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Replacement of maize with graded dry cassava sievate in broiler chicken ration

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Target Audience: Poultry farmers, Nutritionist, Feed manufacturers

Abstract

The study was carried out to evaluate the effect of replacement of maize with graded dry cassava sievate (garri sievate) waste on broilers. A total of 150 day old Anak broiler birds were used for the experiment. The birds were randomly assigned to five (5) treatment diets (after a week stabilization period) in a Completely Randomized Design (CRD). The birds were fed diets containing varying levels of dry cassava sievate to replace maize at 0%, 5%, 10%, 15% and 20% for diets (D) 1,2 3,4 and 5 respectively. The experiment lasted for 49 days. Data were collected on growth parameters; carcass cut parts, organ weight, and economic benefit of the broiler chicken. The result obtained showed that there were significant differences (P<0.05) for all the parameters considered under growth except for feed conversion ratio (FCR). The final weight showed that birds fed treatment diets (D2, D3, D4 and D5) compared (P> 0.05) similarly with those fed the control diet and the values ranged from 1340.0g(D5) to 1546.7g (D2). The total weight gain and average daily weight gain followed the same trend. Average daily feed intake showed birds fed diets 3, 4 and 5 had values (82.11g, 81.56g, 81.70g), which were significantly (P<0.05) lower than those fed the control diet (86.46g). There was no significant difference for gross margin. Percentage dressed weight showed that birds fed the treatment diets compared favourably with those fed the control (1300.00g) but D4 had value (1450.00g)) that was significantly higher than that of the control (D1). Dressed weight and breast followed the same trend. For internal organ, significant differences (P<0.05) were observed in kidney, gizzard, heart, and liver except for intestine, proventriculus, spleen, and lungs. Bird fed diet 2 had a lower (P<0.05) kidney value than those fed the other diets including the control diet. For heart and gizzard, D4 and D5 had values (1.99, 0.44%; 2.03, 0.45%) that were significantly (P<0.05) lower than that of the control (2.39, 0.62%). D4 had lower liver (P0.05) value than the control, which compared with D2, D3, and D5. Cost of diet for diet 1 (₦190.14) was significantly (p<0.05) higher than those of the treatment diets {D2 (₦168.42, D3 (₦160.64)} while diet 4 (₦152.29) and diet 5 (₦145.14) had the least feed cost. The cost of feed consumed and cost per kg weight gain followed the same trend. Birds fed the treatment diets compared (P>0.05) with those fed the control for revenue. Result obtained indicated that cassava sievate can replace 20% of maize in broiler ration without any adverse effect on performance, carcass characteristics, internal organ of the broiler chicken with reduced feed cost and higher income.

Keywords: Cassava, Sievate, broiler chiken, garri, maize, organ

Description of problem

Poultry has short generation interval, prolific, easy to rear and its output can be generally expanded more easily than that of other livestock (1). Moreover, it fits well with the concept of Small-scale Agricultural Development and does not compete for scarce land resources. However, the greatest proportional cost in livestock production is expended on feeding, with the exception of ruminants whose feed is based on pasture. In non-ruminant animals such as pigs and poultry, feed ingredients represent 65 to 70% of the total cost in an intensive production system in Nigeria as in many developing countries (2). Energy source constitutes between 45 and 60% of finished feeds for these animals (3), and at present, maize is the commonly used source of energy in livestock feeds (4). Maize for example is a major feedstuff and it is in high demand for consumption by both humans and livestock. The competition and inadequate supply have invariably led to their constant increasing market price. The high cost of maize is a major contributor to the increasing cost of poultry production. This has made many poultry keepers to reduce their flock or completely shift to other business with lesser financial involvement (5). The current trend in poultry industry is on alternative feedstuff; mainly those that can either directly replace maize or can be incorporated at certain levels in the diet to achieve a comparable worth (6, 7). One of such alternative feedstuff is dry cassava sievate

