GROWTH PERFORMANCE AND COST IMPLICATION OF BROILER CHICKENS FED FORTIFIED COMPOSITE CASSAVA STUMP MEAL BASED DIETS

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ABSTRACT

This study investigated fortifying cassava stump and leaf meals on general performance and cost implication of broiler chickens. Cassava stumps were collected, crushed, subjected to heat treatment and milled (CCSM). Cassava leaves were obtained air-dried and milled (CLM). CLM and CCSM were mixed in ratio 1:9 to produce fortified composite cassava stump meal (FCCSM). The FCCSM was used as feed ingredient. Five starter diets were formulated using FCCSM at the graded levels of 0, 5, 10, 15 and 20 % and designated diets I, II, III, IV and V, respectively. The same procedure was followed for the finisher phase. 150 broiler chicks were assigned to five dietary treatments replicated thrice with 10 chicks per replicate in a Completely Randomized Design. The respective diets were fed to the chicks ad libitum from 1 – 49 days. All data collected were subjected to analysis of variance using SPSS version 17 package. Results showed that highest total weight gain (2477 ± 159.10 g/bird) and best FCR (2.12 ± 0.01) were obtained with birds fed diet I, the lowest total weight gain (2040.28 ± 159.59 g/bird) was obtained from bird fed diet V. The poorest FCR (2.68 ± 0.05) was observed in bird fed diet IV. Bird fed diet V yielded the highest profit/bird produced (₦807.35 ± 12.88). From the results, it is recommended that up to 15 % FCCSM be included in broiler diet without adverse effect on growth performance and up to 20 % level of FCCSM inclusion improved the profit/bird produced.

Keywords: Broiler chicks, Cassava leaf and stump, Fortified composite meal, Growth performance, Cost benefit

INTRODUCTION

Chickens constitute one of the most common sources of animal protein in developed countries but this is not the case in developing countries mostly due to the cost of chicken which is beyond the reach of the common man. Cost of chicken production is high which is as a result of the recent increase in the price of conventional feed ingredients particularly energy source and this is one of the major factors affecting the net return from poultry business. Feed cost makes up to 60 – 75 % of the total cost of production in monogastric animals under the intensive system (Adegbenro *et al.,* 2012). The ever-rising cost of maize is brought about by its declining production and stiff competition for its use by man and other livestock species (Agbede *et al.,* 2002; Hamzat *et al.,* 2003). Therefore, there is a need to explore the use of alternative feed sources that can yield the same output as conventional feedstuff and at a cheaper cost. This will help to reduce the cost of feeds and also minimize the direct competition between man and livestock production for the availability of conventional feed stuffs. One such economical substitute ingredients for maize is cassava meal (Anthony, 2009). Cassava products (roots and foliage) appear to be one of the best possibilities for overcoming the chronic deficit in tropical agricultural production. The use of cassava and its products as an alternative feed ingredient of energy source goes a long way in reducing the feed cost in poultry production (Salami and Odunsi, 2003). A well processed dried cassava meal stands readily as an alternative feedstuff (Eruvbetine *et al*., 2003). Cassava root products are deficient in carotene and carotenoids, so supplements must be added to poultry diets containing these products to maintain normal egg yolk and broiler skin pigmentation (Khajarern and Khajarern, 1991). This can be achieved by supplementing diets containing cassava root with cassava leaf meal. Cassava leaves are highly nutritious, they have high protein levels ranging from 16.6 – 39.9 % (Khieu Borin *et al.,* 2005), and mineral levels, as well as being a valuable source of vitamin B1, B2, C and carotenes. Additionally, the amino acid concentration of cassava leaves is very similar to that of alfalfa (Morgan and Choct, 2016) and the ME ranges from approximately 1590 kcal/kg (Khajarern and Khajarern, 1991) to 1,800 kcal/kg (Ravindran, 1991). Thus, this study was designed to evaluate the potential of fortified composite cassava stump meal as an energy source in broiler chicken diets.

