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Original Research

Performance of broiler chickens fed diets containing high-quality cassava peel

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ABSTRACT
Performance, carcass characteristics and cost benefit of broiler chickens fed diets containing high-quality cassava peel (HQCP) were investigated. A total of one hundred and fifty (150) Abor Acre strain of broiler chicks were purchased and raised at the Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, Abia State. Feeding trial were conducted to evaluate the effect of diets containing varying levels of high-quality cassava peel (HQCP) fine mash on broilers' performance, carcass characteristics, and cost benefit. The birds were acclimatized for three weeks using commercial diets after which they were randomly assigned to four treatment groups; (Diet 1- 0 kg of HQCP, Diet 2- 10 kg of HQCP, Diet 3- 15 kg of HQCP and Diet 4- 20 kg of HQCP per ton of feed for 21 days. Each treatment was replicated into 3 with 10 birds per replicate in a completely randomized design. Data on growth performance, carcass characteristics, and feeding costs were collected and analyzed. The results showed significant (P<0.05) differences in final live weight, feed conversion ratio (FCR), dressing percentage, total feed cost, and feed cost per weight gain across the treatments. Diet 3 and Diet 4 produced birds with the highest live weights of 1.53 and 1.46 kg, respectively. The dressing percentage ranged from 60.53% (Diet 3) - 69.51% (Diet 2). Diet 3 had the lowest total feed cost (N764.67 /kg) while Diet 4 had the lowest feed cost per body weight gain (N1017.79) with a saving cost of N378.35. It was concluded that the replacement of maize with 20 kg high-quality cassava peel (HQCP) in broiler finisher diets improved production performance and saved cost.

Keywords: *Azanza garckeana;* growth; histology; internal organs; rabbit

INTRODUCTION
Cost of production of poultry is mostly associated with the cost of feed of ingredients. Maize is a major ingredient in the poultry diets in this part of the world and its availability and price are influenced by competition between man, industry and livestock. According to Maize Outlook Report (2016), findings have shown that the cost of ingredients used in formulating poultry feeds, particularly maize, has increased by 100% and is invariably affecting the price of poultry products in the market. This coupled with the high cost of importing maize during period of scarcity has worsened the situation. With these trends, researchers/ farmers have continued to search for alternative feed additives that would reduce cost of production of feed despite increase in the cost of feed ingredients.

Recently, more effort has been directed towards harnessing and utilizing by-products and wastes which are not directly utilized by man, thus converting them to value-added products that can be used in feed formation (Atteh, 2002). One of such agro-industrial by-products with potentials of replacing maize in poultry feed is cassava peel and was estimated to be about 15million metric tons in Africa in 2015 (Okike *et al.*, 2015). Cassava is produced in abundance in Nigeria and its tuber products are among the highly consumed for food by animals and humans in sub- Saharan Africa (Ayasan, 2010). Most of the products produced from cassava are usually without its peels which contribute up to 13% of the cassava tuber (Omotosho and Sangodoyin, 2013). The use of cassava peel as a feed ingredient for broiler chickens has gained attention due to its potential as an alternative and cost-effective source of nutrients in poultry diets. Cassava, (*Manihot esculenta*) is a major carbohydrate crop cultivated in the tropics. FAO (2014) reported world production of cassava to be about 157 million metric tons with Nigeria accounting for about 16% of the world's total production. Iyayi and Tewe (1994) and Saroeun (2010) noted conclusively that cassava peels may replace maize and other cereals without any detrimental effects.

The use of cassava peel in poultry production has been limited due to the amount of antinutritional factors present in it such as cyanogenic glycoside (Ogunwole *et al.*, 2017). Over the years, different methods had been used to reduce

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the effect of this anti-nutritional factor such as fermentation and sun drying, while the later sun drying remains the most common methods of reducing anti nutritional factors in cassava (Adeyemo and Sani, 2013; Abu *et al*., 2015). Some of these methods may pose some challenges in quality and quantity of the cassava peel. Also, longer period of drying may encourage the growth of mould and fungal microorganism such as Aspergillus flavus *Aspergillus flavus* (Clerk and Caurie, 1968) which may pose a great risk to poultry and livestock production.