Cassava, (*Manihot esculenta*), is a major carbohydrate rich staple cultivated in the tropics. (8) reported world production at about 157 million tons with Nigeria accounting for about 16% of the world total production. (9) and (10) noted conclusively that cassava may replace maize and cereals without any negative effects. In Nigeria, in spite of cassava availability its use as sole or component of energy source in livestock feed has not been given due recognition. However, there are many pioneering studies (3; 11), which highlighted on the suitability of cassava tuberous meal for broiler feeding and its potential as a good substitute for maize. (12) had advocated that the future market for increased production of this important crop lies with its use as livestock feed. Cassava products and by products are locally valuable and have low cost for farmers to use as feeds for animals. Cassavas root products are rich in carbohydrates and thus are used mainly as sources of energy (13). Though cassava is produced in abundance in most parts of Nigeria, it enjoys limited use relative to cereals, even when its energy content is higher than that in cereals. Dry cassava sievate has energy content of 2260.00 ME kcal/kg and protein content of 8.20% as reported by (14), (15). It contains high amount of non-starch polysaccharides mostly of non-digestible carbohydrate such as cellulose and hemicelluloses which have a high water holding capacity (16)

Hundreds of tons of cassava peels and sievate are produced when cassava root are processed (17) Cassava production is the major occupation of people living in this part of the world (west Africa))(17). It is ranked the 6th most important crop in the world in terms of area planted and production (18) It follows that as far as garri (also called gari) remains a staple carbohydrate food in this part of the world, the availability of cassava sievate is assured. A cassava starch production facility, processing 100 tons of tubers per day has an output of 47 tons of fresh by-products which may cause environmental problems when left in the surrounding or carelessly disposed (19). The use of cassava by-products as feedstuffs or as an alternative substrate for biotechnological processes is a positive way to alleviate environmental problems (20). These by-products include cassava sievate, peels, leaves and stems.

Cassava sievate is the by-product of gari production, it is the left over chaff gotten after cassava pulp is grated, bagged, the water removed through pressure press and then sieved . The left over chaff on top of the sieve is the cassava sievate. It is whitish in colour. Cassava sievate is one of the agro by-product of great importance in animal nutrition which can also help to reduce the cost of poultry feed if adequately utilized (17).The sievate represent 15 to 17% of the root in weight (21).

Cassava sievate was used successfully in layers, causing only a minor decrease in egg production when 15% cassava sievate was included in the diet (22). Cassava sievate replaced 18 – 20% of maize in the diet of rabbit and resulted to growth performance similar to or slightly better than that obtained with the maize based control diet for all inclusion rates (23; 24). A higher inclusion level (40%) reduced growth rate by 9% in comparison with the maize-based diet, but the unit cost of feed to gain remained in favour of sievate utilization (23). There is scarce information on the use of cassava sievate as feed for broiler chicken.

The need to use cassava to replace maize is to reduce feed cost as it would constitute about 45 – 60% of energy demand in broiler diet. This study is therefore designed to evaluate the effect of replacement of maize with graded dry cassava sievate in broiler ration: effect on growth performance, carcass characteristics, organ weight and economic benefits.

Materials and Methods

Experimental location

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm of Micheal Okpara University of Agriculture, Umudike located at latitude 5^{O} 29^{1} North and longitude 7^{O} 32^{1} East in the rainforest zone of Nigeria. It has maximum and minimum daily temperature of 27-36^{o}C and 20-26^{o}C respectively and relative humidity of 57-91%. It is therefore, in a humid tropical environment, where the temperature and relative humidity are significant in agricultural production (25).

Experimental animals and management

A total of 150 day old Anak broiler chickens were procured from a reputable hatchery at Owerri, Imo State. The birds were allowed to stabilize for one week before being exposed to treatment diets. The birds were fed *ad libitum* with constant clean drinking water made available for them. The vaccines such as New castle disease Vaccine (NDV I/O) were administered at day old through the eye. At 2nd week, Gumboro vaccine was administered through the drinking water, and at 3rd week, 2nd dose of NDV were administered through the drinking water. Other medications and vitamin drugs were administered when the need arose. The experiment lasted for 49 days.

Feed preparation

The dry cassava sievate (*garri* sievate) was collected from the villagers at Ebem Ohafia in Ohafia L.G.A, Abia State whose major occupation is *garri* production. After sieving the *garri*, the waste was collected,, sun dried and milled to pass through 2mm sieve and then bagged. During the feed formulation, the dry cassava sievate was used to replace 0%, 5%, 10%, 15% and 20% respectively of maize in the feed. The percentage composition of experimental diet is shown in Table 1.