MATERIALS AND METHODS

Experimental Site: The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, Federal University of Technology, Akure, Nigeria. The University is located on (Latitude $7^0$18″N and Longitude 5^0 10″E), Ondo State, Nigeria (NIMET, 2014). Akure falls within the rainfall zone of the humid tropics which is characterized by the hot and humid climate. The annual rainfall is 1500 mm and the rain period is bimodal with a short break in August. The altitude is about 350.52 m above sea level, the annual humidity is 75 % and that of temperature is 27^0C (Ashaolu and Adebayo, 2014).

Collection of Feed Ingredients: Cassava stumps (the ends trimmed off the cassava tubers) were collected from Igbatoro Cassava Processing Plants, Igbatoro, Akure, Ondo State. The stumps were washed, crushed and pressed to reduce the moisture, and sieved to remove excess fibre. The milled cassava stumps were subjected to heat treatment by frying to reduce the cyanogenic glucosides level and to prevent spoilage. The processes of washing, crushing, pressing, sieving and frying were carried out within 24 hours to prevent fermentation. The cassava leaves were obtained in large quantities and air-dried. Both the cassava stumps and cassava leaves were milled separately and stored before use.

Fortified Cassava Stump Meal Production: The cassava leaf and stump meals produced were mixed in a ratio 1: 9 to produce the fortified cassava stump meal.

Experimental Diets: Five experimental starter diets were produced in such a way that the fortified cassava stump meal was included in the diets at 0, 5, 10, 15 and 20 % and each diet was thoroughly mixed and designated Diets I, II, III, IV and V, respectively. The same procedure was followed for the finisher phase. All the feed ingredients and the formulated diets were proximately analyzed (AOAC, 2005). The gross composition of the starter and finisher diets are as presented in Tables 1 and 2 respectively.

Experimental Layout and Feeding Trials: A total number of two hundred (200) day-old chicks of Abor-Acre breed of broiler chicks were purchased from Farm Support in Ibadan, Oyo State, Nigeria out of which 150 were assigned to five dietary treatments of three replicate and ten chicks per replicate on the day of arrival. The weight of each group (10 chicks) was balanced (± 1 g). The design of the experiment was Completely Randomized Design. The right to conduct the research was granted by the Research Committee of the Department of Animal Production and Health, Federal University of Technology, Akure, Nigeria. Among the routine management practices are, daily observation of the birds, weighing of the feed leftover, feeding of the birds and general cleaning of the environment.

Table 1: Gross Composition of broiler chicken experimental starter fortified composite cassava stump meal based diet (g/100 g)

Ingredients	Diet I	Diet II	Diet III	Diet IV	Diet V
Maize	54.00	49.00	44.00	39.00	34.00
Wheat offal	3.30	3.30	3.30	3.30	3.30
Soybean meal	21.00	21.00	21.00	21.00	21.00
Groundnut cake	12.00	12.00	12.00	12.00	12.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Fortified composite cassava stump meal	0.00	5.00	10.00	15.00	20.00
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Di-calcium phosphate	1.00	1.00	1.00	1.00	1.00
Limestone	1.50	1.50	1.50	1.50	1.50
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Vegetable oil	1.50	1.50	1.50	1.50	1.50
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis					
Crude protein (%)	22.70	22.68	22.63	22.58	22.53
Metabolizable energy (Kcal/kg)	3009.92	3006.31	3002.82	2999.27	2995.72
Calcium (%)	1.12	1.13	1.14	1.14	1.15
Available phosphorus (%)	0.55	0.56	0.57	0.58	0.59
Lysine (%)	1.26	1.26	1.26	1.26	1.27
Methionine (%)	0.48	0.48	0.47	0.47	0.46

**Contained vitamins A (8,500,000 IU); D3 (1,500,000 IU); E (10,000 mg); K3 (1,500 mg); B1 (1,600 mg); B2 (4,000 mg); B6 (1,500 mg); B12 (10 mg); Niacin (20,000 mg); Pantothenic acid (5,000 mg); Folic acid (500 mg); Biotin H2 (750 mg); Choline chloride (175,000 mg); Cobalt (200 mg); Copper (3,000 mg); Iodine (1,000 mg); Iron (20,000 mg); Manganese (40,000 mg); Selenium (200 mg); Zinc (30,000 mg); and Antioxidant (1,250 mg) per 2.5 kg*

Table 2: Gross composition of broiler chicken experimental finisher fortified composite cassava stump meal based diet (g/100 g)