Okike *et al*. (2015) had reported the technical and economic feasibility of the transformation of cassava peels within 6 to 8 hours to a value-added product used as an animal ingredient. These methods involve a combination of different physical methods such as grating, dewatering, pulverizing, and sun-drying.

Considerable evidence points to the possibility of using this processed and aflatoxin free cassava peel, which is referred to as high-quality cassava peel mash (HQCP) as an energy source in livestock feed. Therefore, the objective of this study is to evaluate the effect of varying levels of replacement of maize with HQCP on growth performance and carcass characteristics in broiler chickens' production.

MATERIALS AND METHODS

EXPERIMENTAL SITE AND DESCRIPTION

This trial was conducted at the Teaching and Research farm of Michael Okpara University of Agriculture Umudike, located in the tropical rainforest zone of Nigeria on latitude 5° 29´ E with an elevation of 122 m above sea level, annual rainfall of about 2177 mm, a monthly ambient temperature range of 22-36 °C and relative humidity 50-95% depending on season. (NRCRI, 2023)

TEST MATERIALS

The High-Quality Cassava Peel (HQCP) was processed cassava peel produced within 6 to 8 hours to a stable product as an animal feed ingredient following the methods of Okike *et al*. (2015). This method involves a combination of different physical methods such as sorting, grating, dewatering, pulverizing, and drying.

EXPERIMENTAL BIRDS AND MANAGEMENT

A total of 150-day-old Arbor Acre broiler chicks were sourced from a reputable hatchery in Ibadan, Oyo State. They were raised on commercial feed for 21 days after which one hundred and twenty (n=120) healthy broiler chicks were individually weighed and birds with a weight close to the group mean were randomly assigned to four experimental dietary treatments. The control diet was maize-based diet with 553 kg/ton of maize while diet 2, diet 3 and diet 4 had maize replaced at 100, 150 and 200 kg with HQCP respectively. Each treatment group consisted of 30 birds with replicate of 10 birds each. The birds were offered diets and water *ad-libitum* throughout the experimental period of 21 days. Standard management practices and routine vaccination were strictly observed. A floor space density of 0.3 m^2 per bird was maintained.

EXPERIMENTAL DIETS

Four (4) experimental broiler finisher diets were formulated such that the control diet did not contain HQCP, while substituting the dietary maize composition at levels of 100, 150 and 200kg/ton of feed. The composition of the diets and calculated analysis are shown in Table 1.

DATA COLLECTION

GROWTH PERFORMANCE

The initial live weight of birds was taken at the beginning of the experiment and subsequent weighing was done weekly on individual basis in the morning hours (7-8 am). Weight gain was obtained respectively by subtracting initial live weight from the live weight at the end of the trial. Data on feed intake were determined by difference between the quantity offered and the left over each day. Feed conversion ratio was determined by dividing feed intake by weight gain.

CARCASS CHARACTERISTICS

At day 42, five birds from each replicate with weight closest to the group average were selected and their live weight recorded. Feed was withdrawn from the birds four hours before slaughtering and standard operating procedures were adopted during pre-slaughter and slaughter processes. The birds were slaughtered manually through cervical disarticulation using a sharp knife. The slaughtered birds were scalded at 70°C for 1-2 mins, and manually de-feathered. The carcasses were then carefully eviscerated and split open to remove the entire gastrointestinal tract. Dressed weight and eviscerated weight were taken and recorded. Organs such as gizzard, heart, kidney, liver, lung and spleen were excised and weighed and expressed as a percentage of live weight. Cut parts including back cut, breast, drumstick, head, neck, shank, thigh, and wing were carefully removed, weighed and expressed as a percentage of their respective dressed weight.