Table 1: Percentage Composition of Experimental Diets

Ingredients	D1(0%)	D2(5%)	D3(10%)	D4(15%)	D5(20%)
Maize	60.00	57.55	55	52.50	50.00
Dry cassava sievate	-	5.00	10.00	15.00	20.00
Soyabean meal	30.00	27.50	25.00	22.50	20.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Palm kernel cake	3.30	3.30	3.30	3.30	3.30
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25	0.25
Vit/Min. Premix	0.25	0.25	0.25	0.25	0.25
DL-Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100
Calculated composition					
ME (Kcal/kg)	3014.10	2830.10	2806.10	2702.10	2598.10
Crude protein (%)	22.01	21.83	21.65	21.47	21.29

D1=diet 1 (control diet with no cassava sievate inclusion), D2=diet 2 containing 5% dry cassava sievate, (DCS), D3=diet 3 containing 10% DCS, D4= diet4 containing 1% DCS, D5= diet 5 containing 20% DCS

Data Collection

Data were collected on Growth parameters, Carcass characteristics, Organ proportions and economic benefits.

Carcass characteristics and organ proportions

Carcass characteristics and organ proportions were determined by slaughtering six birds per treatment at the end of the feeding trial that lasted for 49 days. The birds slaughtered were fasted for 24hours to empty the digestive tract but water was supplied *ad libitum*. Slaughtering was done by making a clean cut across the jugular vein and the birds were allowed to bleed for at least three minutes. The birds were de-feathered by dipping into hot water (60%) for one and a half minutes and then the feathers were removed. The carcass was cut into parts and the organs separated according to the procedures described by (26). The entire carcass cut parts (breast, drumstick, thigh, wings and back cut), and the internal organs (liver, gizzard, heart, and kidney) were weighed using a 5000g sensitive electronic balance and expressed as percentage dressed weight and percentage live weight respectively. Both the text ingredient and formulated feed were analysed for proximate composition

Data collected were subjected to analysis of variance (ANOVA) as was described by (27), and significant means were separated using Duncan Multiple Range Test (28).

Result and Discussion

Proximate Composition of Experimental Diets

The results of the proximate composition of the formulated experimental diets and the test ingredient are presented in Table 2.

Table 2: Proximate Composition of Experimental Diets

Parameter (%)	D1	D2	D3	D4	D5	DCS
Dry matter	90.40	89.80	89.70	89.00	88.60	88.55
Crude protein	21.00	20.20	19.25	18.35	17.75	4.35
Ether extract	5.20	4.20	3.60	2.65	1.70	0.00
Crude fiber	4.30	4.45	4.60	4.80	5.40	5.40
Ash	7.14	8.60	8.80	8.90	9.00	1.80
NFE	52.35	52.74	53.45	54.30	54.75	88.45
ME (kcal/kg)	3014.10	2830.10	2806.10	2702.10	2598.10	NA

NFE: Nitrogen Free Extract. DSC=dry cassava sievate

The experimental diets were formulated to meet the minimum nutrient requirement of broiler chickens. It has an energy range of 2707.10 to 3014.10 MEkcal/kg and a crude protein range of_17.75 to 21.00. The presence of high fiber (5.40%) in dry cassava sievate may largely affect dietary energy, which could make dry cassava sievate a higher energy feed ingredient as compared to maize.

Growth Performance

The growth performance of broiler chickens are shown in Table 3.

Table 3: Growth Performance of Broiler Chickens Fed Experimental Diet

Parameters	D 1	D2	D 3	D 4	D 5	S.E.M
Initial weight (g/bird)	126.67	126.67	136.67	130.00	136.67	1.65
Final weight (g/bird)	1473.33^{ab}	1546.67^{a}	1383.33^{b}	1450.00^{ab}	1340.00^{b}	25.80
Weight gained (g/bird)	1346.67^{ab}	1420.00^{a}	1246.67^{b}	1320.00^{ab}	1203.33^{b}	26.74
ADWG (g)	27.48^{ab}	28.98^{a}	25.44^{b}	26.94^{ab}	24.56^{b}	0.55
TFI (g)	4236.79^{a}	4216.67^{ab}	4023.33^{ab}	3996.67^{c}	4003.33^{c}	37.20
ADFI (g)	86.46^{a}	86.05^{a}	82.11^{b}	81.56^{c}	81.70^{c}	0.76
FCR	3.15	2.98	3.25	3.03	3.33	0.06

^{a,b,c} Means across rows with different superscripts differ significantly at P<0.05; S.E.M: Standard Error of the Mean; ADWG: Average Daily Weight Gained; TFI: Total feed intake; ADFI: Average Daily Feed Intake; FCR: Feed conversion ratio.

