Performance and Carcass Quality of Broier Placed on Pro-Vitamin A Cassava and Sweet Cassava-Based Diets

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ABSTRACT--- ***This experiment was carried out to determine the performance and carcass quality of broilers placed on pro-vitamin A cassava and sweet cassava-based diets using maize-based diet as control. The results show that daily weight gain of birds placed on maize-based diet (19.67g) was statistically higher (p<0.05) than those of sweet cassava (14.00g) and pro-vitamin A cassava (15.00g) diets. The daily weight gain of sweet cassava and pro-vitamin A cassava had no significant difference (p>0.05) among themselves. The average daily feed intake of the maize- based diets (54.07g/day) was significantly higher (p<0.05) than that of sweet cassava (49.32g/day) and pro-vitamin A cassava (48.88g/day) diets but the cassava diets showed no significant difference (p>0.05) between each other. The feed conversion ratio of 2.75 for maize, 3.52 for sweet cassava and 3.26 for pro-vitamin A cassava did not show any significant difference (p>0.05) among the diets. The carcass weight showed a higher result in maize-based diet (743.18g), followed by pro-vitamin A cassava diet (681.32g) and sweet cassava showing the least result (655.28g). However there is no significant difference (p>0.05) among the diets. The cost of production was highest with maize based diets (₦1,305.79) while that of sweet cassava (N736.94) and pro-vitamin A cassava (N982.91) were cheaper showing 43.56% and 24.73% cost reduction respectively. The lower cost of production with sweet cassava and pro-vitamin A cassava compensates the lower growth rate, suggesting that any of these variety of cassava can totally replace maize in broiler diet without any deleterious effect when properly processed to reduce the cyanogenic content of the cassava to non-toxic level.***

Keywords--- Pro-vitamin A cassava, Sweet Cassava, Carcass quality, Broiler performance

1. INTRODUCTION

Poultry is on the fastest means to achieving appreciable improvement in the nutritional standard of the populace because of its short generation interval, quick turnover rate and relatively low capital investment [1,2]. The unavailability of grains and the high cost of imported ingredients have made the price of commercial animal feed to increase over 30%. These problems remain the most important constraints to the expansion of commercial poultry production in Nigeria. The high cost of conventional feedstuff has already sent a lot of livestock farmers out of business, thus leading to reduction in overall animal protein production and availability for human's dietary need. The provision of feed alone has been reported to account for 60-80% of total cost of livestock production in developing countries alone [3,4]. In view of this, there is increased interest by poultry farmers on the search for non-conventional feed ingredients that could be cheaper, boost the growth of chickens without compromising quality, organic and readily available[5].

Cassava (Manihot esculenta crantz), a tropical root crop which provides a major source of calories for over 500,000 million people in the tropics and second most important caloric staple food after maize in Africa[6] with Nigeria being the largest producer in the world (34,million tons in 2002)[7] appear to be one of the best possibilities of

overcoming the chronic deficit in tropical agricultural production for cheaper and efficient livestock feed. Its growing use for both human and animal feed can be hampered by the presence of toxic cyanogens, linamarin and lotaustralin, in its leaves and tubers [8]. However different processing methods have been found to reduce the cyanide to a non-toxic level [9,10,11]. The sweet variety of cassava has been used in many researches [12,13] and seem to be a good replacement for maize and other cereal in animal rations. Most recently the pro-vitamin A cassava, a new elite variety, biofortified with pro- vitamin A under the initiative of Biocassava plus to develop cassava germplasm enriched with bioavailable nutrient, globally supported by Bill and Melinda Gates[14] has been produced and implicated with low residual cyanide, high reducing sugar and high total carotenoid.[15]. It's use in animal feed is yet to be explored.

This study is therefore undertaken to compare the performance of birds placed on pro-vitamin A cassava and traditional sweet cassava variety in terms of weight gain, feed intake, feed conversion ratio and carcass weight from starter to finisher to determine which cassava variety can compare favorably with maize in poultry diet and to evaluate the cost of production of broiler placed on cassava-based diets as compared to maize-based diet.

2. MATERIALS AND METHODS

2.1 Experimental Site

The experiment was carried out at the poultry unit of the Akwa Ibom State University, Obio Akpa Campus, Akwa Ibom State, Nigeria, located between latitude $4^{o}32^{'}$ N and $5^{o}33^{'}$ N and longitude $7^{o}25^{'}$E and $8^{o}25^{'}$ E within the humid rain forest of the tropical zone, 70m above sea level and temperature range between 25^{o}C and 26^{o}C, humidity 75-80% and annual rainfall ranging from 2250mm to 2926mm [16]. The building was partitioned into equal apartment measuring $2m^{2}$ each

2.2 Experimental Birds and Management

A total of 72 day old Anark breed of broiler birds were purchased from a local vendor at Abak, Akwa Ibom Satste and used for the eight (8) weeks experiment. All the birds were raised in a deep litter house with a concrete floor. The pens were partitioned into replicates with wire mesh. The 72 day old chicks were brood together for a period of 2 weeks and fed commercial feed *ad-libitum* before being allocated to the treatments in a Completely Randomized Design (CRD).

