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Effect of Feeding Unpeeled Cassava Mash as Substitute for Maize in Layers Diet on Egg Quality and Hematological Parameters

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Abstract

The effect of feeding unpeeled cassava mash on layers to evaluate egg quality and hematological indices was investigated with one hundred and fifty birds that were thirty-four weeks old which were randomly allotted to five dietary treatments of 30 birds and replicated twice with fifteen birds each. The experiment lasted for 10 weeks in a Completely Randomized Design (CRD). Treatment 1 (100% maize) serves as control, while treatments 2, 3, 4 and 5 were 25% unpeeled cassava mash, 50% unpeeled cassava mash, 100% unpeeled cassava mash and 25% peeled cassava mash respectively. There was significant ($P<0.05$) difference in shell surface area, Egg length, Egg breadth, Egg shape index, shell thickness and yolk colour score in all the treatments, while other parameters measured were not significantly different. As for Heamatological indices. There was no significant difference in all parameters measured. Haemoglobin (Hb) increased slightly with increased levels of unpeeled cassava mash inclusion. In conclusion replacement of unpeeled maize up to 100% inclusion level has no deleterious effect on the birds but the best result that can compete favourably with maize is 50% inclusion level. Therefore 50% inclusion level is recommended to farmers to maximize production and achieve desired result.

Keywords: Peeled Cassava Mash, Unpeeled Cassava Mash, Maize, Egg Quality Haematological Parameters

Introduction

It is an established fact that Nigerians have not been able to meet their daily protein requirement as compared to developed countries where protein intake is presently put at 4.82g/caput/day as compared to 35g/caput/day recommended by FAO, [1, 2] respectively. As the demand for livestock products (meat, eggs and milk) are increasing daily due to growing human population there is need to bridge the gap of shortage in one way or the other. Poultry products particularly meat and eggs are at potential to meet this demand due to its low feed conversion ratio (FCR) and short rearing period. The major constraint in meeting this noble target is shortage of feed in meeting livestock nutritional requirement as the major conventional feed (Maize) in monogastric production is inadequate to meet human and livestock demand. Maize (Zea mays) has been the most commonly used conventional energy source of plant origin in feed formulation for poultry. It is sometimes highly expensive, limited or at times scarce, also maize and other cereal grains are highly competed for by animals and human as food. Maize remains an integral component of poultry feed and its inclusion in normal diet could be as high as 60% [3]. The availability of maize all year round for poultry feed has reduced, and this could be attributed to competition for maize by humans and animals, reduced production and high cost of maize. These necessitated for urgent need for an alternative. An alternative feed resource that could be used is cassava (Manihot esculenta crantz), peel and unpeeled mash is relatively less competed for and is cheaper than maize. Its adoption will go a long way to reduce protein in-balance, reduce cost of production and maximization of profit. The use of Cassava Plant Meal (CPM) in diets of monogastric animals especially poultry have received consistent attention lately. The crude protein (CP) contents of CPMs although variable are higher than maize [4, 5]. Based on the performance of broiler [6, 7] and laying chickens [4], when fed graded levels of CPM in replacement of maize, it appears that CPM is equivalent or superior to maize as source of energy feed stuff. Research in the use of cassava as diets for poultry is not new, the renewed interest in the recent times could be attributed to the global concern on sustainable poultry production amidst varying climate and its numerous effect on crop production and yield [8, 9]. Nigeria is the highest global production of cassava with mean yield of 63:031 million MT in 2021 [10]. Despite this, adoption of cassava meals in diets of laying birds is yet unpopular due to the poor nutrient content of cassava root meal [11, 8, 9, 12]. Several researches have evaluated the responses of laying birds to different cassava plants parts namely the roots [13, 14, 8, 9, 15]. The variations in the performance of the experimental birds could be the limiting factor presenting widespread use and adoption. Interestingly substantial studies conducted on cassava plant parts showed suitability at some inclusion levels with cost effective advantage. However, [11] suggested the inclusion of all the cassava plant parts to improve the inadequacies of cassava root meal especially in the diets of laying birds as several authors have studied the response of laying birds to cassava diets. Recently, [4] evaluated egg production performance of Isa brown laying chickens fed CPM diets the authors found comparable performance with birds fed maize-based diet. However, growth development and maturation of reproductive birds for onset of egg lay and peak production as well as other egg quality indices are essentially related to nutrition [4]. Laying birds require an excellent plane of nutrition to build the skeletal structure, gain weight and develop their reproductive organs actively between the growth phase of 8 and 19 weeks for Isa brown breed [12, 13]. Much is yet to be done on total replacement with different CPMs products in the diets of laying birds reared from 8 weeks till the end of egg lay and egg production performance. The study seeks to fill the gap and provide information on the effect of feeding unpeeled cassava mash as substitute for maize in layers diet on egg quality and haematological parameters.