Ingredients	Diet I	Diet II	Diet III	Diet IV	Diet V
Maize	54.00	49.00	44.00	39.00	34.00
Wheat offal	5.80	5.80	5.80	5.80	5.80
Soybean meal	21.00	21.00	21.00	21.00	21.00
Groundnut cake	12.00	12.00	12.00	12.00	12.00
Fish meal	0.10	0.10	0.10	0.10	0.10
Fortified composite cassava stump meal	0.00	5.00	10.00	15.00	20.00
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	1.50	1.50	1.50	1.50	1.50
Di-calcium phosphate	2.00	2.00	2.00	2.00	2.00
Limestone	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Salt	3.00	3.00	3.00	3.00	3.00
Vegetable oil					
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis					
Crude protein (%)	19.70	19.65	19.60	19.55	19.50
Metabolizable energy (Kcal/kg)	3030.24	3026.69	3023.14	3019.59	3016.04
Calcium (%)	1.11	1.11	1.12	1.13	1.13
Available phosphorus (%)	0.50	0.51	0.52	0.53	0.60
Lysine (%)	1.10	1.10	1.10	1.10	1.10
Methionine (%)	0.40	0.40	0.40	0.40	0.40

**Contained vitamins A (8,500,000 IU); D3 (1,500,000 IU); E (10,000 mg); K3 (1,500 mg); B1 (1,600 mg); B2 (4,000 mg); B6 (1,500 mg); B12 (10 mg); Niacin (20,000 mg); Pantothenic acid (5,000 mg); Folic acid (500 mg); Biotin H2 (750 mg); Choline chloride (175,000 mg); Cobalt (200 mg); Copper (3,000 mg); Iodine (1,000 mg); Iron (20,000 mg); Manganese (40,000 mg); Selenium (200 mg); Zinc (30,000 mg); and Antioxidant (1,250 mg) per 2.5 kg*

The birds were also vaccinated against Newcastle disease and Gumboro disease according to the hatchery recommendation. Other drugs used during the experiment include vitamin, coccidiostat and antibiotics.

Growth Performance: The initial weight of each group (10 chicks) was balanced (±1 g). Thereafter, the groups were fed their respective diets *ad libitum* from 1 – 49 days during which weekly feed consumption and weight changes were measured, final weight and the feed conversion ratio was calculated (Adeleke *et al.,* 2011).

Carcass Traits Measurement: At the end of the experimental period, the birds were kept off feed for 12 hours to empty their crop to prevent carcass contamination. Two (2) birds were randomly selected per replicate and used to determine the carcass parameters. Slaughtering was done by severing the jugular vein, after stunning. The birds were bled and were scalded at 60^0C in a water bath for about 30 seconds before de-feathering. Thereafter, the dressed and eviscerated weights were expressed as a percentage of the live weight. The following parts were weighed: head, breast, drumstick, thigh, neck, back, shank and they were expressed as gram per kilogram body weight.

Cost-Benefit Analysis: The cost of producing the experimental diets based on the current market prices for the ingredients. The cost of feed consumed per bird was calculated by the cost of experimental diets consumed divided by number of birds fed (C_{feed}). . The total cost of production was calculated by adding the cost of day-old chicks (C_{seed}), cost of feed consumed per bird (C_{feed}) and cost of management and drug/vaccines used ($C_{management}$) thus: $C_{production} = C_{feed} + C_{seed} + C_{management}$ (Lipton and Harrell, 2004). The average price gained per bird was calculated by subtracting the average price realized per bird from the total cost of production. The other expenses such as day-old chicks, drugs and vaccines were common for all the treatments.

Data Analysis: All data collected were subjected to Analysis of Variance (ANOVA) using SPSS version 17 package. Where significant difference existed, the Duncan Multiple Range Test (DMRT) of the same package was used to separate the means. P<0.5 was accepted as significant.

