Agro-Science Journal of Tropical Agriculture, Food, Environment and Extension
Volume 16 Number 2 (May 2017) pp. 46 - 51
ISSN 1119-7455

THE EFFECT OF REPLACING MAIZE WITH PROCESSED CASSAVA (GARRI) ON THE PERFORMANCE, CARCASS CHARACTERISTICS AND BLOOD INDICES OF BROILER FINISHER BIRDS

Esiegwu, A.C.
Department of Animal Science and Fisheries, Imo State University, PMB 2000 Owerri, Nigeria.
email: arthuresiegwu@yahoo.com

ABSTRACT

An experiment was carried out to determine the replacement value of maize with garri on the performance, carcass characteristics and blood indices of broiler finisher birds. Twenty-four hour fermented cassava (Garri) was used to formulate four broiler finisher diets at 0, 10, 20, and 30% inclusion levels. Sixty, five weeks old broiler chicks were randomly assigned to four treatment diets of fifteen birds per treatment in a completely randomized design and each treatment was further replicated three times of five birds per replicate. The birds were fed for 28 days. Results show that average daily feed intake, feed conversion ratio and feed cost per kg weight gain of broilers did not differ significantly (P > 0.05) among the treatment diets. The average daily weight gain of birds was significantly decreased (P < 0.05) at 30% dietary level. The internal organ weights (heart, liver, and gizzard) and the dressed weights of thigh, breast muscle, wings, back muscle and neck (did not show any significant differences (P > 0.05). The haemoglobin (Hb) and packed cell volume was significantly decreased at 30% dietary levels, while the white blood cell (WBC) was significantly decreased (P < 0.05) at 20% and 30% dietary levels. The neutrophils, basophils, eosinophils, monocytes and lymphocytes did not show any treatment effect (P > 0.05). Serum glutamate oxaloacetate transaminase (SGOT) and Serum glutamate pyruvate transferase (SGPT) was significantly decreased (P < 0.05) at 30% dietary level compared to the control. Urea and creatinine were decreased (P < 0.05) at 10 and 30% dietary treatment levels. No significant (P>0.05) differences however existed in total proteins, albumins, globulin and cholesterol levels. It was therefore concluded that 24-hour processed cassava (garri) have potential to replace maize at 10% inclusion levels without any adverse effect on growth performance of broiler finishers.

Key words: Garri, performance, carcass, blood indices, broiler finisher.

INTRODUCTION

In Nigeria, the poultry industry has been challenged greatly by the use of maize as the main source of energy feed for the animals. Maize is also widely consumed by man in differently processed ways. Udedibie (2007) reported that, because it is a major human food and also used as raw material for various industries, its demand outstrips its supply, leading to more than 2000% increase in its price within the last 20 years. This high value placed on maize has mounted so much pressure on its demand that too many people are chasing the few tons available in the market leading to increase in price. Essentially, the high rate of inflation in Nigeria, coupled with the sudden outburst of stem borer attack on maize production since 2016 in Nigeria, that devastated hectares of maize plot, aggravated the scarcity of maize grains (Esiegwu, 2017). It is therefore necessary to research into possible alternative feed energy sources that can support maize in sustaining the poultry and livestock industry. In Nigeria, cassava and its by-products have great potential as an important energy feed resource in diet formulations for livestock and poultry. Tsegai *et al.* (2002) reported that cassava is an excellent source of energy. IITA (2002) identified and highlighted the characteristics of the common forms of cassava products available in Nigeria. These include garri, fufu, cassava chips, cassava flour, starch, farina, tapioca, macaroni, cassava bread and pudding. Garri is a gritty, starch staple with high energy content which is derived from cassava (*Manihot esculenta Crantz*) (Ernesto *et al.,* 2000). It is processed from fermented, gelatinized fresh cassava tubers. Cassava is high in cyanogenic glucosides, linamarin and lotaustralin which on hydrolysis yield hydrogen cyanide (HCN) which is highly toxic (Udedibie *et al*., 2004;

Please cite as: Esiegwu, A.C. (2017). The effect of replacing maize with processed cassava (garri) on the performance, carcass characteristics and blood indices of broiler finisher birds. *Agro-Science*, **16 (2)**, 46-51. DOI: https://dx.doi.org/10.4314/as.v16i2.7