Materials and Methods

Study Area

The study was conducted at the Teaching and Research Unit of the College of Agriculture Jalingo, Taraba State, Nigeria (latitude $8^0 53$” longitude $11^0 23$”E) of the equator in savannah zone of Northern Nigeria [8].

Cassava Processing / Plant Meal Product Development

The cassava plant meal products were developed using the protocol of [14]. The cassava used in formulating the diets was harvested and processed according to the above process. The tubers were harvested, washed and chipped and processed into pieces.

Management of Experimental Animals

A total of one hundred and fifty (150) birds of a commercial hybrid of egg producing strain chicken (Isa brown). Management was intensive in cages of a two-tier battery in an open side type poultry house, thus afforded good ventilation and drought free environment, stocking rate was three birds per cage unit. The birds were purchased locally and weighed at the beginning and end of the study. The temperature of the pen was between 32^0C and 34^0C Feed and water were supplied *ad libitum.* Routine and necessary management practices were carried out on the birds as the experiment lasted for ten (10) weeks.

Experimental Design and Diets

The experiment was conducted in a Complete Randomized Design (CRD). There were five dietary treatments with thirty birds each, replicated twice with fifteen birds. Diets were formulated and compounded based on 100kg, consisting of four different levels of peeled and unpeeled cassava mash inclusion. Other ingredients sourced from Jalingo main market. These are the dietary treatments.

Treatment 1 — 100% maize (control).
Treatment 2 — 25% unpeeled cassava mash
Treatment 3 — 50% unpeeled cassava mash
Treatment 4 — 100% unpeeled cassava mash
Treatment 5 — 25% peeled cassava mash

Chemical Analysis

Proximate analysis of the experimental diets was carried out as specified by [15].

External egg quality determination

The egg weight is the weight of the whole egg and it was measured with Amput High Precision weighing balance. The length and width were measured using the digital veneer caliper. The egg shells were air dried for 24 hours after careful breaking and their weight were measured using the Amput High Precision weighing balance. Egg thickness was then measured with the micrometer screw gauge. This was done by measuring the thickness of three point of the egg shell and their average determined.

Internal egg quality determination

Egg was broken on a flat plate, the albumen height was measured using the tripod micrometer. The yolk was then separated from the albumen and the yolk weight was measured using the Amput High Precision weighing balance. Albumen weight was determined by deducting the egg weight from the yolk and shell weight. Yolk height and width were measured with the digital venier caliper. Yolk colour was determined using the DSM colour fan. The egg yolk that was already separated from the albumen were placed on a plain white surface and examined under normal daylight. The DSM colour fan was placed beside it and the intensity yolk colour that matched the yolk colour number was recorded.

Collection and Treatment of Blood Sample

Haemotological analysis was carried out using the blood collected at the end of the experiment. The blood was collected from the wing of three selected birds per treatment group with the aid of needle and syringe. Twelve milliliter of blood was collected from each bird and transferred immediately into a set of sterile plastic bottles with and without anti-coagulant for haematological indices. The analysis was done at Federal Medical Centre, Jalingo.