RESULTS

Growth Performance: The influence of fortified composite cassava stump meal diets on the performance of broiler chickens of age 1 – 49 days indicated that the final body weight (FBW) and total weight gain (TWG) of bird fed Diet I was not significantly different (p>0.05) from birds fed Diets II, III and IV (Table 3). Numerically, highest FBW (2517.00 g/bird) and highest TWG (2477.18 g/bird) were recorded in birds fed Diet I, while lowest FBW (2080.00 g/bird) and lowest TWG (2040.28 g/bird) were observed in birds fed Diet V. The best feed conversion ratio (FCR) of 2.12 was recorded in bird fed Diet I, and was significantly (p<0.05) lower than those fed diets III, IV and V but statistically similar to bird fed Diet II (2.16). The weekly feed intake (Figure 1) and weekly weight gain (Figure 2) indicated that both feed intake and weight gain increased exponentially from week 1 through week 7.

Carcass Traits: Carcass quality of broiler chicken fed varying levels of fortified composite cassava stump meal-based diet indicated that among all the parameters measured, only the neck weights were significantly influenced (p<0.05) by the dietary treatments (Table 4). Dietary inclusion of fortified composite cassava stump meal did not have significant effect (p>0.05) on dressed, eviscerated, drum stick, thigh, wing, back, head, breast and shank weights. Numerically, birds fed Diet I had the highest breast weight (256.60 ± 5.55 g/kg body weight), while the least breast weight (228.40 ± 10.92 g/kg body weight) was observed in birds fed Diet IV. Birds fed Diet II had better eviscerated percentage (78.92 ± 1.62 %) and drumstick (101.20 ± 1.08 % g/kg body weight), while poor eviscerated percentage (75.04 ± 3.07 %) and drumstick (97.89 ± 3.56 % g/kg body weight) occurred in birds fed Diet IV.

Table 3: Growth performance of broiler chickens fed composite fortified cassava stump meal

Parameter	Diet I	Diet II	Diet III	Diet IV	Diet V
Initial weight (g)	39.82 ± 0.79	39.71 ± 0.59	39.67 ± 0.49	39.72 ± 0.49	39.72 ± 0.30
Final weight (g)	2517.00 ± 159.29[a]	2346.67 ± 180.95[a]	2340.00 ± 104.08[a]	2286.67 ± 20.28[ab]	2080.00 ± 160.00[b]
Weight gain (g)	2477.18 ± 159.10[a]	2306.95 ± 181.52[a]	2300.33 ± 104.31[a]	2246.95 ± 20.05[ab]	2040.28 ± 159.59[b]
Feed intake (g)	5263.50 ± 58.95[b]	4987.91 ± 23.03[c]	5160.26 ± 103.75[bc]	5465.55 ± 29.47[a]	4657.61 ± 51.31[d]
Feed conversion ratio	2.12 ± 0.01[a]	2.16 ± 0.03[a]	2.24 ± 0.03[b]	2.68 ± 0.05[c]	2.21 ± 0.01[b]

Means without identical superscripts in the same horizontal row are significantly different (p<0.05)

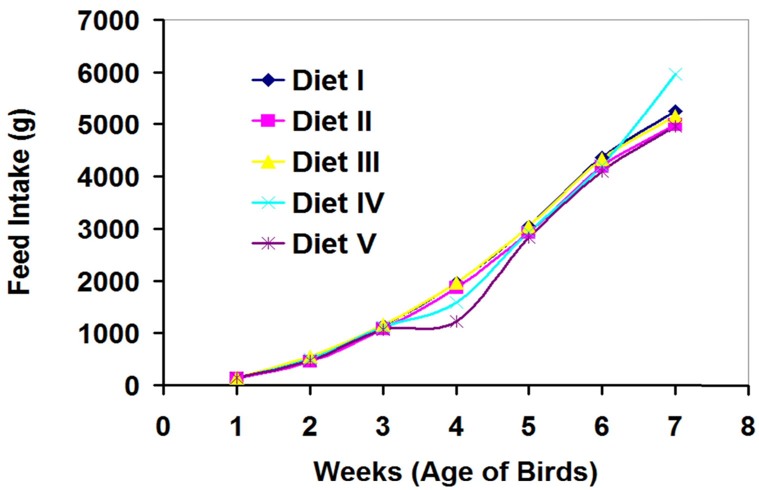

Figure 1: Weekly feed intake of birds fed fortified composite cassava stump meal diets