Routine management practices in terms of medication and vaccination were strictly observed. Birds were fed two times a day with the Experimental diets.

2.3 Sources of Diet Ingredients

The pro-vitamin A variety of cassava (UMUCASS 36) was obtained from Vika farms, Uyo, Akwa Ibom State. The sweet cassava, maize, soya bean meal, wheat offal, fish meal, palm kernel cake, palm oil, bone meal, salt, vitamin premix, lysine and methionine were obtained from local sellers in the market and feed meal shops in Abak town and its environs in Akwa Ibom State.

2.4 Preparation of Cassava Flour

Both pro-vitamin A and white cassava tubers were washed and peeled to remove the skin and cortex and the exposed parenchymatous tissue was chipped into small flat sizes. These were sun-dried for three (3) consecutive sunny days. The chips were ground into coarse flour and stored in nylon bags until it was used for feeding experiment [9].

2.5 Experimental Diets

Two phases of diets were formulated for each treatment. The first phase was the starter's marsh containing 23% crude protein and the second phase was that of the finishers containing 20% crude protein. Treatment one (T1) which was the control had maize as the main energy source, while treatment two (T2) had pro vitamin A cassava variety and treatment three (T3), white sweet cassava variety as their main energy sources respectively. Tables.1 and .2 show the composition of the starter and finisher diets respectively

Table 1. Composition of starter diet

Ingredients	Maize based diet %	Sweet Cassava Based Diet %	Pro-vitamin A Cassava Based Diets %
Maize	32.89	-	-
Sweet Cassava	-	39.93	-
Pro-vitamin A cassava	-	-	39.93
Soya-bean meal	9.91	14.60	14.60
Fish meal	7.34	10.82	10.82
Groundnut Cake	11.01	16.23	16.23
Wheat offal	17.26	6.30	6.30
Palm Kemel Cake	18.09	6.62	6.62
Bone meal	2.00	2.00	2.00
Salt	0.50	0.50	0.50
Palm oil	-	2.00	2.00
Vitamin premix	0.50	0.50	0.50
Lysine	0.25	0.25	0.25
Methionine	0.25	0.25	0.25
Total	100.00	100.00	100.00
Crude Protein	23.0	23.0	23.0
Crude Fibre	3.26	4.46	4.46
Metabolizable Energy (Kcal/kg)	2.27	2.90	2.87

Table 2. Composition of finisher diet

Ingredients	Maize based diet %	Sweet Cassava Based Diet %	Pro-vitamin A Cassava Based Diets %
Maize	37.36	-	-
Sweet Cassava	-	45.63	-
Pro-vitamin A cassava	-	45.63	39.93
Soya-bean meal	6.65	11.96	11.96
Fish meal	4.93	8.86	8.86
Groundnut Cake	7.39	13.29	13.29
Wheat offal	20.55	7.56	7.56
Palm Kemel Cake	19.62	7.20	7.20
Bone meal	2.00	2.00	2.00
Salt	0.50	0.50	0.50
Palm oil	-	2.00	2.00
Vitamin premix	0.50	0.50	0.50
Lysine	0.25	0.25	0.25
Methionine	0.25	0.25	0.25
Total	100.00	100.00	100.00
Crude Protein	20	20	20
Crude Fibre	6.13	6.90	6.90
Metabolizable Energy (Kcal/kg)	3.18	3.19	3.19

2.6 Data Collection and Analysis

Daily feed intake records were taken every morning by subtracting the quantity of feed remaining from the quantity given the previous day. The birds were weighed at day old and at the beginning of the experiment after two weeks brooding. Subsequent weights were taken weekly till the end of the 8 weeks the experiment lasted

At the end of the experimental period, three birds per treatment were randomly selected, starved overnight and weighed for carcass evaluation. The birds were slaughtered by severing the jugular vein, scalded in warm water for a minute and de-feathered by manual plucking. The birds were eviscerated and weighed to obtain their dressed carcass weight. Weights were obtained for edible carcass parts:- drumstick, thigh, back, breast and wings. The dressed carcass weights were expressed as percentages of live weight.

