. B. (2010). Haematological parameters of the Nigerian local grower chickens fed varying dietary level of palm kernel cake. Proceeding of the 35th annual conference of Nigeria society for Animal Production held at University of Ibadan Oyo State Nigeria. 247 - 252.
15. Banerjee, G. C. (2009). A Texbook of Animal Husbandry 8th ed. Oxford and IBH Publishing Co. PVT. Ltd. New delhi India. 2009. 118 – 139.
16. Ahiwe, E. U., Emenalom, O. O., Etuk, E. B. and Okehie, U. N. (2014). Performance of broiler fed diet containing boiled Christmas bush (*Alchornea cordifolia*) seed meal. Proceeding 39th annual conference Nigerian Society of Animal Production Babcock, Ogun State Nigeria. 398 – 402.
17. Poole, T. B. (1987). UFAW Hand book of care and management of laboratory animals. 6th ed. University Foundation for Animal Welfare. Longman Scientific and Technical, Harlow, UK. 308.
18. Akinola, L. A. F. and Etuk, M. O. (2015). Haematological and serum biochemical response of broiler fed varying levels of indomie waste-based diets. IOSR. *Journal of Agriculture and Veterinary Science. 8(3): 66 – 7.*
19. *Kenedy, R. (2011). CBC (Complet*e Blood Count) Interpretation. The medical doctors' library. http:// www. medical-library. net/cbc red blood cells. html.
20. Mitruaka, B. M. and Rawnsley, H. M. (1997). Clinical biochemical and haematological reference values in normal experimental animals publishing Inc. pp106 – 112.