Chauynarong *et al*., 2009). Ojo and Akande (2013) reported the proximate composition of garri to be 1.27% crude protein, 11.74% moisture, 0.12% ash, 1.24% fibre, 1.08% fat and 84.55% carbohydrate. These nutrient values show that garri has a high energy level that could be of importance to livestock and poultry. Enidiok *et al.* (2008) reported the moisture, total cyanide and fiber content of garri to vary from 26.2 –40.02%, 1.51–2.81mg HCN/100g and 1.80– 2.40%, respectively. The largest reduction in cyanide according to him took place on the third and fourth day of fermentation. Despite this anti-nutrient limitation, garri is available, cheap and has high energy component which could downplay the threat of maize scarcity and its increasing cost.This research therefore, was aimed at evaluating the feed value of garri on the performance, carcass characteristics and blood indices of broiler finishers.

MATERIALS AND METHODS

Experimental site

This experiment was carried out at the poultry unit of the teaching and research farm, Imo State University, Owerri. It is located within the South-Eastern agro-ecological zone of Nigeria. Owerri lies between latitude $5^0$29'North and longitude $7^0$20'East. It is about 91m above sea level with annual rainfall, temperature and humidity ranging from 1,500mm to 2,200mm, 20.0–27.5^{0}C and 75–90%, respectively (Accuweather, 2015).

Source and processing of garri meal

The fresh cassava tubers used for the experiment were bought from Umuokanne in Ohaji Egbema Local Government Area of Imo State. The cassava tubers were peeled, washed, ground into a meal with garry grating machine and put into raffia bags. Graded pressure was applied on the bags to facilitate the dewatering from the pulverized cassava. Thereafter, it was allowed to stay for 24 hours under the sun for fermentation to take place. The half-dried cassava meal was then sieved to remove the fibre. Subsequently, it was toasted for about 30 minutes at varying temperature ranges of between 80 – 100^{0}C in an open metal pan. Samples of the garri meal were subjected to proximate and phytochemical analysis according to AOAC (2010).

Experimental diets

Four finisher broiler diets were compounded, incorporating garri meal at 0%, 10%, 20% and 30% inclusion levels respectively, partly replacing maize in the control diet. The diets were thus designated as T_0, T_{10}, T_{20} and T_{30} respectively. The ingredients and calculated nutrient composition of the diets are shown in Table 1.

TM/Vit.premix means Trace mineral vitamin premix

Experimental birds and design

One hundred and twenty (120) four-weeks old Agrited broiler birds bought from a reputable dealer in Owerri were used for the trial. The birds were randomly divided into four groups of 30 broilers, and each group was randomly assigned to one of the four treatment diets in a completely randomized design (CRD). Each group was replicated thrice with 10 birds per replicate, housed in a deep litter pen measuring 1m×1.5m. Feed and water were provided *ad libitum*. The trial lasted for 28 days.

Data collection

The birds were weighed at the beginning of the experiment to obtain their initial body weights and thereafter on weekly basis. Daily feed intake was determined by subtracting the weight of leftover feed from the weight of the feed given the previous day. Data were collected on feed intake, body weight changes. Feed conversion ratio was calculated by dividing the average daily feed intake by average daily weight gain.

Haematology and blood biochemistry

At the end of the 28 day feeding trial, blood samples were collected from 3 birds per treatment. 2mls of blood collected was placed in the specimen bottles with Ethylene diamine tetra acetic acid (EDTA), whereas 5mls of the blood samples were placed in the specimen bottle without EDTA for determination of haematological and blood biochemical indices, respectively. Blood was analyzed within 3 hours of collection for red blood cell (RBC) count, haemoglobin concentration (HB), white blood cell count (WBC), packed cell volume (PCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), mean corpuscular volume (MCV) and differential WBC counts as outlined by Ochei and Kolhatkar (2000). Blood biochemical indices analyzed included total protein, cholesterol, urea, creatinine, enzymes and the sodium, potassium, carbonate and chloride electrolytes following the procedures proposed by Ochei and Kolhatkar(2000).