2.7. Statistical Analysis

All the data collected were subjected to analyses of variance and the means were separated by Duncan multiple range test using the statistical package for social sciences (SPSS) version 17. One way analysis of variance (ANOVA) was used for comparison of the means. Differences between the means were considered to be significant at $(p < 0.05\}$

2.8. Proximate analysis

The moisture**,** dry matter, ash, crude fibre and lipid contents of the cassava varieties were determined using the AOAC[17].

2.9 Carotenoid analysis

The carotenoid content of the fresh cassava samples was determined using the method of Rodriguez-Amaya and Kimura[15].

2.10. Cyanide analysis

The residual cyanide levels of the flours of the cassava varieties were determined using the alkaline picrate method [16].

Table 3.Proximate analysis , vitamin A and residual cyanide contents of the diets.

Nutrient	Maize %	Pro-vitamin A Cassava %	Sweet cassava %
Dry matter	90.75	90.20	90.23
Crude protein	10.00	3.00	3.00
Ether Extract	2.43	1.12	0.85
Crude Fibers	3.86	3.60	3.40
Ash	1.53	2.28	1.35
NFE	82.29	8.70	92.15
Vitamin A (mg)	1.20	0.70	6.60
Residual cyanide (ppm)	-	3.02	3.00

3. RESULTS AND DISCUSSION

Table 4 Summary of the Performance of Broiler Placed on Pro-Vitamin A and Sweet Cassava-based Diets

	Maize-based Diet	Sweet-Cassava based Diet	Pro-vitamin A cassava-based Diet	SEM
No. of Birds	24	24	24	3.51
Average initial weight (g)	226.67	216.67^{b}	213.33	43.13
Average final weight (g)	1060.00^{a}	796.67^{b}	836.67^{b}	39.67
Average weight gain (g)	833.33^{a}	580.00^{b}	623.3^{b}	0.92
Average daily gain (g)	19.67^{a}	14.00^{b}	15.00^{b}	52.29
Average feed intake (g)	2271.12^{a}	2155.60^{b}	2052.98^{b}	1.50
Average daily intake (g)	54.07^{a}	49.32^{b}	48.88^{b}	0.26
Feed conversion ratio	2.75	3.52	3.26	2.32
Cost of production per bird (₦)	1305.79^{a}	736.94^{c}	982.91^{b}	
% Cost reduction		43.56	24.73	

Values in the same row with same superscript show no significant difference (p>0.05)

Table 5. Summary of the carcass weight of broiler placed on Pro-vitamin A and sweet cassava-based diets

	Maize-Based Diet	Sweet Cassava Diet	Pro-Vitamin A Diet	SEM
Live weight (g)	1200.00	1180.00	1080.00	0.12
Breast (g)	250.56	221.04	227.67	6.36
Thigh and drumstick (g)	282.11	244.99	260.95	6.56
Back (g)	108.10	96.11	97.35	2.49
Wing (g)	47.97	44.80	46.25	0.59
Neck (g)	54.44	48.34	49.10	1.6
Carcass weight (g)	743.18	655.28	681.32	27.54
Dressing percentage (%)	61.93[a]	55.53[b]	63.09[a]	2.41

Values in the same row with same superscript show no significant difference (p>0.05)

The results in table.4 indicate that the average daily feed intake of birds placed on maize-based diet (54.07g/day) was significantly higher (P<0.05) than those of sweet cassava (49.32g/day) and pro-vitamin A cassava diets (48.88g/day) but the results of the cassava based diets are not significantly (p>0.05) different from each other. This difference in feed intake between the maize and cassava based diets could be as a result of dustiness and marshy texture of the cassava diets. This result agree with the findings reported by Ochetim [12] that marshy texture of cassava based diets coupled with the lower bulk density are contributing factors to lower feed intake. The result also agrees with the findings of Tewe and Egbunike [20] that dustiness of cassava feedstuff can reduce feed intake in poultry which adversely affects productivity. Onabowale [21] reported that dustiness of cassava feedstuff causes irritation of the respiratory tracts of the chicken unless the feed is pelletized or some oil is added. Literature also shows that dustiness and bulkiness are closely related to palatability and limit feed intake [22].

The average daily weight gain shown in table 4 shows that the weight gain of birds placed on maize-based diet (19.67g) was significantly higher (P<0.05) than those of sweet cassava-based diet (14.00g) and pro-vitamin A cassava based diet (15.00g). The average daily weight of the two cassava varieties were not significantly (P>0.05) different from each other. The higher significant difference in the maize diets could be as a result of the reduced feed intake of birds placed on the cassava-based diets due to dustiness and palatability. This agrees with the work of Ochetim [12] who found a decrease of 10% production in final body weight of broiler placed on 100% cassava-based diet with maize reference diet.