Data Analysis

The data obtained were analyzed using one-way analysis of variance (ANOVA) while the means are separated using [16] test of [17] package.

Results and Discussions

Table 1 shows the gross composition of the experimental diets, while Table 2 reveals the proximate analysis of cassava mash (Peeled and Unpeeled). As shown in the table, the Dry matter (DM), Crude Protein (CP), Crude Fibre (CF), Ether Extract (EE) and Ash were all better in unpeeled cassava. However, nitrogen free extract (NFE), calcium and phosphorous were better in peeled mash. The higher level of DM, CF, CP and EE in unpeeled mash was due to high levels of these nutrients contained in the peels. This supports the work of [18] that the peels contain a higher level of CP, EE and Ash. The values obtained falls within the range of 1.5-3.5% reported by [19] for CP, 1.3-7.7%, CF, 0.8- 3.2%, EE, 88.0-94.1% NFE and 1.6% Ash. The proximate analysis of the experimental diets is as shown in Table 3. The crude protein range of 16.38-17.92% is slightly less than the range of 18.00-20.00% recommend by [20], Table 4 reveals the results of egg quality parameters.

Shell Surface Area

There were significant (p<0.05) difference between means of diets 1 (control) and that of diet 3 and 4 but the difference among the means of diets 2, 3, 4 and 5 were not significant (P>0.05)1and also diets 1, 2, and 5 were not significantly different. Diet 1 (control — 100% maize) had the highest value which is 74.21 followed by diet 5 (25% cassava peel mash) 73.74 and diet 3 (50% unpeeled cassava mash) had the least value of 70.91. This is in agreement with [27].

Egg Length (CM)

There was significant (P<0.05) different between means of diet 1 (control) and diet 2 but there were no significant difference among treatments 2, 3, 4 and 5 (cassava based diets) respectively. Meanwhile, treatment 1 (control) had the highest egg length mean value of 5.81cm while treatment 2 had the lowest mean value of 5.58cm. It's worthy of note here also that egg length increased with increased inclusion levels of cassava. This result is in conformity with [28].

Egg Breadth (CM)

The result of analysis of variance for egg breath indicated that diet 4 was significantly (P<0.05) different from dietary treatments 1, 2 and 5. However, there were no significant difference among treatment 1, 2, 3 and from 3, 4 and 5 respectively. The highest egg breadth mean value of 4.32cm was recorded for treatment 4. Treatments 2, 3 and 5 recorded the following values 4.31, 4.21 and 4.30cm respectively. The result is also in consonant with [34].

Egg shape index

The values obtained for the effects of treatment on the egg shape index did not follow any pattern. Egg from diet 2 (25% unpeeled cassava mash) had the highest value of 0.77 and egg obtained from birds fed diets 4 had a value of 0.75 which is the lowest. Treatment 2 was significantly (P<0.05) different from the means of treatment 3 and 4. However, there were no significant differences among the means of treatment 1, 3, 4 and 5 respectively. This is also in agreement with [34].

Yolk Weight (g) and Percentage (%)

Yolk weight of eggs obtained from birds fed diets 1 (Control) had the highest value, but the highest value for yolk percentage was recorded for eggs obtained from birds fed diet 3 (50% unpeeled cassava mash). The values obtained for the five treatment were 15.03g (25.31%), 14.18g (24.65%), 14.14g (25.45%), 14.15g (25.40%) and 14.58g (24.80%). There were no significant (P>0.05) differences among the means of the five treatments for yolk weight and yolk percentage. Result obtained is also in agreement with [27].

