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The Substitutional Value of Cassava Meal, Supplemented and Unsupplemented with Palm Oil for Maize in Broiler Diets

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Abstract: Two trials were conducted to investigate the effect of palm oil supplemented and unsupplemented cassava meal for maize in broiler ration. One hundred 7-day old unsexed broiler chicks of Arbor acre strain were used in each trial. Both trails had birds randomly allotted to each of five treatment diets with two replicate groups per diet in a Completely Randomized Design (CRD). Each treatment groups had 20 birds with 10 birds per replicate. Each of the trials lasted 5 weeks. In trial 1, dietary maize was substituted for cassava meal at 0, 25, 50, 75 and 100%. The result shows that birds fed diet 1 had significantly higher ($p<0.05$) mean final live weight gain (1344.0g) and mean total cost of feed consumed (N200.40) while the mean total weight gain (g) among the various treatments was comparable. The feed- to- gain ratio became numerically poorer (2.41 to 3.64) as the substitution level of cassava meal for maize increased from 25 to 100% while the cost decreased (N69.00 to 50.74) numerically, though, 25% and 50% substituted levels seemed advantageous both in terms of performance and economics of production. In trial 2 five isonitrogeneous (24%CP) and isocaloric diets (3000 kcal/kgME) were formulated with a progressive (0, 25, 50, 75 and 100% replacement of maize with palm oil supplemented cassava meal. In feeding trial, the mean total weight gain, feed-to-gain ratio and cost of total feed intake were significantly influenced ($p<0.05$). Birds fed diet 2 gave the best ($p<0.05$) performance, followed by diet s 1 and 3, while others gave a poor performance. Both the cost per kg feed (N) significantly decreased ($p<0.05$) as the level of substitution increased from 0-100%. Therefore substituting dietary maize with palm oil supplemented cassava meal at 25% demonstrates both productive and economic advantage over diet 1 and others.

Key words: Cassava meal, palm oil, supplemtation, maize, broiler chicken

INTRODUCTION

Shortage of proteins of animal origin is prevalent in all parts of Africa, where it is estimated that, on average, 10g of animal protein is consumed per day compared to a recommended daily intake of 35g[1-3]. Poultry production has been identified in most African countries especially in Nigeria with a singular aim of offsetting the huge animal protein deficit of the people[3]. However, this effort is being hampered by the high cost of commercial poultry production[4], yet poultry production especially, for broiler chickens remain one of the veritable ways of achieving sustainable and rapid production of high quality animal protein to meet the increasing demand of the African populace.

One of the major challenges to researchers in the tropics is the provision of alternative feeds for monogastric animals. Maize, a conventional feedstuff, has remained the major energy source in compounded diets for poultry and other non-ruminants. The various use to which maize is being committed, such as staple food for man, brewing and confectionary, has placed additional cost constraints on its continued use in poultry diets. The solution is to explore the use of local or alternative feedstuffs, hitherto underexploited by poultry farmers[5,6]. Among other alternatives which could be used as energy sources for poultry, cassava is of great importance. It has very high potential as alternative to maize as source of energy in poultry diets even though it is lower in protein and other essential nutrients[7-9].

However, one serious draw-back in the use of cassava as feed stuff for non-ruminants is its content of cyanogenic glucosides, linamarin and lotaustralin, which, on hydrolysis inside the animal, produces Hydrogen Cyanide (HCN) which is highly toxic[9,10]. The ability of cassava to produce cyanide is the basis of its toxicity. It is suggested[11] that for cassava root meal to be used in poultry feeds, it has to be processed so as to reduce its total cyanide content from 360 mg kg^{-1} to about 15-20 mg kg^{-1}. Various methods have been devised for

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Table 1: Percentage composition of the experimental diets fed to broiler chicken from 7-42 days of age (trial 1)

	Dietary treatment				
Ingredients	1	2	3	4	5
Yellow maize	55.00	41.25	27.50	13.75	0.00
Cassava meal	0.00	13.75	27.50	41.25	55.00
Soya bean meal	34.00	34.00	34.00	34.00	34.00
Fish meal (Danish)	2.00	2.00	2.00	2.00	2.00
Blood meal	3.80	3.80	3.80	3.80	3.80
Bone meal	3.00	3.00	3.00	3.00	3.00
Oyster shell	1.50	1.50	1.50	1.50	1.50
Common salt	0.25	0.25	0.25	0.25	0.25
Vit. Mineral premix 1	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Total (%)	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
Crude protein (%)	24.02	23.31	22.28	21.25	20.22
Metabolizable energy (kcal kg^{-1})	3034.0	3006.84	2979.34	2951.84	2924.34