The reduced weight could also be as a result of 100% inclusion of cassava in the diets from the starter phase. This could have caused unsatisfactory growth of starter chicks which have immature intestinal microflora to properly handle micro-organisms such as Aspergllus niger which can infect cassava during drying on concrete floor although antibiotics were administered to the birds from the beginning of the experiment to check the problem posed by microorganism. This could have caused a depressive performance. This agrees with the findings of Tewe and Egbunike [20].

The result in table 4 shows that the feed conversion ratio was highest in sweet cassava-based diet (3.52), followed by that in pro-vitamin A cassava (3.26) and lowest in the maize-based diet (2.75). However, the values were not significantly (P>0.05) different from each other showing that all the birds in different treatment diets performed similarly. The similarity could be as a result of the isonitrogenous and near isocaloric content of the diets which allowed the birds to have equal nutrient. It could also be due to the reduction or much elimination of the anti-nutritional and depressive factors of cyanogenic glucoside, linamarin and lotaustralin in the form of hydrogen cyanide (HCN) to a low and non-toxic levels by sun-drying. This agrees with Tewe [23] that the limitation of cassava and its products for livestock feeding due to the presence of HCN could be reduced considerably by sun-drying and cassava flour can be safely incorporated into livestock feed when HCN is below 100ppm (mg/kg). The safe cyanide content also agree with the work of Ogundu *et al* [9] who obtained 93.77% reduction of cyanide in cassava by sun-drying for 3 consecutive sunny days reducing fresh cassava edible portion with 52.95 ppm of HCN to 3.30ppm. Literature has also shown that cyanide content of cassava roots less than 50mg/kg is non-toxic, [24] and will not decrease any performance. Any residual cyanide would have been converted to thiocyanide (SCN) by rhodanase enzyme in the liver using sulphur from sulphur containing amino acids such as methionine, lysine, cystene and cysteine. This brings the cyanide that would have caused depression to a negligible or zero level. [22,20].

The resuls in Table 4 also shows that the cost of producing one broiler from starter to finisher is highest in maize-based diet (₦1,305.79) followed by that of pro-vitamin A cassava based diet (₦982.91), while the lowest is that of sweet cassava-based diet (₦736.94). The cheaper cost of production by birds on cassava based diet could be as a result of the cheaper cost of sweet cassava tubers and pro-vitamin A cassava than maize in the market. As at the time of this research, the cost of 1kg of maize was ₦180, while that of sweet cassava and pro-vitamin A cassava were ₦40 and ₦80 respectively. The result shows that sweet cassava-based diet and pro-vitamin A cassava-based diets reduced the cost of poultry production with 43.56% and 24.73% respectively. This result agrees with the work of Ochetim [12] who reported

that cassava- based diets reduced the cost of production compared to maize-based diet with 30%. It also agrees with the work of Ogundu *et al* [25] who obtained 34.18% and 40.46% cost reduction with 75% and 100% pro-vitamin A cassava replacement of maize in poultry finisher respectively.

The values of live weight, breast, back, wing, neck and carcass weights of the three experimental diets as shown in table 5 showed no significant difference statistically (P>0.05). This result signifies that the treatments did not affect the characteristics of meat. The result agrees with the reports by Sultana *et al* [26] who indicated that the drumstick, wing, neck and breast showed no significant difference regardless of dietary supplementation of cassava meal.

Mortality was not recorded in any of the treatment diets throughout the experimental period . This could be as a result of reducing or near elimination of HCN to a non-toxic level by sun-drying and treating the starters with antibiotics that would have eliminated the Aspergillus niger normally associated with infection during sun-drying on concrete.

4. CONCLUSION

This experiment of feeding broiler birds from starter to finisher with sweet cassava based diet and pro-vitamin A cassava based diet using maize as a reference diet has shown that sweet cassava and pro-vitamin A cassava can be used to replace maize totally without any deleterious effect. It has also shown that using cassava to replace maize in poultry diet can be very economical although there is lower performance especially at the starter level. The economic gain would compensate the slight lower performance.

The experiment also shows that drying cassava chips for at least three (3) consecutive sunny days can remove cyanogenic glucoside and reduce the toxic hydrogen cyanide (HCN) to a level that will not cause mortality among broiler birds . Cassava diets have no influence on the carcass of the broiler birds. Adequate treatment of broiler starters with antibiotics can effectively handle the problem of aflatoxicosis caused by Aspergillus niger in younger chicks with no record of mortality.

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