FEED-COST BENEFIT

The economic analyses were done to determine the economic advantage of using high-quality cassava peel in diets of broiler chickens. Cost/kg feed was obtained by adding the price per kg of feed ingredients multiplied by their proportions in the feed formula and then dividing by 100. Daily feed cost (DFC) was obtained by multiplying the cost per kg feed by daily feed intake while the total feed cost (TFC) was obtained by multiplying total feed intake by the cost per kg feed. The cost per kg weight gained was also obtained by multiplying the feed conversion ratio by cost per kg feed.

Table 1.0: Ingredients Composition of Diets.

Ingredients	Diet1 (control)	Diet 2	Diet 3	Diet 4
Maize	55.3	45.3	40.3	35.3
Soya bean meal	12	12	12	12
Full fat soya	20.5	20.5	20.5	20.5
Fish meal	4	4	4	4
Soya oil	2.5	2.5	2.5	2.5
Wheat bran	2	2	2	2
Bone meal	3	3	3	3
Lysine	0.1	0.1	0.1	0.1
Methionine	0.1	0.1	0.1	0.1
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
HQCP	____	10	15	20
Total	**100**	**100**	**100**	**100**
Calculated Values				
Crude Protein %	20.27	20.00	19.80	19.61
Met.Energy, kcal/kg	3040.10	3023.86	3015.71	3007.61
Crude Fiber, %	4.00	4.17	4.34	4.51
Ether Extract, %	6.59	6.26	6.10	5.93
Calcium, %	1.41	1.41	1.41	1.42
Phosphorous, %	0.98	0.97	0.96	0.96

***** Each 2.5 Kg contains: Vitamin A =12,000,000i.u, Vitamin D3 =2,500,000i.u, Vitamin E =30,000 mg, Vitamin K3 =2,000 mg,Vitamin B1 =2,250 mg, Vitamin B2 =6,000 mg, Vitamin B6 =4500 mg, Vitamin B12 =15 mcg, Niacin =40,000 mg, Pantothenic Acid=15,000 mg, Folic Acid =1,500 mg, Biotin =50 mcg, Choline Chloride =300,000 mg, Manganese =80,000 mg, Zinc =50,000 mg,Iron =20,000 mg, Copper =5000 mg, Iodine =1000mg, Selenium =200 mg, Cobalt =500 mg, Antioxidant =125,00 0mg, Met: Metabolizable

DATA ANALYSIS

The experimental design was a completely randomized design and data generated were subjected to analysis of variance using the SPSS (V25) (SPSS, 2017) package. This means separation was done by Duncan's New Multiple Range Test following the procedure outlined by Steel and Torrie (1980).

Completely randomized design model: $Y_{ij} = \mu + T_i + \varepsilon_{ij}$

Where:

Y_{ij} = individual observation

μ = Overall mean

T_i = Treatment Effect

ε_{ij} = Random error.

RESULTS

GROWTH PERFORMANCE

The growth performance of finisher broiler fed high-quality cassava peel is shown in Table II. The result of the final weight, weight gained and average daily weight gained had the same level of significances across the treatment groups, were broiler chickens fed control diet were significantly (P < 0.05) higher than those fed diet 2 containing 15% HQCP, but they were not significantly(P > 0.05) different from the remaining treatment groups. The result of the total feed intake and the average daily feed intake showed that there was no significant (P > 0.05) difference across the treatment groups, but broiler chickens fed control diet and 10% HQCP had the highest mean followed by those fed 20% HQCP while those fed 15% HQCP had the lowest mean. The result of feed conversion ratio showed that broiler chickens fed control diet were significantly (P < 0.05) lower to those fed 15% HQCP, but they were not significantly (P > 0.05) different from the remaining treatment groups.