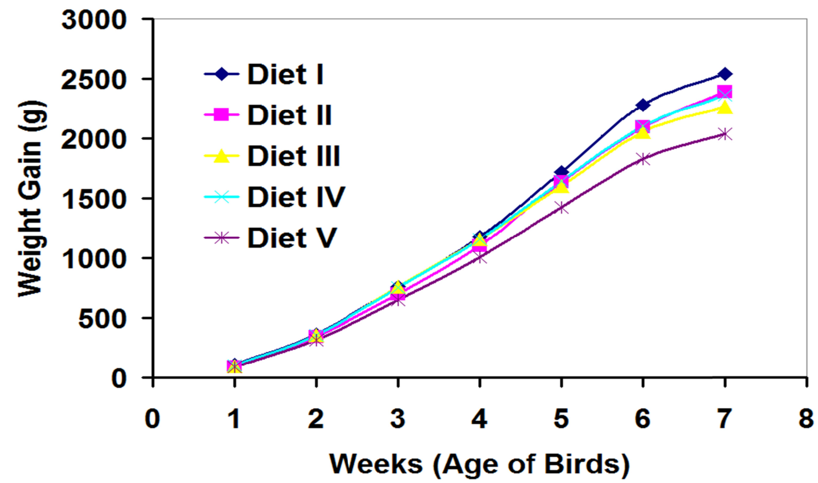

Figure 2: Weekly weight gain (growth performance) of birds fed fortified composite cassava stump meal diets

Table 4: Carcass trait of broiler chicken fed composite fortified cassava stump meal

Parameter	Diet I	Diet II	Diet III	Diet IV	Diet V
Dressed weight (%)	91.87 ± 0.25	90.35 ± 1.61	92.35 ± 0.37	95.07 ± 3.05	95.07 ± 3.04
Eviscerated weight (%)	78.77 ± 0.50	78.92 ± 1.62	78.86 ± 0.77	75.04 ± 3.07	77.76 ± 1.10
Drum stick(g/kg body weight)	95.46 ± 2.28	101.20 ± 1.08	99.50 ± 3.59	97.89 ± 3.56	92.69 ± 6.83
Thigh (g/kg body weight)	101.73 ± 3.62	102.17 ± 4.79	102.43 ± 3.03	100.04 ± 4.30	99.10 ± 1.60
Wing (g/kg body weight)	70.26 ± 1.60	72.78 ± 1.20	68.17 ± 1.14	69.68 ± 4.07	70.64 ± 1.48
Back (g/kg body weight)	152.63 ± 3.63	155.02 ± 2.83	154.38 ± 4.24	146.67 ± 6.80	157.44 ± 3.77
Head (g/kg body weight)	22.63 ± 1.41	22.29 ± 1.02	22.44 ± 0.77	20.31 ± 0.52	23.19 ± 1.09
Neck (g/kg body weight)	40.60 ± 1.25^{b}	38.95 ± 1.17^{bc}	45.93 ± 0.72^{a}	35.68 ± 1.94^{c}	39.36 ± 2.08^{bc}
Breast (g/kg body weight)	256.60 ± 5.55	244.33 ± 10.55	239.79 ± 11.02	228.40 ± 10.92	236.69 ± 10.12
Shank (g/kg body weight)	33.30 ± 0.93	35.04 ± 1.15	35.96 ± 2.08	33.73 ± 1.47	33.95 ± 1.95

Means without identical superscripts in the same horizontal row are significantly different (p<0.05)

Table 5: Economy of production of broiler chickens fed fortified composite cassava stump meal-based diets

Parameters	Diet I	Diet II	Diet III	Diet IV	Diet V
Cost of day-old chick	180	180	180	180	180
Cost of feed consumed (₦/Bird)	925.32 ± 23.63^{a}	853.18 ± 19.07^{a}	858.16 ± 85.59^{a}	865.16 ± 9.12^{a}	742.65 ± 22.30^{b}
Cost of drug + vaccine (₦/Bird)	250.00 ± 0.00	250.00 ± 0.00	250.00 ± 0.00	250.00 ± 0.00	250.00 ± 0.00
Total cost of production (₦/Bird)	1175.32 ± 23.63^{a}	1103.18 ± 11.01^{a}	1108.15 ± 49.41^{a}	1115.16 ± 5.27^{a}	992.65 ± 12.88^{b}
Sales price of bird (₦/Bird)	1800 ± 0.00	1800 ± 0.00	1800 ± 0.00	1800 ± 0.00	1800 ± 0.00
Net profit/bird produced (₦)	624.68 ± 23.63^{b}	696.82 ± 11.01^{b}	691.85 ± 49.41^{b}	684.84 ± 5.27^{b}	807.35 ± 12.88^{a}