The slightly low final weight can be attributed to hatchery or breed problem since it cuts across the entire treatment. However, there were significant differences (P<0.05) for all the growth parameters such as final weight, weight gained, average daily weight gain, total feed intake, average daily feed intake except for the initial weight and feed conversion ratio (FCR). The treated diets compared (P0>0.05) favourably with the control for final weight with values ranging from 1340.00g(D5) to 1546.67g(D2). This showed that the treated diets met the nutrient requirement for raising broiler chicken (29; 30) and that cassava sievate can successfully replace maize up to 20% in the diet of broiler chickens. The total feed intake of birds fed diet 1 (4346.67g) were significantly higher (p<0.05) than other treatment diets. The range was 3996.67g for D4 to 4236.79g for D1. Average daily feed intake followed the same trend with values ranging from 81.56g for D4 to 86.46g for D1. The decrease in feed intake as the level of replacement of maize with cassava sievate increased could be attributed to the fibrous nature of the diet which perhaps brought about

physical bulk which limited the intake of the more fibrous diet (31). The positive comparism (P>0.05) of the treated feed with the control for FCR showed that birds fed these feed were able to convert the feed to meat just as did those fed the control diet.

The carcass yield of broiler chickens fed experimental diets is shown in Table 2. There were significance differences (p<0.05) in the live weight, dressed weight and breast weight except for dressing percentage, drumstick, thigh, wings and back cut. .The live weight ranged from1300.00g for the control to 1450.00 for D4. Dressed weight followed the same trend. . However the treated diets compared favourably (P>0.05) for breast weight with the control with values ranging from 23.46%(D2) to 30.62 %(D5). The higher dressed weight obtained by birds fed treatment diets showed that a good portion of the live weight is edible (32). The higher breast weight of birds fed diet 5 may be an indication of better conversion of dietary nutrients into meat (17). The numerical high values obtained for back cut for treated diets relative to the control shows that the diets supported tissue deposition of this part (33). Also the comparable weights of the carcass cut parts on all the diet supported the assertion that at various level of inclusion of cassava sievate as replacement for maize the birds can perform well without any deleterious effect on performance, since dressed weight of cut part is suggested to be relative value of dressed saleable carcass for maximum profit in cockerel chicken (34, 35). The experiment revealed better performance for birds fed experimental diets relative to birds fed the control diet. Therefore, cassava sievate can replace maize up to 20% inclusion level to enhance performance and improved carcass yield of broiler chickens.

Table 4: The carcass yield of broiler chickens fed experimental diet

Parameters	D1	D2	D3	D4	D5	S.E.M
Live weight (g/bird)	1300.00^{b}	1400.00^{ab}	1400.00^{ab}	1450.00^{a}	1366.67^{ab}	18.53
Dressed weight (g/bird)	900.00^{b}	983.33^{ab}	991.67^{ab}	1016.67^{a}	941.67^{ab}	15.94
Dressing %	69.25	70.34	70.80	69.03	69.21	0.61
Drum stick %	15.40	14.87	15.25	15.48	15.22	0.29
Thigh %	16.38	21.21	16.27	16.45	16.70	1.10
Breast %	26.92^{ab}	23.46^{b}	29.06^{ab}	26.11^{ab}	30.62^{a}	0.95
Wings %	13.75	14.03	13.69	14.22	15.41	0.53
Back %	21.12	20.51	21.54	22.02	21.95	0.44

^{a,b,c} Means across rows with different superscripts differ significantly at P<0.05; S.E.M: Standard Error of the Mean.

Organ Proportion of Broiler Chickens

The organ proportion of broiler chickens fed experimental diet is shown in Table 5. There were significant differences (P <0.05) observed in kidney, gizzard, heart, and liver except for intestine, proventriclus, spleen, and lungs among treatment groups. The kidney value ranged from 0.26(D3) to 0.47(D5). Diet 4 performed significantly (P<0.05) better than the control for gizzard. The control had the highest gizzard value (2.39) while the lowest was obtained in D4. The treated feed D2, D4, and D5 were significantly (P<0.05) lower than the control for heart. The range is 0.44 (D4) to 0.66(D2). The liver followed the same range as the heart with range of 1.78 (D4) to 2.12 (D5) The lack of effect (P>0.05) in the values of spleen and other organs of broiler chickens fed the control and treatment diets implies that cassava sievate can be included in the diet of

broiler chickens and the immunity of the birds against disease would not be compromised since spleen is the major source of lymphocytes and the storage site for white and red blood cells(17). In general, the range of values of the organs obtained is similar to values reported by (17). Also, the similarity (P >0.05) of the relative carcass cut parts and organ weight obtained in this study indicated that the inclusion levels of the cassava sievate did not have additional metabolic stress or toxicity on the birds. The result also showed that the treatment diets compared favourably with the control diets in the relative organ weights indicating that cassava sievate can replace maize in the diets of broilers up to 20% without any deleterious effect on the relative organ weights and carcass cut parts of the birds but promoted healthy growth of the organs.