Table II: Growth performance of finisher broiler fed diet containing high quality cassava peel

Parameters g/b	Diet 1 (Control)	Diet 2 (10kg HQCP)	Diet 3 (15 kg HQCP)	Diet 4 (20 kg HQCP)	SEM
Initial weight	560.00	543.33	594.67	597.33	10.73
Final weight	1418.67[a]	1288.67[ab]	1245.67[b]	1354.67[ab]	27.17
Weight gained	858.67[a]	745.33[ab]	651.00[b]	757.33[ab]	27.61
ADWG	40.89[a]	35.49[ab]	31.00[b]	36.06[ab]	1.31
TFI	2030.67	2030.67	1983.33	2026.67	15.81
ADFI	96.70	96.70	94.44	96.51	0.75
FCR	2.36[b]	2.72[ab]	3.10[a]	2.69[ab]	0.11

[ab] Means within the rows with different superscripts differ significantly P<0.05; SEM- Standard error of the mean; ADWG: Average daily weight gained; TFI: Total feed intake; ADFI: Average daily feed intake; FCR: Feed conversion ratio; HQCP: High-quality cassava peel

CARCASS, OFFAL AND ORGAN PROPORTIONS

The carcass characteristics of finisher broiler fed high quality cassava peel are shown in Table 3. The result of the live weight, dressed weight, dressing (%), wings, thigh and drumstick showed that there were no significant (P > 0.05) different across the treatment groups. The dressing (%) showed that broiler fed diet 2 containing 10% HQCP had the highest mean followed by control diet, diet 4 while diet 3 had the lowest mean. The result of the back cut showed that broiler chickens fed diet 4 20% HQCP was significantly (P < 0.05) higher than those fed control diet (0% HQCP) but were not significantly (P > 0.05) different from the other treatment groups.

The offal characteristics of finisher broiler fed high quality cassava peel is shown in Table 4. The result of the shank, head, neck and gizzard showed that there were no significant (P > 0.05) difference across the treatment groups.

The organ proportions of finisher broiler fed high quality cassava peel is shown in Table 5. The result of the liver, lungs, kidney and spleen showed that there were no significant (P > 0.05) difference across the treatment groups, while the heart of broiler chickens fed 10 % HQCP, 15 % HQCP and 20 % HQCP were not significantly (P < 0.05) different from each other, but were significantly (P < 0.05) higher than those fed control diet.

Table III: Carcass characteristics of finisher broiler fed diet containing high quality cassava peel

Parameters	Diet 1 (Control)	Diet 2 (10kg HQCP)	Diet 3 (15kg HQCP)	Diet 4 (20kg HQCP)	SEM
Live weight, g/b	1633.33	1450.00	1533.33	1466.67	49.79
DW, g/b	1083.33	916.67	933.33	950.00	43.72
Dressing %	66.36	69.51	60.53	64.88	2.41
Breast cut %	32.68	28.54	28.17	28.86	0.91
Wings %	11.51	12.31	11.99	11.63	0.43
Thigh %	13.60	14.06	14.49	13.76	0.40
Drumstick %	12.90	13.53	13.64	13.35	0.26
Backcut %	16.22[b]	17.48[ab]	18.24[ab]	21.02[a]	0.74

[a,b,:] means within the rows with different superscripts differ significantly P<0.05; SEM- Standard error of the mean; DW: dressed weight; g/b: gram/bird; %: Percentage; HQCP: High quality cassava peel

FEED-COST BENEFITS

The feed cost benefit characteristics of finisher broiler fed high quality cassava peel are shown in Table 6. The result of cost per kg of feed showed that those fed 10% HQCP, 15 % HQCP and 20 % HQCP had no significant (P > 0.05) across the treatment groups, but diet 3 is significantly (P > 0.05) higher, followed by diet 2, diet 4 and diet 1.

Table IV: Offal characteristics of finisher broiler fed diet containing high quality cassava peel.