Vitamin Mineral Premix provided per 2.5 kg per tonne of diet; vit A, 15,000, 000iu; vit D3, 3,000,000iu; vit E, 30,000iu; vit B 6, 4,000mg; ; Niacin, 40,000mgr; ;vit B12, 20mgr; pantotheric acid, 10,000mgr; folic acid, 1000mgr; Biotin, 80mgr; choline chlorides, 50mgr; antioxidant, 125g; manganese, 96gr; zinc, 60gr; iron, 24gr; copper, 6gr

detoxifying cassava tuber meal. These include cooking[12], soaking in water[13], sun drying[7] and use of additives[14,7]. Results of these processes are conflicting and also, live animal experiments conducted using cassava tuber meal have also given contradicting results[15,16,6].

The studies here in reported were, therefore designed to determine the performance of broilers fed different levels of palm oil supplement and unsupplemented sun-dried cassava tuber meal as substitute for dietary maize.

MATERIALS AND METHODS

Experimental location: The experiment was conducted at the poultry unit of the Teaching and Research Farm of the Michael Okpara University of Agriculture, Umudike, Abia State. Umudike is located at latitude 5° and 29^{l} North and longitude 1,7°32^{l} East in the forest zone of Nigeria. The climate of the region is characterized by a mean daily temperature range of 27-35°C all through the year. Average rainfall is about 2000mm per annum with double maxima pattern. The experiment was conducted within the months of March and May, 2004.

Procurement and processing of test ingredient: The cassava tuber used for the experiment were obtained from the farms of the National Root Crop Research Institute, Umudike, Abia State. The freshly harvested tubers were peeled and ground to form a sort of paste after which it was pressed to reduce moisture content and then sun dried for a period of one week.

Trial 1: effects of unsupplemented cassava meal as a substitute for maize in broiler diet

Composition of diets: Five diets were formulated. Diets (D) 1 was designated as the control while diets 2, 3, 4 and 5 had maize replaced with cassava meal at the following levels: 25, 50, 75 and 100%, respectively. The percent crude protein and the metabolizable energy (kcal kg^{-1}) of the diets reduced as the level of substitution increased from 25 to 100%.

The dietary crude protein ranged between 24.02% (D1) and 20.22% (D5) while the metabolizable energy (kcal kg)$^{-1}$ ranged from 3034.00 (D1) to 2924.34 (D5). The percentage composition and calculated analysis of the diets are shown on Table 1.

Experimental birds and their management: One hundred seven-day-old, unsexed broiler chicks of Arbor Acre strain were procured, weighed and randomly allotted to the five dietary treatments in 2 replicate lots of 10 chicks each. The birds were provided with water and fed the five experimental diets ad libitum from day 8 to 42 in a Completely Randomized Design (CRD). Health management practices carried out included the administration of Newcastle disease vaccine(i/0); infectious bursal disease (Gomboro) vaccine; Newcastle disease vaccine (Lasota); antistress and coccidiostat.

Parameters measured: Initial live weights of the chicks were taken. Differences in chick weights between week 2 and week 6 were recorded. Data on weekly feed intake and weight gain were collected. Feed-to-gain-ratio were calculated by dividing the total feed intake per bird by total weight gain. The data were subjected to an analysis of variance (ANOVA), while differences between means were separated using the Least Significant kifference (LSD)[17].