Statistical analysis

Data collected were subjected to analysis of variance using the SPSS software (2012).

Significant means were compared using Duncan's New Multiple Range Test (DNMRT) (SPSS, 2012).

RESULTS AND DISCUSSION

Performance of the experimental broiler finishers

The proximate composition of garri is shown in Table 2, whereas, Table 3 shows the performance of broiler finishers fed the experimental diets. The crude protein (1.40%) and the percent carbohydrate (83.71%) were similar to the values (1.27%) and (84.55%) for proteins and carbohydrates reported by Ojo and Akande (2013). The hydrocyanic acid of garri dropped to 10.80mg as against the 80mg/kg recorded for the raw cassava after fermentation and toasting. However, it was observed that 24-hours fermentation and subsequent toasting was not enough to remove all the hydrocyanic acid of the garri. As shown in Table 3 there were no significant differences ($P > 0.05$) among treatments in final body weight, average daily feed intake (ADFI), and feed conversion ratio (FCR). There were however, significant ($P<0.05$) differences among treatment means in average daily weight gain (ADWG). Birds on treatment 2 (10% garri) had the highest ADWG, and this was significantly higher ($P<0.05$) than the ADWG of birds on treatment 4 (30% garri). Birds on treatments 1 and 3 (0 and 20% garri) had comparable ($P>0.05$) ADWG. However, T2 (10 %) dietary level was significantly better than ($P < 0.05$) T4 (30 %) dietary level but similar to the control and T3 (20 %) for weight gain.

This finding is in contrast to the report of Okorie *et al.* (2017) whose average daily weight gain ranged from 60.42g to 77.74g for broiler finishers fed enzyme supplemented toasted mucuna sloanei meal and Ogbangba and George (2013) with average daily weight gain (52g to 63g) for broiler chickens fed cassava tuber meal. However, the average daily gain in this study is similar to 37.24 and 35.01g for finisher broilers fed neem leaf meal at 0 and 5% dietary levels respectively (Olowu *et al*., 2013) The feed conversion ratio (2.85) at 10% level of inclusion was lower than 2.96 to 3.73 reported by Enyenihi *et al.* (2013) for broiler finishers fed gelatinized cassava tuber meal but higher than 1.76 to 2.30 for broiler chickens fed cassava tuber meal (garri) (Ogbamgba and George, 2013). The findings is in contrast with the study of Ogbamgba and George (2013) who reported better weight gain at 25% replacement level of garri for maize.

Carcass characteristics

Table 4 shows the carcass characteristics of broiler finishers fed processed cassava (garri). There were no treatment effect ($P>0.05$) on the dressing percentages and breast muscles compared to the control. The breast muscle at 20 and 30% dietary levels were comparable to the control. This implies that garri and maize are similar nutritionally and capable of tissue synthesis in finisher broilers under the same environment (Isikwenu *et al.,* 2013). The thigh/drumstick was significantly ($p < 0.05$) increased at 30% dietary level whereas the shank was significantly ($p<0.05$) decreased at30% dietary level. The organs (gizzard, liver and heart) were not statistically affected ($P > 0.05$). This implies that the anti-nutient HCN in the garri had no toxic or damaging effect on the carcass growth and development. This finding supports the report of Udedibie and Asoluka (2008) which stated that laying hens and older broilers have capacity to tolerate dietary HCN at levels up to 25 ppm.

Table 1: Ingredient and calculated nutrient composition of the experimental diet

Ingredients	T1 (0%)	T2 (10 %)	T3 (20%)	T4(30) %)
Maize	60	50	40	30
Garri	0.0	10.0	20.0	30.0
Soybean meal	15.0	15.0	15.0	15.0
Groundnut cake	10.0	10.0	10.0	10.0
Fish meal	2.0	2.0	2.0	2.0
Blood meal	1.0	1.0	1.0	1.0
Palm kernel meal	3.0	3.0	3.0	3.0
Wheat offal	4.0	4.0	4.0	4.0
Bone meal	4.0	4.0	4.0	4.0
Salt	0.25	0.25	0.25	0.25
TM/Vit. premix	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Calculated nutrient composition				
Crude protein	20.55	19.55	18.81	18.08
ME (kcal/kg)	2881.53	2879.99	2878.44	2876.90
Ether extract	3.85	33.55	3.26	2.97
Crude fibre	4.02	4.13	4.25	4.37
Calcium	1.58	1.58	1.58	1.558
Phosphorus	1.10	1.08	1.05	1.02
Lysine	1.27	1.25	1.22	1.20
Methionine	0.60	0.58	0.56	0.54