Parameters %	Diet 1 (Control)	Diet 2 (10kg HQCP)	Diet 3 (15kg HQCP)	Diet 4 (20kg HQCP)	SEM
Shank	2.59	3.92	3.79	4.19	0.31
Head	2.23	1.81	2.26	2.24	0.09
Neck	3.40	4.91	4.34	4.40	0.30
Gizzard	2.96	3.55	3.17	2.84	0.14

[a,b,:] means within the rows with different superscripts differ significantly P<0.05; SEM- Standard error of the mean; %: Percentage; HQCP: High-quality cassava peel.

Table V: Organ proportions of finisher broiler fed diet containing high quality cassava peel

Parameters %	Diet 1 (Control)	Diet 2 (10kg HQCP)	Diet 3 (15kg HQCP)	Diet 4 (20kg HQCP)	SEM
Liver	1.90	1.98	1.96	1.76	0.06
Lungs	0.49	0.56	0.52	0.48	0.02
Kidney	0.39	0.33	0.31	0.32	0.02
Spleen	0.13	0.14	0.13	0.14	0.00
Heart	0.33^{b}	0.41^{a}	0.41^{a}	0.46^{a}	0.02

[a,b:] means within the rows with different superscripts differ significantly (P<0.05); SEM- Standard error of mean; %: Percentage; HQCP: High quality cassava peel

Table VI: Feed cost benefit of finisher broiler chickens fed high quality cassava peel

Parameters N	Diet 1 (Control)	Diet 2 (10kg HQCP)	Diet 3 (15kg HQCP)	Diet 4 (20kg HQCP)	SEM
Cost/kg of feed	420.35	399.35	385.55	378.35	4.83
Daily feed cost	40.64^{a}	38.95^{a}	36.41^{b}	36.51^{b}	0.60
Total feed cost	853.59^{a}	810.95^{a}	764.67^{b}	766.79^{b}	12.50
Cost/ kg Wt gained	993.43	1087.56	1196.49	1017.76	35.72

[ab] Means within the rows with different superscripts differ significantly P<0.05; SEM- Standard error of the mean; Wt: weight; HQCP: High quality cassava peel

difference but were significantly (P > 0.05) lower than control diet. The result of daily feed cost showed that there were no significant (P > 0.05) difference between diet 1 and diet 2 but were significantly (P > 0.05) higher than diet 3 and 4 respectively. The result of total feed cost showed that there is no significant different difference (P > 0.05) across the treatment groups. The result of cost per kg of weight gained showed that there is no significant (P > 0.05) difference

DISCUSSION

There have been wide variations in broiler responses to use of cassava peel in poultry diets. These were attributed to differences in quality, variety of cassava, processing methods, to mention but a few. However, there are various literature reports on the inclusion levels of this unconventional agro by-product in broiler diets without adverse effect by animal nutritionist in Nigeria (Duru and Dafwang, 2010). The initial weight, final weight and average weight gained recorded in this study were similar to those reported by Abu *et al.* (2015), whereas the report of Adekeye *et al*. (2021) recorded higher values where final weight range between 1.74- 2.08 kg. The result of the final weight and weight gain showed that broiler chickens fed diet 2 and diet 4 had higher weight compared to those fed with diet 3 which might be due to the lower energy intake because broiler chickens eat to satisfy their energy requirement. The average weight gain showed that those fed diet 4 are higher than those fed diet2 and 3 which might be as a result of high energy intake. The high inclusion of HQCP (20kg) in diet 4 could have resulted to lower palatability, poor acceptability and thus lower feed intake, thereby leading to the lower weight gain recorded from chicken fed the diets, but reverse was the case in the sense that diet 4 fed 20kg HQCP did much better compared to those fed of lower percentage than it (10 – 15kg HQCP), but broiler chickens are known to eat more when diets are palatable and coarse when compared to finely ground and unpalatable diets (Leeson, 2008). Gillette *et al*. (1983) opined that birds are more responsive to weakly flavoured food than strongly flavoured foods. The feed conversion ratio showed that diet 4 (20kg HQCP) had the best feed conversion ratio which is as a result of efficiency of feed utilization as compared to those fed diet 2 and 3.