Economic analysis: Cost analysis was carried out at the end of the experimental period to assess the economic viability of the ingredients used. The cost kg^{-1} feed

Table 2: Percentage composition of the experimental diets fed to broiler chicken from 7 – 42 days of age (trial 2)

	Dietary treatments				
Ingredients	1	2	3	4	5
Yellow maize	55.00	41.75	27.50	13.75	0.00
Cassava meal	0.00	13.75	27.50	41.25	55.00
Palm oil	0.00	0.50	0.50	0.75	2.25
Soya bean meal	34.00	30.50	26.00	22.00	15.05
Fish meal (Danish)	2.00	2.00	5.00	7.25	10.25
Blood meal	3.80	6.80	8.30	9.80	12.75
Bone meal	3.00	3.00	3.00	3.00	3.00
Oyster shell	1.50	1.50	1.50	1.50	1.50
Common salt	0.25	0.25	0.25	0.25	0.25
Vit. Mineral premix 1	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Total (%)	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
Crude protein (%)	24.02	24.00	24.00	24.00	24.00
Metabolizable energy (kcal kg^{-1})	3034	3016.20	3007.20	3008.2	3005.00

Vitamin Mineral Premix provided per 2.5kg per tonne of diet same as in Trial 1

Table 3: Effect of feeding unsupplemented cassava meal as a substitute for maize in broiler chicken diets

	Diet					
Parameters	1	2	3	4	5	LSD
Mean initial (g)	142.50	142.50	143.00	144.00	144.00	2.48^{NS}
Mean final live weight (g)	1344.0^{a}	1057.0^{b}	999.0^{b}	975.0^{b}	942.0^{bc}	161.1*
Mean total weight gain (g)	1201.0^{a}	915.0^{a}	856^{ab}	$831.o^{ab}$	798.0^{bc}	161.1*
Mean total feed intake (g)	2903.0	2560.0	2978.0	3029.0	2702.0	830.0^{NS}
Feed-to-gain ratio	2.41	2.79	3.47	3.64	3.64	1.25NS
Mean total cost of feed intake (N)	200.4^{a}	165.8^{b}	178.4^{b}	167.3^{b}	137.0^{c}	35.73*
Feed cost (N/kg)	69.00	64.75	59.87	55.31	50.31	00.00NS

abc – Means within a row with different superscripts are significantly different ($p<0.05$)

ingredient used and that of the diets were noted. The mean feed intake was used to calculate the mean cost of feed consumed by the birds under each of the treatment.

Trial 2: Effect of palm oil supplemented cassava meal as a substitute for maize in broiler diet

Composition of diets: A total of five isonitrogenous (24% crude protein) and isocaloric (3000 k cal kg^{-1}) diets were formulated with a progressive (25, 50, 75 and 100%) replacement of maize with palm oil supplemented cassava meal. The diets were fortified with the synthetic amino acids-lysine and methionine. The feed was presented to the birds in mash form.. The dietary composition is presented in Table 2.

Experimental birds and their management: One hundred 7 day- old, unsexed broiler chicks of arbor acre strains were procured, weighed and randomly allotted to the five treatment diets with two replicate groups per diet in a Completely Randomized Design (CRD). Each treatment group had 20 birds with two replicates of 10 birds each.

Throughout the 5 weeks trial, feed and water were supplied ad-libitum. The health management, economic analysis and data analysis are as described in Trial 1.

RESULTS

Data on the performance and economics of production of broiler chicken fed the various dietary levels of cassava meal (trial 1) are presented in Table 3.

The calculated percent crude protein for diet 1 is 24.02 while 23.31, 22.28, 21.25 and 20.22 were for diets 2, 3, 4 and 5, respectively with a corresponding metabolizable energy of 3034.0, 3006.84, 2979.34, 2951.84 and 2924.34 kcal kg^{-1}. Birds fed diet 1 had a significantly higher ($p<0.05$) mean final live weight gain (1344.0 g) and mean total cost of feed consumed (N200.40) while the mean total weight gain (g) was not significantly different ($p>0.05$) among the various treatments. The feed-to-gain ratio was numerically poorer (2.41 to 3.64) as the substitution level of cassava meal for maize increased from 25 to 100% while the feed cost numerically decreased from N69.00 to N50.74.

