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Effects of Replacement of Maize With Graded Levels of Cassava Grit on Growth Performance, Nutrient Utilization and Carcass Characteristics of Broiler Chickens

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Abstract: **The study was carried out to determine the effects of substituting maize with graded levels of cassava grit on performance, nutrient digestibility and carcass analysis of broiler chicken. Experimental diets were formulated such that maize was substituted with cassava grit at 0, 20, 40, 60, 80, and 100% replacement levels. A total of one hundred and eighty day old broiler chicks were equally and randomly allotted to the treatments. Daily feed intake and weekly weight gain were monitored while feed conversion ratio was estimated. At the 8th week, faecal samples were collected, dried and analyzed to determine the nutrient composition, thereafter used for nutrient digestibility. Data were also collected on organs and carcass weights. Gradual decrease in proximate composition of diet was recorded as the replacement level of cassava grit increased. The final weight, total weight gain and daily weight gain decreased significantly (P<0.05) as the replacement levels of cassava grit increased. The feed conversation ratio (FCR) increased (P<0.05) as the replacement level increased, only 40% replacement level was statistically (P>0.05) similar to the control. The result of nutrient digestibility was not consistent with replacement levels although better nutrient digestibility (P<0.05) was recorded for the cassava grit compared to the control. Cassava grit had significant (P<0.05) influence on all carcass components' proportions except head. The proportion of primal cuts especially the breast and thigh were significantly (P<0.05) enhanced by the test ingredient with T_3 (40% inclusion level) most favoured. Organ proportion to the live weight were also influenced (P<0.05) but no definite trend was followed and the values obtained up to 60% replacement were mostly similar (P>0.05) to that of control. It could therefore be concluded that the use of cassava grit up to 40% replacement level could be adopted since it has the most favourable FCR and promising primal cuts.**

Keywords: **Maize, Cassava Grit, Broiler, Performance and Primal Cuts**

I. Introduction

Poultry production as an aspect of livestock production is important to the biological needs, economic and social development of the people in any nation [1]. Its products edible (meat and egg) are considered as one of the most popular food in Nigeria, because there is neither taboo nor a cultural practice that is against their production and consumption. Its development has also been described as the fastest means of bridging the protein deficiency gap prevailing in most of the developing countries. It could also serve as a source of foreign earnings complementing crude oil; if properly harness [2]. Despite the acknowledged importance of poultry production, it is characterized by low production level due to limited finance for the procurement of basic poultry equipment and input materials especially feed [3]. Poultry usually consume just enough feed to meet their nutrient requirements especially energy requirement. This control intake is based primarily on the energy in the diet. Thus, increasing the concentration of dietary energy will decrease feed intake. However, ingredients involve in energy provision are very expensive which in turn influence the production cost of the birds. This has called for research to identify cheaper and local available energy feeding stuff in Nigeria.

The use of cassava and its products as an alternative feed ingredient of energy source goes a long way in reducing the feed cost [4]. It can be processed into different products and by-products. Some of which are Garri, Starch, Cassava flour, Tapioca, Flakes and Cassava grit. A well processed dried cassava meal stands readily as an alternative feeds [5]. Cassava grit is a by-product of garri processing plant which has been known to be an energy feedstuff, popularly used as a staple food in Sahara Africa diet [6].This research study therefore was designed to investigate and evaluate the potential of the cassava product (Cassava grit) as an energy source feed ingredient in broiler diet.

II. Materials and Methods

Location:

The study was carried out at the Broiler section of poultry unit of Teaching and Research Farm, Ladoke

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Akintola University of Technology, Ogbomoso, Oyo State, Nigeria.

Source of Test Ingredient:

The cassava grit used was procured at garri processing Centre, Arada Market Ogbomoso, Oyo State, Nigeria. The tuber was peeled off, grated and pressed for three days, during which fermentation sets in. On the fourth day, the pressed cassava was roasted and then sieved. The shaft that failed to pass through the sieve was the test ingredient (cassava grit) used.