There was an observed similar increase in live and dressed weight of broiler chickens fed 10, 15 and 20kg of HQCP when compared to those fed control diet which had the better weight and higher feed conversion efficiency. The dressing (%) of those fed diet 2 had the best value with (69.51%) followed by those fed with control diet (66.36%), diet 4 (64.88%) and diet 3 (60.53%) as the least in the treatment. Schmidt *et al*. (2009) reported that the overall body muscle mass is more expressed in breast muscle of broiler chickens. HQCP inclusion did have negative effect on the choice part. The breast cut (28.17-32.68 %) obtained, were higher than the values reported by Adekeye.*et al*. (2021) and thighs were also higher than values obtained by Dayal *et al.* (2018) for the thigh (11.81 %). The chicken fed diet 2 obtained the highest wing value (12.31 %) followed by those fed diet 3 (11.99 %), diet 4 (11.63 %) and control diet (11.51 %) stating that HQCP had no detrimental effect on wing development. The highest percentage weight for drumstick (13.64 %) and back cut (21.02 %) was obtained from 15 and 20kg of HQCP respectively. The result showed that higher levels of HQCP supported the development of the parts. The result of the broiler chickens fed HQCP had the highest percentage diets 3 and 4 respectively on the shank (4.19%), head (2.26%) while diet 2 with 10kg HQCP had the highest percentage for the neck (4.19%) and gizzard (3.55%). The result stated that high quality cassava impacted on the cut parts positively and increased their body weight. The heart, liver, lungs and kidney weight were influenced by the dietary treatments. Higher heart and liver weight is an indication of metabolic stress or toxicity. Heart weight has been observed to be proportionate with the growth rate (Schmidt *et.al.*, 2009) while Dayal *et al.* (2018) have also documented higher liver weight on inclusion of cassava peels. When cassava as incorporated in the diet of broiler, there were no sign that the higher inclusion levels posed challenge to the birds. The relative organs were similar, an indication that the inclusion levels of HQCP were safe. This gross observation notwithstanding, future studies is expected on the effect of cassava peel inclusion in broiler diet on haematology and serum biochemical indices to proof whether it has any detrimental effect to either the liver or the blood.

The result of our trial showed that the cost of feed per kg body weight gain was lowest in diet4 (containing 20kg HQCP) indicating that 20kg replacement of maize with HQCP is a cost effective and cheaper source of energy and more economical than maize as corroborated by Adekeye *et al.* (2021). The decrease in feed cost per kg body weight gain with the dietary replacement of costly ingredients with cheaper ones has previously been reported when 20kg of HQCP was included in feed showed that more meat could be obtained at less cost. It was then apparent that the inclusion of HQCP in broiler diets could be advantageous in the long run in that it resulted in the reduction of cost of feed needed to gain a kilogram of weight. The most economic feed is in the order of diet 4, 3, 2 and 1. Thus, stating that diet 4 did better or had the best result in this experiment.

CONCLUSION

HQCP can replace maize up to 200kg/ton of feed and thus having significant positive effect on performance. The replacement levels were also found to yield higher economic value as their inclusion reduced cost/kg of feed and significant cost/kg weight gained as this would result to significant savings in the quantity of maize which is in greater need for human consumption. Thus, HQCP can replace maize up to 20kg/100kg feed to achieve optimum performance and economic gains.

REFERENCES

Ayasan, T. (2010). Use of cassava and products in animal nutrition. *Journal of Agriculture, Faculty of Gaziosmanpasa University*, 27, 73-83.

Adeyemo, I. A. & Sani, A. (2013). Haematological parameters and serum biochemical indices of broiler chickens fed Aspergillus niger hydrolyzed cassava peel meal-based diet. *International Journal of Research and Reviews in Applied Sciences*, 15:3

Abu, O. A., Olaleru, I. F., Oke, T. D., Adepegba, V. A. & Usman, B. (2015). Performance of broiler chicken fed diets containing cassava peel and leaf meals as replacements for maize and soya bean meal.