*Provided the following per kg of feed; vitamin A, 1000iu; vitamin D3, 1500iu; vitamin E, 51mg; vitamin K, 2mg; Riboflavin, 3mg; Pantothenic acid, 10mg; Nicotinic acid, 25mg; Choline, 350mg; Folic acid, 1mg; Mg, 56mg; Iodine, 1mg; Fe, 20mg; Zn, 50mg; Co, 1.25mg.

Haematological and biochemical indices

Data on the haematological and serum biochemical indices of broiler finishers fed garri are shown in Tables 5 and 6. The results showed that haemoglobin (HB), packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC), mean cell volume (MCV), and mean cell haemoglobin concenteration (MCHC), were significantly (P< 0.05) affected by treatments. The haemoglobin, packed cell volume, red blood cell and mean cell volume decreased significantly (P<0.05) at 30% dietary inclusion level of garri. Low values of haemoglobin and red blood cell has been implicated as signs of anaemia (Mohammed and Oloyede, 2009). The value for haemoglobin (11.10g/dl) at 30% dietary level was lower than the normal range (11.60–13.68g/dl) reported by Wikivet (2013). This was an indication that at 30% inclusion level, the feed was no longer very good for the health of the birds. The normal values of the packed cell volume and haemoglobin recorded in the present study at 10 and 20% dietary level is an indication of normal physiological functioning and effective circulatory exchange within the blood.

The values of packed cell volume from this study (33.00%–39.00%) showed that T4 (30.0%) inclusion level fell below the normal range 35.9%–41.0% reported by Merck (1979) and Wikivet (2013). The decrease in haemoglobin, packed cell volume and red blood cell at 30.0% dietary level could be attributed to the negative effect of the anti-nutrient HCN that may have inhibited the absorption and utilization of nutrients resulting in the physiological upset of these cells. Haemoglobin functions to convey oxygen from the lungs through the veins to different parts of the body where it is released to burn nutrients to provide energy for body activities. A decrease in haemoglobin is a sign of reduction in nutrient metabolism and utilization hence, vital body activities such as growth, production, reproduction and other productive functions may be impeded or reduced. White blood cell decreased significantly (P < 0.05) at 20.0% and 30.0% dietary levels. This was an indication that there was no infection of the blood as a result of the anti-nutrient. White blood cell increases in the course of infection or invasion by a foreign body so as to resist them. Similarly, white blood cell differentials (neutrophils, basophils, eosinophils, monocytes and lymphocytes) showed no treatment effect (P > 0.05). Biochemical indices affected by treatments (P<0.05) were urea, creatinine and serum glutamate oxaloacetate transferase (SGOT). The values showed that the diet did not affect the protein quantity and quality negatively. High level of urea is an indication of low protein quality (Nworgu *et al.,* 2007). The urea content of the blood decreased with the inclusion of processed cassava (garri). In other words, garri consumption did not reduce the quality of the proteins at the level used. Serum enzymes are normally used to measure the toxicity of feed to the organs or damage done to the organs. An increase in serum enzymes is a sign of toxicity or damage to an organ. In this trial, alkaline phosphatase were statistically the same while serum glutamate oxaloacetate transaminase (SGOT) and serum glutamate pyruvate transferase (SGPT) decreased significantly (P<0.05) as the level of garri included in the diets increased. This is an indication that at these levels of inclusion, there was no deleterious effect of garri on the organs. Serum creatinine decreased significantly (P<0.05) with the inclusion of garri in the diet. Excess creatinine in the blood of animals is from muscle when wasting occurs and creatinine phosphate is catabolized (Yuegang *et al*., 2008). Significant reduction in values of creatinine was an indication of no muscle wastage.