Proximate composition carried out revealed that cassava grit, like other products from cassava tuber, had low crude protein (3.73%), crude fibre (4.05%), ether extract (1.65%), NFE (71.69%) and metabolizable energy was calculated to be 2890.61 kcal/kg, using Pauzenga's equation for metabolizable energy; (M.E(Kcal/kg) = 37 x %CP + 81.8 x %Fat + 35.5 x %NFE) [7].

Other bulk ingredients were purchased from reputable feed mill stores in Ogbomoso.

Formulation of Experimental Diets:

Diets were formulated such that, Diet 1 (0%) served as control, while diets 2, 3, 4, 5 and 6 contain 20, 40, 60, 80, and 100% cassava grit respectively (Table 1).

Table 1: Gross composition of experimental broiler diets (g/100g DM)

Ingredients	Starter Diets						Finisher Diets					
	T_1	T_2	T_3	T_4	T_5	T_6	T_1	T_2	T_3	T_4	T_5	T_6
Maize	50	40	30	20	10	0	45	36	27	18	9	0
Cassava grit	0	10	20	30	40	50	0	9	18	27	36	45
Fixed ingredient	50	50	50	50	50	50	55	55	55	55	55	55
Total	100	100	100	100	100	100	100	100	100	100	100	100
Laboratory Analysis of finisher diets												
Calculated CP (%)	22.28	22.03	21.79	21.43	21.29	20.95	20.98	20.71	20.41	20.13	19.87	19.68
Calculated ME (kcal/ g diet)	3.186	2.956	2.873	2.814	2.795	2.779	2.983	2.946	2.867	2.828	2.784	2.742

CP = crude protein, ME = metabolizable energy and fixed ingredient = Groundnut cake, Soya, Maize offal, Fish, meal, Oyster shell, bone meal, lysine.

T_1= control, T_2, T_3, T_4, T_5 and T_6= 0%, 20%, 40%, 60%, 80% and 100% cassava grit replacement level respectively. The fixed ingredients were adjusted for balance of the percentage CP

Experimental Animals:

A total of one hundred and eighty (180) day old broiler chicks were procured for the experiment. They were randomly distributed to six treatments of 30 birds per treatment. Each treatment was sub divided into three replicates of 10 birds per replicate in a completely randomized design. The birds were given all the managerial practices required by broiler under intensive production system as at when due. Feed and water were supplied *ad-libitum* throughout the experimental period. Feed supplied were weighed and the left over in the feeder were also weighed to determine feed intake.

Data Collection:

The birds' weight and feed consumed were determined on weekly basis and the following parameters were calculated: average daily feed intake, average daily weight gain and feed conversion. At the commencement of 8th week, faecal samples were collected from two randomly selected birds per replicate. The faeces were oven-dried, weighed and analysed for nutrient composition. The nutrient composition obtained from the faeces and feed were used to calculate the nutrient digestibility.

At the end of studying period (8 weeks) two birds per replicate were randomly selected, tagged, starved for 12 hours in the presence of abundant water, they were then slaughtered, eviscerated and cut to parts. Live weight, slaughtered weight, carcass weight as well as weight of the liver, lungs, kidney, heart, spleen, head, neck, backs, breast, wing, drumstick, shank, thigh and abdominal fat were recorded and used to determine their respective proportions.

Chemical Analysis:

Samples of experimental diets as well as the faeces were analyzed for CP using Kjedahl procedure/technique, CF using distillation method, EE using Soxhlet extraction procedure and GE using Gallenkamp Ballistic Bomo Calorimeter, all as described in the procedure of AOAC [8].

Statistical Analysis:

Data collected were subjected to analysis of variance using SAS [9] package software and the means that were significant were separated using Duncan multiple range test of the same software.

III. Results

Gradual decrease in the mean value of proximate composition of the experimental diets was observed (table 1) both at starter and finisher diets. However, the values still fall within the recommended range of nutrient requirement of broiler bird.