International Journal of Science and Technology, 4(4):169-173.

Adekeye, A. B., Amole, T. A., Oladimeji, S.O., Raji, A.A., Odekunle, T.E., Olasusi, O., Bamidele, O. & Adebayo, A.A. (2021). Growth performance, carcass characteristics and cost benefit of feeding broilers with diets containing high quality cassava peel (HQCP). *African Journal of Agricultural Research,* Vol. 17(3), 448-455.

Atteh J. (2002). Principles and practices of livestock feed and manufacturing.1st ed. Ilorin: Adlek Printer.

Clerk, G.C. and Caurie, M. (1968). Biochemical changes caused by some Aspergillus species in root of cassava (*Manihot esculenta* Crantz). *Tropical Science*, 10:149-154.

Dayal, A.D., Diarra, S.S., Lameta, S., Devi, A. and Amosa, F. (2018). High cassava peel meal-based diets with animal fat and enzyme for broilers. *Livestock Research for Rural Development*, 30(6):99.

Duru, S. and Dafwang, I. I. (2010). Effect of maxigrain supplementation of diets with or without rice offal on the performance of broiler chicks. *International Journal of Poultry Science*, 9 (8): 761-764.

Food and Agriculture Organization (FAO) (2014). Crop residues and agro-industrial by-products in West Africa: Situation and way forward for livestock production. Animal Production and health. Rome. *http://www.fao.org/3/i3562e/i3562e.pdf*. Accessed Oct 23 2019

Gillette, K., Thomas, D.K. and Belingham, W.P.A. (1983). Parametric study of flavoured food avoidance in chicks. *Chemical Senses* 8:41-57.

Iyayi, E.A. and Tewe, O.O. (1994). Serum total protein, Urea, and creatinine levels as indices of quality of cassava diets for pigs. *Tropical Veterinary*. 36, 59-67.

Maize Outlook Report (2016). http://www.fao.org/3/ai5703e.pdf&ved=2ahUKEwih2srHtbnkAhVHa8AKHZJaD1kQFjABegQIBBAB&usg=AOvVaw0fiS4vEJZLCu2ZPQnpIRZz

NRCRI. (2023). Agro-meterologic Unit, National Root Crops Research Institute Umudike, Nigeria.

Ogunwole, O.A., Adesope, A.I., Raji, A.A. and Oshibanjo, O.D. (2017). Effect of partial replacement of dietary maize with cassava peel meal on egg quality characteristics of chicken during storage. *Nigerian Journal of Animal Science*, 19 (2):140-152.

Okike, I., Samireddypalle, A., Kaptoge, L., Fauquet, C., Atehnkeng, J., Bandyopadhyay, R., Kulakow, P., Duncan, A. and Blummel, M. (2015). Technical innovations for small-scale producers and households to process wet cassava peels into high quality animal feed ingredients and Aflasafe™ substrate. *Food Chain*, 5:1-2.

Omotosho, O.A. and Sangodoyin, A.Y. (2013). Production and utilization of cassava peel activated carbon in the treatment of effluent from the cassava processing industry. *Water Practice and Technology*, 8:2.

Schmidt, C.J., Persia, M.E., Feierstein, E., Kingham, B. and Saylor, W.W. (2009). Comparison of a modern broiler line and a heritage line unselected since the 1950s. *Poultry Science*, 88:2610-2619.

Saroeun, K. (2010). Feed selection and growth performance of local chickens offered different carbohydrate sources in fresh and dried form supplemented with protein-rich forages. M.Sc. Thesis, Swedish University of Agricultural Sciences, Uppsala, Sweden.

Statistical package for social sciences (SPSS) (2017). Statistical package for social sciences version 25. Windows Microsoft Inc. USA.

Steel, R.G.D. and Torrie, J.H. (1980). Principles and Procedures of Statistics. A Biometrical Approach (2nd edition) McGraw-Hill Book Co. New York.