Table 2: Proximate composition of garri

Composition	Content (% DM)
Moisture	9.25
Crude protein	1.40
Crude fibre	3.50
Ash	1.19
Ether extract	0.95
Nitrogen free extract	83.71
Metabolizable energy (Kcal/Kg)	3.1546
Hydrogen cyanide (raw cassava)	80mg/100g
Hydrogen cyanide (garri)	10.80mg/100g

Table 3: Performance parameters of the experimental finisher broilers fed processed cassava (garri)

Parameters	T_1 (0%)	T_2(10%)	T_3(20%)	T_4(30%)	SEM
Initial body weight (g/bird)	386.77	386.77	386.77	386.77	3.333
Final body weight (g/bird)	1403.33	1533.33	1416.77	1376.67	57.250
Total weight gain (g)	1016.56	1146.56	1030.00	990.00	57.130
Average daily gain (g)	36.30^{ab}	40.95^{a}	36.79^{ab}	35.36^{b}	1. 540
Average daily feed intake (g/bird)	116.95	117.04	115.35	121.16	4.520
Feed conversion ratio	3.25	2.85	3.16	3.33	0. 171
Feed cost per kg (₦)	112.43	104.93	97.43	89.93	
Feed cost/kg weight gain (₦)	365.40	299.41	307.89	299.53	

ab means within the same row with different superscripts are significantly different (P<0.05

Table 4: Carcass characteristics of broiler finishers fed processed cassava (garri)

Parameters	T_1 (0%)	T_2 (10%)	T_3 (20%)	T_4 (30%)	SEM
Live weight (g/bird)	1483.33^{ab}	1566.67^{a}	1450.00^{ab}	1333.33^{b}	66.144
Dressed weight (% LW)	54.43	60.12	62.74	60.60	3. 285
Thigh/drum stick (% LW)	18.31^{b}	19.43^{ab}	16.89^{b}	25.58^{a}	2. 112
Breast muscles (% LW)	19.35^{a}	16.53^{b}	18.59^{ab}	18.84^{ab}	0. 697
Neck (% LW)	1.91	3.21	2.77	2.93	0.402
Back (% LW)	5.95	6.78	7.27	7.69	0.722
Shank (% LW)	3.02^{b}	3.21^{b}	3.43^{b}	5.42^{a}	0.573
Wings (% LW)	19.10	16.02	15.38	18.79	2.28
Gizzard (% LW)	2.39	2.42	3.00	2.87	0.352
Liver (% LW)	0.57	2.77	3.22	3.47	0.607
Heart (% LW)	0.38	0.32	0.34	0.38	0. 020
Intestinal length (Cm)	240.00	245.00	225.00	241.67	12. 2.76

ab means within the same with different superscripts are significantly different (P <0.05)
% LW means percent of live weight

Table 5: Haematological indices of broiler finishers fed processed cassava (garri)

Parameters	T_1 (0%)	T_2 (10%)	T_3 (20%)	T_4 (30%)	SEM
Hb (g/dl)	12.00^{ab}	12.40^{a}	11.70^{ab}	11.10^{c}	0.161
PCV (%)	37.67^{a}	39.00^{a}	36.67^{a}	33.00^{b}	0. 687
WBC ($x10^9$/l)	11.20^{a}	11.30^{a}	10.60^{b}	10.67^{b}	0.113
RBC (10^{12}/l)	11.97^{ab}	12.33^{a}	11.70^{b}	11.53^{b}	0.176
ESR (mm^3/hr)	37.67^{ab}	33.33^{a}	46.67^{a}	46.67^{a}	3.333
MCV (fl)	31.63^{a}	31.63^{a}	31.33^{a}	28.60^{b}	0.435
MCH (pg)	10.03	9.93	10.00	9.63	0.158
MCHC (g/dl)	31.60^{b}	31.63^{b}	32.20^{b}	33.63^{a}	0.296
Neutrophils (%)	56.33	55.33	56.33	55.33	1.716
Basophiles (%)	Nil	Nil	Nil	Nil	Nil
Eosinophil (%)	01.00	1.67	1.33	1.33	0.289
Monocytes (%)	1.33	1.33	1.67	1.67	0.334
Lymphocytes (%)	41.33	41.67	40.67	41.67	1.764