Table 2 shows the performance characteristics of the birds fed the experimental diets. The results revealed that feed intake was not affected (P>0.05) by the level of inclusion of cassava grit. However, reverse was the case with final weight, weight gain and daily weight gain. The experimental birds fed control diet had better (P<0.05) daily gain compared to those birds placed on the diet with

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test ingredients. These parameters were observed to be decreased (P<0.05) as the inclusion level increased. Feed conversion ratio increased (P<0.05) as the inclusion level of cassava grit increased.

Similarly, significant differences (P<0.05) were recorded in the nutrients digestibility of broiler birds fed cassava grit based diets (Table 3). There was a significant (P<0.05) difference in the dry matter digestibility (DMD) across the treatments, it increased as the inclusion level of the test ingredient increases up to 80% (T_5) replacement levels and higher than the control even at 100% maize replacement level. A similar trend observed in CPD, EED and NFE. The CFD decreased (P<0.05) significantly as the inclusion level increased while Ash and GED had no definite trend but significantly (P<0.05) influenced.

Average slaughtered weight of experimental birds obtained from T_1, T_2, T_3 and T_4 (1453.01g, 1571.50g, 1546.42 and 1575. 93g respectively) were statistically similar (P>0.05) and higher than those recorded from treatments T_5 and T_6 (Table 4). T_6 recorded the least value (1249.89). Similar trend was observed from scalded and carcass weight. The proportion of head to carcass weight was not influenced (P>0.05) by the dietary inclusion level of cassava grit. While other cut parts were all significantly (P<0.05) affected by varying inclusion levels of cassava grit. Significantly (P<0.05) higher proportion of breast and thigh which were even higher than the control was obtained from 40% inclusion level. The abdominal fat of birds fed treatments 2, 3, 4, and 5 (2.06%, 1.19%, 2.07% and 1.17% respectively) were similar (P>0.05) to that of control which was statistically (P<0.05) different from treatment 6 (2.24%).

Table 5 shows relative organ characteristics of broiler fed varying inclusion level of cassava grit. Gizzard was significantly (P<0.05) influenced. It decreased as the inclusion level increased. The liver had highest proportion (3.34% of body weight) at 100% replacement level and this was similar (P<0.05) to T_1 and T_4 (3.29% and 3.33%). The least proportion (2.49%) was recorded at T_3 (40% replacement level). Lungs of highest proportion (0.91%) was recorded at T_4 though statistically (P>0.05) similar to T_1, T_3, and T_5. Kidney had same proportion (0.95%) at T_3 and T_6 while highest proportion was recorded for T_1 (1.04%), indicating that the variation cannot be totally attributed to the use of cassava grit.

Table 2: Growth performance characteristics of broiler chicken on experimental diet

Parameter	T_1	T_2	T_3	T_4	T_5	T_6	SEM
Initial weight (g)	47.29	45.96	46.11	48.09	43.60	44.08	0.54
Average daily Feed intake(g)	135.01	148.07	132.12	131.94	148.13	129.96	6.12
Final weight(g)	1483.33^{a}	1136.67^{b}	1163.33^{b}	1073.33^{bc}	976.76^{c}	950.00^{c}	34.78
Weight gain(g)	1436.05^{a}	1090.71^{b}	1117.22^{b}	1025.24^{bc}	933.06^{c}	905.92^{c}	34.78
Average Daily gain(g)	25.64^{a}	19.48^{b}	19.95^{b}	19.31^{c}	16.66^{c}	16.18^{c}	0.62
FCR	5.40^{a}	7.71^{b}	6.69^{ab}	7.67^{b}	9.28^{c}	8.35^{c}	0.49

^{a,b,c} means on the same row with different superscripts were significantly different (P<0.05)
T_1= control, T_2, T_3, T_4, T_5 and T_6= 0%, 20%, 40%, 60%, 80% and 100% cassava grit replacement level respectively.