Yolk Height (cm)

There were no significant (P>0.05) differences among all treatments as regard their effect on yolk height. The values obtained for the effect of dietary treatments on the yolk height however did not follow any pattern. Yolk height of eggs obtained from birds fed 100% maize mash (diet 1 - control) and birds fed 25% peeled cassava mash had the highest values of 1 .66cm each and followed by eggs from birds fed with 50% unpeeled cassava mash (diet 3), so also the yolk height of eggs obtained from birds fed diet 2 and 4 is 1.63cm each. The result concur with [29].

Albumen weight (g) and percentage (%)

The values obtained for the five treatments are 37.69% (63.73%), 37.00g (64.4S%) 35.22g (64.32%), 34.68g (62.23%) and 37.66g (63.93%). There were no significant differences among the five treatments. Eggs of birds fed diet 1 had the biggest albumen weight of 37.96g followed by eggs of birds fed diet 5 with 37.66g and least value obtained diet 4. However, the situation was not the same for albumen percentages. Diet 2 had the highest albumen percentage of 64.48%, followed by eggs of diet 3 and the least value of 62.23% was obtained from eggs of diet 4. The result also concur with [29].

Shell Weight (g) and Percentage b(%)

There were no significant differences among the mean values of shell weight and percentage of eggs obtained from birds fed the five diets. The mean values of the eggs shell weight and percentage of eggs obtained from birds fed diet 4 were the highest and those of diet 2 were the lowest. This result is in conflict with yolk weight and percentage, in which diet that had the highest weight was different from the diet that had highest yolk percentage. There were no significant differences between the values as obtained by [28].

Shell Thickness (mm)

Diet 4 was significantly (P<0.05) different from mean values of treatment 2 and 3. Also no significant difference was observed between treatments 1 and 5 shell thickness of eggs produced by birds fed dietary treatments 1-5 were 0.40, 0.36, 0.37, 0.41 and 0.38 respectively. The highest value was recorded in treatment 4 and the lowest value was recorded in treatment 3. The shell thickness is positively affected by the diet as also obtained by [28].

Yolk Colour Score

There was significant (P<0.05) different between the mean value of treatment 2 and 3 as regards their effect on yolk colour but no significant differences were observed among the mean values of treatments 1, 2, 3 and 5 respectively. Yolk of eggs obtained from birds fed diet 2 had the highest score of 3.40 followed by eggs from diets 5 (3.07) and the least yolk colour score of 1.04 was obtained from eggs of birds fed diets 4. The significant difference among the treatment means of shell surface area, egg length egg breadth and egg shape index was due to differences shown by egg weight and that is in agreement with [9] on similar study. The non-significant difference observed among treatment means of yolk height, weight and percentage parameters followed the same trend exhibited in the mean values of egg weight. The parameter could therefore be related to egg weight since these factors are not affected by dietary diets among the five treatment means, yolk height, weight and percentage values should also not be affected by the diet. This is also in line with what was reported by [21] and [22] on similar work. The average shell thickness supports the works of [23] and [9] that the average shell thickness of domestic fowl is about 0.3 4mm, also values obtained for albumen weight and percentage shell weight and percentage were in the same range with the values of

0.30-0.65 and 0.20-0.60 given by [9] and [23] respectively. The diet does not affect yolk colouration in all the dietary treatment, this can be attributed to the fact that both cassava and maize have the same effect on yolk colouration in agreement with [22]. The result of the heaeamato1ogical analysis of blood sample of layers fed unpeeled cassava mash as a replacement of maize diet is as shown in Table 5. There were significant (P<0.05) difference in PCV, Hb, WBC, Lymphocytes, MCV, MCH and MCHC and also within treatments with the increase of unpeeled cassava mash in the diets. Haemaghobin (Hb), Red Blood Cell (RBC), White Blood Cell (WBC) and Packed Cell Volume (PCV) increased significantly (P<0.05) and this agrees with the result of [24]. The slight variation in haemoglobing value measured tends to confirm that diets affect the blood profile of layers. The values obtained for PCV, MCV and MCH are significantly different as the amount of unpeeled cassava replacement increases (P<0.05). Packed Cell Volume (PCV), Haemodobin (Hb), Red Blood Cell (RBC), Mean Cell Volume (MCV) Mean Cell hemoglobin (MCH) and Mean Cell haemoglobin concentration (MCHC) fell within the values reported by [25, 24, 26, 27]. Most parameters fall within the range of healthy birds as confirmed by [28].