In trial 2, Table 2 presents the composition of diets, while Table 4 summarizes the performance and economy of production data among treatments. Among the parameters measured only the mean total weight gain, feed –to-gain ratio and cost of total feed intake (N) were significantly ($p<0.05$) influenced by the diets. The feed-to-gain ratio for birds fed diets 1, 2 and 3 was significantly ($p<0.05$) better than those fed diets 4 and 5. Differences

Table 4: Effect of feeding palm oil supplemented cassava meal as a substitute for maize in broiler chicken diets

	Diets					
Parameter	1	2	3	4	5	LSD
Mean initial (g)	140.5	140.0	141.5	141.5	140.0	1.64
Mean final live weight (g)	1250.0^{b}	1504.0^{a}	1187.0^{c}	988^{d}	737^{e}	139.0
Mean total weight gain (g)	1109^{b}	1364.0^{a}	1046.0^{c}	846.0^{d}	597.0^{e}	139.4
Mean total feed intake (g)	3125.0	30.36	2752.0	3050.0	2657.0	371.8
Feed-to-gain ratio	2.82^{ab}	2.22^{a}	2.63^{ab}	3.61^{c}	4.45^{d}	0.21
Mean total cost of feed intake (N)	216.0^{a}	197.0^{b}	167.0^{bc}	174.6^{b}	145.9^{d}	23,40
Feed cost (N kg^{-1})	69.00	64.90	60.96	57.23	54.97	0.05

Abc – Means within a row with different superscripts are significantly different ($p<0.05$). 1 USD = N139

in this parameters among diets 1, 2 and 3 were not significant. Birds fed diets 4 and 5 gave a significantly poor feed-to-gain ratio of 3.61 and 4.45 respectively. Birds fed diet 2 gave significantly ($p<0.05$) highest mean total weight gain (1364.0g), followed by diets 1(1109g), 3(1046g), 4(846g) and 5(597g), respectively. The cost per kg of feed (N) numerically decreased as the level of substitution increased from 0 – 100% (D1 to D5) while the cost of total feed intake (N) also significantly ($p<0.05$) decreased in the same manner as cost per kg feed (N).

DISCUSSION

The superiority of diet 1 (Trial 1) over the other is an evidence that maize, as an energy source, is nutritionally superior to cassava meal[17-19]. This further corroborated the results obtained by 8 and 20, who observed a linear decrease in weight of poultry resulting from the increase in the quantity of cassava meal included in the ration. This may not be unconnected with the dilution of the nutrients as the cassava meal inclusion increased. This is because while maize contains 8.8%CP, 4.10%EE, 2.10% CP, 1.0% ash and 3510 kcal kg^{-1} ME, cassava meal contained 1.50% CP, 0.25% EE, 0.95%CF, 1.01% ash and 1700 kcal kg^{-1} food energy[18]. The drop in the cost of production as the substitution level of cassava meal for maize increased is due to the fact that cassava meal is cheaper than maize. This finding is in agreement with the results of 3.

In trial 2, the values observed for birds fed diets 2 and 3 is an evidence that substituting palm oil supplemented cassava meal for maize at 25 and 50% seems profitable for production performance. The numerically higher mean weight gain observed for birds fed diet 2 could be due to associative dynamic relationship between the dietary nutrients, which may have been enhanced. Adding fat to poultry feed is normal and acceptable because this addition has been shown usually to increase the metabolizable energy of the whole diet beyond that expected from the fat itself[18-21]. It was further observed that[22] that food intake and body weight gains in chicks were increased in the presence of dietary fat which improves efficiency of feed utilization.

The depreciation in performance observed in birds fed diets 3, 4 and 5 could be attributed to the following: progressive reduction of maize in the diets[23], high percentage of added dietary fat[22] and fish meal in a bid to produce isonitrogeneous and isocaloric diets, prussic acid content of the cassava root and/or to a phosphorylase inhibitor present in the rind of the cassava tubers[22,24,25] and other intrinsic factors. Since the cost/kg feed (N) is not significantly different among the different diets, there's the tendency to think that any of the diets which optimizes return could be selected. However, when cost of total feed intake (N) is closely considered, it will be observed that substituting cassava meal for maize beyond 25% and or 50% at best may not optimize good monetary returns, since cost of feed consumed constitutes above 65 to 70% of cost of production.

CONCLUSION

Results from trial 1 suggest that maize as dietary energy source in poultry diet is nutritionally superior to cassava meal. Nevertheless, substituting cassava meal for maize at 25%, 50%, 75& and 100% also gave a comparable results to diet 1, though 25% and 50% are numerically better. Results from trial 2 suggest that substituting palm oil supplemented cassava meal for maize at 25 and or 50% seems profitable for productive performance, especially, where maize is costly and scarce..

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