^{abc} means within the same row with different superscripts are significantly different (P <0.05).
ESR:means erythrocyte sedimentation rate

Table 6: Serum biochemical indices of broiler finishers fed processed cassava (garri)

Parameters	T_1 (0%)	T_2 (10%)	T_3 (20%)	T_4 (30%)	SEM
Urea (mmol/L)	6.60^{a}	5.63^{c}	6.03^{c}	5.63^{c}	0.09
Creatinine (mmol/L)	62.27^{a}	53.00^{c}	55.33^{c}	56.67^{c}	1.47
Cholesterol (mmol/L)	7.27	7.40	7.30	7.53	0.219
Total protein (g/d)	57.00	53.67	57.00	55.67	2. 461
Globulin (g/d)	34.00	32.00	33.33	34.00	4.121
Albumin (g/d)	23.00	21.67	22.67	21.67	1.447
Sodium (mmol/L)	41.67^{ab}	39.00^{c}	40.00^{bc}	42.67^{a}	0.687
Potassium (mmol/L)	1.17	1.1	1.13	1.27	0.071
Bicarbonate (mmol/L)	10.93^{ab}	10.42^{b}	10.87^{b}	11.47^{a}	0.195
Chlorine (mmol/L)	22.67	23.00	23.00	25.00	1.098
Alk. phosphate	1.17	1.10	1.13	1.13	0.071
SGOT	11.80^{a}	11.50^{ab}	11.57^{ab}	11.40^{b}	0.105
SGPT	7.33^{a}	16.97^{b}	6.93^{b}	6.93^{b}	0.105

^{abc} means within the same row with different superscripts are significantly different (P < 0.05).
Alk. Phosphatase means alkaline phosphatise

CONCLUSION

From the result of the present study, it was observed that broilers on 10% dietary inclusion level of garri had improved weight gain. Dietary inclusion of cassava processed meal based diet (garri) did not exert any deleterious effect on carcass, organ weights and blood indices of broilers. Therefore, it is recommended that the use of garri as an alternative energy source in the diet of broilers should not exceed 10% inclusion level, due to its cost effectiveness at this level.

REFERENCES

Accuweather(2015). Weather for Owerri, Nigeria. http://www.accuweather.com/en/ng/owerri/253317/weather-forecast/253317.Retrieved on November **15** 2015.

AOAC (2010). Official methods of analysis. 19th edition. Association of official Analytical chemists. Washington D. C. USA.

Chauynarong, N., Elangovan, A. V. and Iji, P. A. (2009). The potential of cassava products in diets for poultry. *Worlds Poultry Sci. J.,* 65: 23 – 35.

Demoranville, V. E. and Best, M. A. (2013). Haematocrit. Encyclopedia of surgery. A guide for patients and caregivers. Available at: enwikipedia.org/wiki/haematology.

.Enidiok, S. E., Attah, L. E. and Otuechere, C. A. (2008). Evaluation of moisture, Total cyanide and Fiber contents garri produced from Cassava (Manihot utilissima) varieties obtained from Awassa in Southern Ethiopia. *Pakistan Journal of Nutrition* 7 **(5):** 625 – 629.

Enyenihi, G. E., Esiegwu, A. C., Esonu, B. O., Uchegbu, M. C. and Udedibie, A. B. I. (2013). Gelatinization of fermented cassava tuber meal and its nutritive value for broilers. Nigerian Journal of Animal Production. Volume 40 **(2):** 71 – 79.

Ernesto, M. Cardoso, A. P., Cliff, J. and Bradbury, J. H. (2000). Cyanogens in cassava flour and roots and urinary thiocyanate concenteration in Mozambique. *Journal of Food Composition and Analysis,* **13**: 1 – 12.

Esiegwu, A. C. (2017). Effect of fermented sorghum seed meal on the performance, carcass characteristics and blood profile of broiler finisher chicken. *Nig. J. Anim. Prod*. 44**(3):** 300 – 308.