Conclusion and Recommendation

From the result of this experiment unpeeled cassava mash at three levels of inclusion (25%, 50% and 100%) can compete favourably well with maize in supporting egg production and quality. At 50% level of inclusion results tended to be better than 100% inclusion considering egg weight and other parameters and there was no deleterious effect on haematology.

It is therefore recommended that unpeeled cassava mash can be used by farmers at 50% inclusion level to replace maize in layers diet since it is cheaper.

Table 1: Gross composition of the experiment diets

Ingredients (%)	Dietary Treatments				
	1	2	3	4	5
Maize	41.9	32.4	22	-	32.4
Unpeeled cassava mash	-	10.0	22	46	-
Cassava mash peeled	-	-	-	-	10.0
Corn bran	13	12	8	5.0	12
PKC	10	10	10	8.4	12
BDG	7.5	5.0	4	-	5
Soya	14	15	17	19	15
Roasted soya	2	4	5.4	10	4
Fish meal	1.5	1.5	1.5	1.5	1.5
Oyster shell	7.5	7.5	7.5	7.5	7.5
Bone	2	2	2	2	2
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.1	0.1	0.1	0.1	0.1
Calculated energy	2598.5	2600	2599.1	2599.6	2600
Calculated protein	16.7	16.7	16.7	16.6	16.7

Premix per kg supplied 800iu vitamin A, 1200 vitamin D_3, 11mg vitamin E, 2mg vitamin K_3, 7mg riboflavin, 10mg nicotinic acid, 7mg pantothenic acid, 0.08mg cobalamin, 900mg choline, 1.5mg folic acid, 1.5mg biotin, 125mg antioxidant (santoquin) 25mg Fe, 80mg Mn, 2mg Cu, 50mg Zn, 1.2mg I, 0.2mg Co and 0.1mg Se.

Table 2: Proximate analysis of Cassava mash (Peeled and Unpeeled)

Parameter of Cassava	Peeled (%)	Unpeeled (%)
Dry matter	86.78	88.65
Crude Protein	1.54	4.06
Crude fibre	1.3	9.95
Ether extract	0.7	1.45
Ash	1.32	3.06
NFE	95.14	81.48
Calcium	0.13	0.18
Phosphorus	0.10	0.09
Cyanide (ppm/mg/kg)	59.4	91.08

Table 3: Proximate Analysis of the Experimental Diets

Nutrient Composition (%)	Dietary Treatments				
	1	2	3	4	5
Dry matter (DM)	90.62	91.03	90.23	90.00	89.84
Crude Protein (CP)	17.92	16.94	17.50	16.38	17.22
Crude fibre (CF)	3.84	5.65	4.94	5.99	3.68
Ether extract (EE)	3.70	5.20	4.85	4.05	4.78
Ash	9.64	7.87	9.83	6.89	12.24
NFE	64.90	64.34	63.88	66.69	62.10
Calcium	3.92	3.90	3.78	3.82	3.95
Phosphorus	0.65	0.53	0.54	0.64	0.60

Table 4: Egg quality parameters

Parameters	Treatments				
	1	2	3	4	5
Shell surface area	74.21^{a}	72.47^{ab}	70.91^{b}	71.01^{b}	73.74^{ab}
Egg length	5.81^{a}	5.58^{b}	5.61^{ab}	5.64^{ab}	5.69^{ab}
Egg breadth	4.32^{a}	4.31^{a}	4.21^{bc}	4.20^{c}	4.30^{ab}
Egg shape index	0.76^{ab}	0.77^{a}	0.75^{b}	0.75^{b}	0.76^{ab}
Yolk weight	15.03	14.19	14.14	14.15	14.58
Yolk percentage	25.31	24.65	25.43	25.40	24.80
Yolk height	1.66	1.63	1.64	1.63	1.66