Table 4: Organ proportion of broiler chickens fed experimental diet

Parameters %	T1	T2	T3	T4	T5	S.E.M
Intestine	4.64	4.16	3.09	3.17	3.89	0.27
Proventiculus	0.54	0.61	0.62	0.48	0.50	0.02
Kidney	0.45^{a}	0.46^{a}	0.26^{b}	0.37^{a}	0.47^{a}	0.02
Gizzard	2.39^{a}	2.11^{ab}	2.08^{ab}	1.99^{b}	2.03^{b}	0.05
Spleen	0.16	0.12	0.11	0.13	0.17	0.01
Heart	0.62^{a}	0.54^{b}	0.66^{a}	0.44^{c}	0.45^{c}	0.03
Liver	2.01^{a}	1.95^{a}	1.97^{a}	1.78^{b}	2.12^{a}	0.04
Lungs	0.59	0.61	0.57	0.59	0.67	0.02

^{a,b,c} Means across rows with different superscripts differ significantly at P<0.05; S.E.M: Standard Error of the Mean.

Economics of Production of Broiler Chickens Fed Experimental Diet

The economics of production of broiler chickens fed experimental diet is shown in Table 5.

Table 5: Economics of production of broiler chickens fed experimental diet

Parameters	D1	D2	D3	D4	D5	S.E.M
Cost of diet (₦/kg)	190.14^{a}	168.42^{b}	160.64^{b}	152.29^{c}	145.14^{c}	4.15
Cost of feed consumed (₦)	805.56^{a}	710.17^{b}	645.24^{c}	608.65^{d}	581.04^{d}	21.83
Cost/kg weight gained (₦/kg)	599.07^{a}	501.58^{b}	529.00^{b}	456.76^{c}	483.10^{c}	15.06
Revenue (₦)	1473.33^{ab}	1546.67^{a}	1383.33^{b}	1450.00^{ab}	1353.33^{b}	25.28
Gross margin (₦)	721.58	836.49	738.10	841.35	658.37	31.72

^{a,b,c} Means across rows with different superscripts differ significantly at P<0.05; S.E.M: Standard Error of the Mean.

There were significant differences (p<0.05) in the cost of diet per kg, cost of feed consumed, cost per kg weight gained and revenue while there were no significant differences (p>0.05) in the gross margin recorded among the treatment diets. The control had the highest (P<0.05) cost of diet than the treatment diets and among the treatment diets D4 and D5 had the least. It was observed that the cost of feed continue to decrease as cassava sievate inclusion increases. The same trend was observed in cost of feed consumed and cost per

kg weight gain. D2 had the highest revenue followed by D1 and D4. The range is ₦1353.33(D5) to ₦1456.67(D2). The replacement of maize with cassava sievate reduced the cost of producing a kilogram of feed with increased incorporation of cassava sievate in the diets of broilers and this was also reflected in the cost per kilogram weight gain. At higher inclusion levels (15% and 20%) of cassava sievate, revenue was improved and this might have accounted for the decrease in unit cost per weight gain and cost per kg of feed consumed by the birds fed diet 4 and 5. This is in line with the report of(17) that the lower feed cost per kilogram of meat produced on the cassava sievate inclusion diet suggest that the feed material is a viable alternative feed ingredient, economically available and not in high demand by man, hence it can be used to replace maize up to 20% level in broiler diets.

Conclusion and Applications

The study established that:

1. **B**irds fed cassava sievate had lower feed intake, better feed utilization, better dressed salable carcass cut parts and good relative organ weight than those fed the control diet
2. It is more efficient and cost effective to use cassava sievate in place of maize in raising broiler chicken
3. The lower feed cost per kilogram of meat produced on the cassava sievate inclusion diet suggest that the feed material is a viable alternative feed ingredient, economically available and not in high demand by man, hence it can be used to replace maize up to 20% level in broiler diets
4. It was therefore concluded that cassava sievate can be included up to 20% level in the diet of broiler chicken to enhance growth, reduce feed intake, yield higher saleable cut parts, and better economic return.

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