Means without identical superscripts in the same horizontal row are significantly different (p<0.05)

Birds fed Diet III had the highest thigh weight (102.43 ± 3.03 g/kg body weight), while bird fed Diet V had least thigh weight (99.10 ± 1.60 g/kg body weight). Highest wing value (72.78 ± 1.20) and lowest wing value (68.17 ± 1.14) were recorded in birds fed Diet II and Diet III, respectively. Birds fed Diet V recorded the highest values of back (157.44 ± 3.77 g/kg body weight) and head (23.19 ± 1.09 g/kg body weight) weights.

Cost-Benefit: The cost-benefit of production of fortified composite cassava stump meal diets as energy source in broiler chicken diets showed that there were significant differences ($p<0.05$) observed in cost of feed per bird, cost of production per bird and profit made from sales of birds. Cost of feed (₦ 925.32 ± 23.63) and production (₦ 1175.32 ± 23.63) was highest in diet I. Diet V which contain the highest level of fortified composite cassava stump meal yielded the highest profit better (₦ 807.35 ± 12.88). Also, as the levels of fortified composite cassava stump meal increases in the diet, profit obtained increases. Cost of day-old chicks, cost of drug and vaccinations per bird, and sales price per bird were the same for all the treatments (Table 5).

DISCUSSION

There were variations in live weights of birds fed varied percentages of FCCSM, except for birds fed 5 % FCCSM which had nearly similar value with the bird fed 0 % FCCSM. This result was similar to the report of Duruna *et al.* (2006) who reported a significant difference in the live weight of broilers fed varying levels of *Anthronata macrophyla* seed meal. There were also significant differences in neck weight and this corroborated with the report of Rafiu *et al.* (2015) who reported significant differences in neck values arising from the replacement of maize with graded levels of cassava grit in diets fed to broiler chickens. The dressed out percentage obtained in this study was higher than the values obtained by Okosun and Eguaoje (2017) on growth performance, carcass response and cost-benefit analysis of cockerel fed graded levels of cassava grit supplemented with moringa leaf meal. There were no significant differences in percentage weight of breast, shank, wing, drumstick and thigh. This report disagreed with the findings of Tesfaye *et al.* (2013) who reported a significant difference in the breast muscle of broilers fed cassava root chips, but agreed with the report of Okosun and Eguaoje (2017) who reported that the head, neck, thigh, muscle, shank and wing weights of birds fed did not differ among the treatment diets.

Cost of feed production decrease progressively as the inclusion of fortified composite cassava stump increases. The variation in the cost of feed production indicated that Diet V had the least cost of feed produced and least cost of feed consumed. This result agreed with the findings of Omoikhoje *et al.* (2008) who reported that the inclusion of 30 % level of unpeeled cassava waste meal in the diets of rabbits led to a reduction in the cost of feed, cost of feed/kg weight gain, cost of production and improvement in the profit margin. This was also in agreement with the report of Omoikhoje *et al.* (2008) that least-cost of feed consumed was recorded in birds fed 100 % cassava grit meal (CGM) could be as a result of cheap cost of cassava grit used in the diet. In the same vein, the total cost of production was least in the diet with 20 % FCCSM and this could be due to the cheap nature of the basal diet that reduced the cost of formulating the diet per kilogram. However, the highest profit was generated from bird fed Diet V compare to other birds fed Diets I – IV. Zahari and Alimon (2006) had earlier reported improvement in the feed efficiency through the accelerated use of local feedstuff in other to reduce high production cost thereby increasing profit.

Conclusion: In this study, it was demonstrated that having up to 15 % level of FCCSM did not adversely affect growth and feed efficiency in broiler chickens. It indeed brought about an increased profit margin in the production process. From the outcome of this study, it is therefore recommended that farmers and feed millers could use FCCSM up to 15 % as a replacement for maize in broiler chicken diets.

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