Albumen weight	37.96	37.00	35.21	34.68	37.66
Albumen percentage	63.73	64.48	64.32	62.23	63.93
Shell weight	6.51	6.24	6.27	6.92	6.63
Shell percentage	10.96	10.87	11.25	12.37	11.27
Shell thickness	0.40[ab]	0.36[b]	0.37[b]	0.41[a]	0.38[ab]
Yolk colour score	2.64[ab]	3.40[a]	2.89[ab]	1.04[a]	3.06[ab]

Table 5: Haematological analysis of blood sample of layers fed unpeeled cassava mash maize replacement

Layers feeding groups	Treatments					
	1	2	3	4	5	6
	(100%) maize	(25%) unpeeled mash	(50%) unpeeled mash	(100%) unpeeled mash	(25%) peeled mash	S.E.M
PCV (%)	27[a]	32[bc]	37[c]	42[d]	51[cde]	1.26
Hb (g/1)	7.7[a]	8.7[a]	9.2[a]	9.4[a]	9.1[a]	0.65
RBC (X10^9/L)	2.49[a]	2.88[a]	3.20[ab]	3.90[b]	4.52[cd]	0.85
Neutrophils	11	12	22	14	24	2.25
Lymphocytes	62[a]	72[b]	82[c]	83[c]	87[d]	1.87
Monocytes	-	-	-	-	-	
Basophils	03	02	02	01	-	0.04
MCV	128[a]	131.8[b]	135.3[c]	128.2[a]	132.1[b]	0.89
MCH (pg)	47.9[c]	45.7[b]	45.3[a]	44.8[a]	44.7[a]	0.67
MCHC (%)	35.7[a]	34.6[a]	34.2[a]	33.8[a]	33.5[a]	0.35

[abcd] means with different superscripts in a row are significantly different ($P<0.05$).

RBC – Red Blood Cell; WBC – White Blood Cell; MCV – Mean Cell Volume; MCH - Mean Cell Haemoglobin; MCHC – Mean Cell Haemoglobin Concentration; HB – Haemoglobin; PCV – Packed Cell Volume; CPM – Unpeeled Cassava Mash.