Table 3: Nutrient digestibility of broiler chickens fed Cassava Grit based diets

Parameter(%)	T_1	T_2	T_3	T_4	T_5	T_6	SEM
DMD	57.22^{b}	71.64^{ab}	68.84^{ab}	68.53^{ab}	80.76^{a}	78.74^{a}	2.51
CPD	61.93^{b}	73.89^{ab}	68.76^{ab}	69.25^{ab}	77.55^{a}	78.90^{a}	2.24
EED	81.57^{b}	86.85^{ab}	84.51^{ab}	83.40^{ab}	90.02^{a}	98.46^{ab}	1.11
CFD	51.76^{a}	49.23^{ab}	$45.43.^{b}$	45.34^{b}	45.29^{b}	45.19^{b}	11.49
ASH	28.90^{b}	51.85^{ab}	48.49^{ab}	43.69^{ab}	65.98^{a}	62.20^{a}	4.49
NFED	68.39^{b}	79.74^{ab}	78.59^{ab}	78.59^{ab}	87.05^{a}	85.69^{a}	1.88
GED	83.56^{b}	89.25^{ab}	87.88^{ab}	86.97^{ab}	92.59^{a}	91.45^{a}	0.81

^{a,b,c} means on the same row with different superscripts were significant (P<0.05).CPC = Crude protein digestibility, SEM = Standard Error of Means, DMD = Dry Matter Digestibility, EED = ether Extract digestibility. CFD = Crude fibre digestibility, NFED= nitrogen free extract digestibility, GED= gross energy defensibility.
T_1= control, T_2, T_3, T_4, T_5 and T_6= 0%, 20%, 40%, 60%, 80% and 100% cassava grit replacement level respectively.

Table 4: Carcass characteristics of broilers fed varying levels of cassava grit based diets

Parameter	T_1	T_2	T_3	T_4	T_5	T_6	SEM
Slaughtered wt (g)	1453.01^{a}	1571.50^{a}	1546.42^{a}	1575.93^{a}	1283.95^{b}	1249.89^{b}	59.45
Scalded wt (g)	1117.70^{a}	1208.90^{a}	1189.55^{a}	1212.25^{a}	987.65^{b}	961.45^{b}	49.30
Carcass wt (g)	879.95^{ab}	946.55^{a}	967.60^{a}	922.90^{a}	783.30^{bc}	766.20^{c}	20.22
Head (%)	4.18	3.94	4.23	3.82	4.14	4.27	0.17
Neck (%)	5.38^{a}	4.37^{ab}	4.05^{b}	4.04^{b}	4.40^{ab}	5.20^{a}	0.26

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Back (%)	13.42^{c}	12.51^{d}	15.09^{a}	14.40^{ab}	15.20^{a}	14.17^{bc}	0.04
Breast (%)	17.99^{b}	15.88^{d}	19.47^{a}	17.38^{bc}	17.61^{b}	16.17^{cd}	0.26
Wing %)	9.65^{c}	12.62^{a}	9.47^{c}	9.15^{c}	10.18^{c}	11.39^{b}	0.22
Drumstick (%)	10.99^{a}	10.77^{ab}	10.40^{b}	10.02^{bc}	9.84^{c}	10.50^{abc}	0.17
Thigh (%)	11.71^{b}	12.90^{a}	12.78^{a}	11.79^{b}	12.51^{ab}	12.18^{ab}	0.21
Shank (%)	5.38^{b}	5.38^{b}	5.67^{ab}	5.73^{ab}	5.75^{ab}	5.86^{a}	0.14
Abdominal fat (%)	0.19^{b}	2.06^{ab}	1.19^{ab}	2.07^{ab}	1.17^{ab}	2.24^{a}	0.46

^{abc} means within rows with different superscripts differed significantly (P<0.05), CG=cassava grit.
T_1= control, T_2, T_3, T_4, T_5 and T_6= 10%, 20%, 40%, 60%, 80% and 100% cassava grit replacement level respectively.

Table 5: Organ characteristics of broilers fed varying levels of cassava grit based diets.