Isikwenu, J. O., Akpodiete, O. J., Omeje, S. I. and Okagbare, G. O. (2010). The effects of replacing groundnut with urea-treated and fermented brewer's dried grains on nutrient digestibility, retention and carcass characteristics of broiler finishers. *Nig. J. Anim. Prod*. 37(**1**): 1 – 12.

IITA (International Institute of Tropical Agriculture) (2002). Competitiveness workshop in opportunities for cassava in Nigeria. Book anga, IITA. Ibadan.

Merck Veterinary Manual (1979). A handbook of diagnosis and therapy for veterinarians. 5th edition. Merck and Co. Inc. Rahway. N. J. USA p.21, 1613.

Mohammed, N. O. and Oloyede, O. B. (2009). Growth performance of broiler chicks fed *Aspergillus niger*-fermented *Terminalia catappa* seed meal based diet. *Global Journal of Biotechnology and Biochemistry*. 4(**2**): 179 – 183.

Nworgu, F.C.,Ogungbenro, S.A. and Solesi, K.S. (2007). Performance and some blood chemistry indices of broiler chickens served fluted pumpkin (*Telfariaoccidentalis*) leaves extract supplement. *American Euraisan Journal of Agric. and Environ.Science*. 2(**1):** 90 – 98.

Ochie, J. and Kolhatkar, A. (2000). Medical laboratory science. Theory and practice. Tata McGraw-Hill company limited New Delhi.

Ogbamgba, K. O. and George, S. O. (2013). Effect of processed cassava tuber meal (garri) on the performance and serum metabolites of broilers. International Journal of Science and Research. Volume 4 Issue **3** 2319 – 7064.

Ojo, A. and Akande, E. A. (2013). Quality evaluation of garri produced from cassava and sweet potato tuber mixes. Afr. J. Biotechnol. Vol. 12 (**31**): 4920 – 4924.

Okorie, K. C., Esiegwu, A. C. and Okonkwo, V. N. (2017). Effect of enzyme (Zympex 0.8) supplementation on performance and blood indices of finisher broilers fed diets containing toasted *Mucuna sloanei* meal. Int'l Journal of Agric. And Rural Dev. Vol. 20(**1):** 2986 – 2992.

Olowu, O. P. A., Asaniyan, E. K. and Agbede, J. O. (2013). Performance, organ characteristics and economics of finisher broiler fed neem (*Azadirachta indica*) leaf meal as a replacement for maize. Nigerian Journal of Animal Production, Vol.40**(2):** 45 – 51.

Purves, W. K., Sadava D., Onans, G. H. and Heller, H. C. (2003). Life: the science of biology (7th ed.) Sunderland, mass associates 954.

SPSS (2012). Statistical package for social sciences, version 21. USA IBM Corporation.

Tsegai, d. and Kormawa, P. C. (2002). Determinant of urban household demand for cassava products in Kaduna, Northern Nigeria. In: Conference of international research for development, Witzenhause, 9-10 October.

Udedibie, A. B. I. (2007). Wetting method improves nutritive value of cassava for broilers in Nigeria. Cassava Cyanide Diseases Network News, 9: 1- 2.

Udedibie, A. B. I., Alozie, I. L. and Duru, H. I. (2007). Effects of 12-hour wetting of sun-dried cassava tuber meal on its HCN content, performance and haematological indices of broiler chicks. *Anim. Prod. Res. Adv*., **3**: 1-5.

Udedibie, A. B. I., Anyaegbu, B. C., Onyechekwe, G. C. and Ogbukporo, O. C. (2004). Effects of feeding different levels of fermented and unfermented cassava tuber meals on performance of broilers. *Nig. J. Anim. Prod*., **31:** 211 – 219.

Udedibie, A. B. I. and Asoluka, C. O. (2008). Effects of 5-hour wetting of sun-dried cassava tuber meal on the HCN content and dietary value of the meal for young chicks. Nig. J. Anim. Prod., **35:** 25 – 31.

Wikivet. Haematology (2013) available at en.wikipedia/wiki/haematology.

Yuegang, Z., Chengjum, W. and Chengjum, T. (2008). Simultaneous determination of creatinine and uric acid in human urine by high performance liquid chromatography. *Analytic science*. **24**: 1589 – 1592.