References

1. Aderemi FA, Lawal TE, Iyayi EA. Nutritional value of Bio-degraded cassava root sieriates (CRS) and its utilization by layers. Journal of Food Technology. 2006; 4(3):216-220.
2. FAO. Food and Agricultural Organization of the United Nation – Slaughter of livestock. In: Heinz G and Srisuvan T. (Ed). Guidelines for human handling transport and slaughter of livestock - chapter 7, 2001.
3. Ogunwole OA, Lawal HO, Idowu AI, Oladimeji SO, Abayomi FD, Tewe OO. Carcass Characteristics, Proximate, Composition and Residual Retinol in Meal of Broiler Chickens Fed - Carotene Cassava (Manihot Esculenta Erantz) grits-based diets. Journal of Animal Production Research. 2016; 28(2):102-117. ISSN 0189-0514.
4. Ogundeji ST, Akinfala EO. Egg production performance and egg quality of laying birds fed cassava plant meal based diet. Nigerian Journal of Animal Science. 2020; 22(1):289-297.
5. Aderemi FA, Adenoiwo TK, Oguntunji AO. Effect of whole cassava meal on performance and egg quality characteristics of layers. Journal of Agric Science. 2012; 4:195-200.
6. Akinfala EO, Aderibigbe AO, Matanmi O. Evaluation of the nutritive value of whole cassava plants as replacement for maize in the starter diets for broiler chicken. Livestock Research Rural Development. 2002; 14:6.
7. Mantanmi O, Akinfala EO, Aderibigbe AO, Akinsuyi MA. Response of cockerel fed whole Cassava Plant Meal based Diet in the Humid Tropics. Tropics Journal of Animal Science. 2004; 7(1):83-89.
8. Taraba State Official Diary (TRSD), 2008.
9. Tewe OO. Indices of cassava safety for livestock feeding: Being Paper in International ACTA Horticulture Workshop on Cassava Safety. IITA Ibadan, 1994, 241-248.
10. Tewe OO, Kasali OBN. Effect of cassava peel processing on the nutrient utilization and physiopathology of the African giant rat (Cricetomus gambianus). Water house tropical agriculture. Trinidad. 1982; 63(2):125-128.
11. Salami RI, Odunsi AA. Evaluation of processed cassava peel meals as substitutes for maize in the diets of layers. International Journal of Poultry Science. 2003; 2(2):112-116.
12. Anaeto M, Sawyerr AF, Alli TR, Tayo GO, Adeyeye JA, Olarinmoye AO. Cassava leaf silage and cassava peel as dry season feed for West African dwarf sheep. Global Journal of Science Frontier Research Agriculture Veterinary Science. 2013; 13(2):1-4.
13. Morgan NK, Choct M. Cassava: Nutrient Composition and nutrient value in poultry diets. Animal Nutrition Journal. 2016; 2:253-261.
14. Okrathok S, Sirisopapong M, Mermilled P, Khempaka S. Modified dietary fibre from cassava pulp affects the cecal microbial population, short-chain fatty acid and ammonia production in broiler chickens. Poultry science. 2023; 102(1):102265. https://www.sciencedirect.com/science/article/pii/50032579122005612
15. FAOSTA. A cassava industrial revolution, 2023. https://www.fao.org/3/y5548e/y5548e07.htm
16. Adekanye TA, Ogunjimi SI, Ajala AO. An assessment of cassava processing plants in Irepodun Local Government Areas, Kwara State Nigeria. World Journal of Agricultural Research. 2013; 1(1):14-17.
17. Bakere AG, Zindove TJ, Iji PA, Stamatopoules K, Cowieson AJ. A review of limitations to using cassava meal in poultry diets and the potential role of exogenous microbial enzymes. Tropical Animal Health Production. 2001; 53(4):426. Doi: 10.100%/511250 – 021 - 02853 - 6 PMID: 3433 8935.
18. Kana JR, Kreman K, Mube KH, Teguia A, Manjeli V. Effect of substituting maize with cassava root meal on laying performances of local breed chickens under informed management condition in Cameroon.