Parameter (%body weight)	T_1	T_2	T_3	T_4	T_5	T_6	Sem
Gizzard (%)	3.29^{a}	2.73^{b}	2.62^{b}	2.51^{b}	2.50^{b}	2.33^{b}	0.05
Liver (%)	3.21^{a}	2.93^{ab}	2.49^{c}	3.33^{a}	2.84^{bc}	3.34^{a}	0.09
Lung (%)	0.90^{a}	0.73^{b}	0.87^{a}	0.91^{a}	0.88^{a}	0.76^{b}	0.05
Kidney (%)	1.04^{ab}	0.96^{abc}	0.95^{bc}	1.06^{a}	0.87^{c}	0.95^{bc}	0.07
Heart (%)	0.57^{a}	0.44^{b}	0.64^{a}	0.59^{a}	0.64^{a}	0.49^{b}	0.03
Spleen (%)	0.20^{a}	0.11^{c}	0.13^{bc}	0.18^{a}	0.17^{ab}	0.16^{ab}	0.03
Proventiculus (%)	0.61^{b}	0.73^{a}	0.58^{b}	0.75^{a}	0.55^{b}	0.60^{b}	0.03

^{abc} means within rows with different superscripts differed significantly (P<0.05).
T_1= control, T_2, T_3, T_4, T_5 and T_6= 10%, 20%, 40%, 60%, 80% and 100% cassava grit replacement level respectively.

IV. Discussion

Variation in growth performance characteristics obtained were in accord with [10] who reported significant (P<0.05) differences in final weight, weight gain, daily weight gain and feed conversion ratio when unpeel cassava grit was fed to layers. Higher feed conversion ratio recorded in cassava grit based diets could be traced to the progressive decline in dietary energy and protein with increasing inclusion level of dietary cassava grit (table1). This probably responsible for increasing feed intake in order to meet up with nutritional requirement especially energy of the broiler birds who significantly exhibit higher live bodyweight as the dietary energy increased [11], as such resulted in the observed higher feed conversion ratio[12].

Cassava grit is highly digestible and could be called a potential energy source in poultry diets as significant differences (P<0.05) were recorded in crude protein, ether extract, nitrogen free extract and gross energy digestibility of the birds. Those placed on cassava grit had higher digestibility potential than the control, the values increased as the inclusion level increased which was in line with earlier report of Hidalgo [13]. This observation could be traced to the combined efforts of the two processing methods (fermentation and roasting) employed which had a significant role in further reduction of anti-nutritional factor especially cyanide that could have impaired its utilization [14]. However, in line with the decrease in percentage crude protein observed as the inclusion level of cassava grit increased (table 1), the decreasing daily gain, increased feed intake (table 2) and the observed high digestibility potential (table3), could probably be an indication that the protein constituent (amino acid) of the test ingredient lacks the essential ones. Cassava roots are poor in protein content and low in amino acids such as lysine and methionine, some reports even indicated the absence of methionine in cassava edible roots [16] [15].

The variation in carcass proportions cannot be totally attributed to the use of cassava grit because no definite trend was observed. The shank increased (P<0.05) as the inclusion level of cassava grit increased. The significant (P<0.05) increase in cut parts such as the breast, wing and thigh together with significant (P<0.05) increase abdominals fat suggests that cassava grit has a fattening effect on broilers probable because the absorption, utilization and deposition of the end products (e.g. soluble energy) are relatively high [11].

The decreasing proportion of gizzard implies that the test ingredient posed a lesser stress on the gizzard during grinding activity/digestion process. The increase in size of liver might be due to its metabolic activities on the anti-nutritional factor residue (hydro-cyanide) present in the diets [17]. Since it was only reduced by the processing methods employed not that it was totally eliminated. Increased metabolic activities of the liver in an effort to detoxify cyanide and at the same time make up for the reduced protein inhibited by the anti-nutritional factors through increased production of proteolytic enzymes by the pancreas resulting in its increase in size [18].

V. Conclusion

It could therefore be concluded that replacement of maize proportion in the broiler diet using cassava grit up to 40% replacement level could be adopted since it has most favourable FCR and promising primal cuts. However, further study could be conducted on its economic implication especially at higher inclusion levels.

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