Livestock Research for Rural Development. 2013; 25(177). Retrieved March 31, from: https://www./rrd.org/irrd25/10/kana25177htm
19. Kyawt Y, Hidemi T, Win MH, Sarayut T, Yoshimi I, Yasuhiro K. Effect of cassava substitute for maize based diets on performance characteristics and egg quality of laying hens. International Journal of poultry Science. 2014; 13:518-524.
20. Chanaksom M, Boonkaewwan C, Kayan A, Gongruttananum N. Evaluation of molt induction using cassava meal varying the length of feeding period in order (90 weeks laying hens> poultry science, 2019. 98.103382/ps/pez 110.
21. Simao A, Santos M, Fraguas R, Braga M, Margues T, Duarte M, *et al*. Antoxidants and Chlorophyll in cassava leaves at three plant ages. African Journal of Agricultural research. 2013; 8:3724-3730. Doi: 10.5897/AJAR 6746.
22. Ogunwole OA, Adesope Al, Raji AA, Oshinbanjo OD. Effect of partial replacement of dietary maize with cassava peel on egg quality characteristics of chicken during storage. Nigeria Journal of Animal Science. 20l7; (2):140-152.
23. Akinfala EO, Tewe OO. Utilization of whole cassava plant by growing pigs in the tropics. Livestock Research Rural Development. 2004; (13)5:14-18. http:www.cipav.org.co/irrd12.htm.
24. Bendezu HCP, Sakomura NK, Venturini KS, Sato J, Haschild L, Matheiros EB, *et al*. Response of laying hens to amino acids intake. In: N.K Sakomura. R.M. Gous, I: Kyriagakis, and L. Hauschild (Eds), Nutritional modelling for pig and poultry (Vol. 1, PP 259-268) wallingford, UK. CAB International, 2015.
25. Anene DO, Akter Y, Thomso PC, Groves P, O'shea CJ. Variation and Association of Hen Performance and Egg Quality traits in individual Early-laying ISA Brown Hens Animals MDPIAG. 2020; 10(9):1601. Retrieved from http://dx-doi.org/10.3390/ani10091601.
26. Akinfala EO, Aderibigbe AO, Matanmi O. Evaluation of the Nutritive value of whole cassava plant as a replacement for maize in the starter diets for broiler chicken. Livestock Research Rural Development. 2002; 14:l-6.
27. AOAC. Official methods of Analysis of Association of official Analytical Chemists. 18th Edition, Washington, D.C, 1990.
28. Duncan DB. Multiple range of multiple F-tests Biometrics. 1955; 11:1-42.
29. SAS. SAS user's guide version 9.1 for windows, Statistical Analysis, 2009.
30. Smith OB. A review of ruminant responses to cassava-based diets. In: Proceeding of the JITA/ILCA University of lbadan workshop on the potential utilization of cassava as a livestock feed in Africa. IITA, Ibadan, Nigeria, 2002, 14-18.
31. Olomu JM. Monogastric Animal Nutrition Principles and Practice. 2nd Edition ISBN 984-2692-53 0 Jackson publishing, 1995, 224.
32. Ogunwole OA, Adesope AI, Raji AA, Oshinbanjo OD. Effect of Partial Replacement of Dietary Maize with cassava peel meal on egg quality characteristics of chicken during storage. Nigerian Journal of Animal Science. 2017; (2):140-152.
33. Ogundeii ST, Akinfala EO. Egg Production Performance and Egg laying birds fed cassava plant meal based diet. Nigerian Journal of Animal Science. 2020; 22(1):289-297.
34. Anaeto M, Adighibe LG. Cassava Root Meal as Substitute for maize layers Ration. Brazilian Journal of poultry Science, 2011. ISSN 1516-635x Vo1.13/n.2/53-156.
35. Oluyemi JA, Robert FA. Poultry production in warm wet climate. Macmillan Publishers, London and Basing stoke, 2009, 197.
36. Tewe OO, Egbunike GN. Utilization of cassava in non-ruminant feeding. In: Cassava. Cassava as livestock feed in Africa (SK. Hahn, L. Reynolds and G.N. Egbunike (Eds). IITA. Ibadan and ILCA, Addisaba, 2009, 28-3.
37. Muhammed NO, Oloyede OB. Haematological parameters of Broiler chicks fed Aspergillusniger-fermented Terminalia Catappa Seed Meal-based diet. Global Journal of Technology Owerri, 2009, 254.
38. Post JJJ, Rebel MJ, Terhuune AAHM. Automated Blood cell count. A sensitive and reliable method to study corticesterone. Related stress in Broilers, ID - Lelystad Institute for Animal Science and Health Lelystad. The Netherlands, 2007, 777-781.
39. Adeyemo IA, Sani A. Haemotological parameters and serum Biochemical indices of Broiler chickens fed Aspergillus Niger Hydrolyzed cassava peel meal based diet. IJRRAS. 2013; 15(3). Vol. 151 issue 3 .24 pdf.
40. Asaniyan EK. Performance and egg quality parameters of laying chickens fed cassava (Manihot esculenta) plant meals based diet research square, 2023. Doi: https//doi.org/10.21203/rs-2816419/v1.