REPLACEMENT OF MAIZE WITH CASSAVA ROOT MEAL EITHER ALONE OR MIXED WITH BREWERS YEAST SLURRY IN DIETS FOR GROWING-FINISHING PIGS

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ABSTRACT

Twenty four (24) crossbred grower pigs of Large White, Landrace, Hampshire and Duroc breeds, which averaged 43.96kg liveweight, were allocated in groups of 4 pigs and two replicates, to each of 3 diets. Diet I was a maize-based control while in diets II and III, cassava root meal (CRM) solely, or its mixture with brewers yeast slurry (CRM-BYS) replaced all of the maize in the control. The pigs were group - housed in concrete floor pens where they were fed the test diets to appetite, and had water *ad libitum* over a 30-day period. Performance parameters were measured during this period, and at the end of it, 4 pigs from each treatment were slaughtered and their carcasses characterized. Average daily feed (ADF), average daily gain (ADG), feed/gain ratio for diets I, II and III were 2.08, 2.07, and 2.01 kg; 0.63, 0.60 and 0.64 kg; 3.31, 3.48 and 3.15 respectively. The differences were not significant ($P>.05$). Feed cost/kg liveweight gain was significantly ($P<.05$) reduced from ₦19.43 to ₦14.65 and ₦11.28 when dietary maize was replaced by CRM and CRM/BYS respectively. Linear and jointed carcass measures, and organ weight did not differ significantly ($P>.05$) in the different diets. These data show a net advantage of replacing dietary maize with cassava root meal or its mixture with brewers yeast slurry for growing-finishing pigs under the defined conditions.

KEY WORDS: Cassava Root, Maize, Brewers Yeast Slurry, Pigs.

INTRODUCTION

Cassava has become an important animal feed in the last two decades. In all regions of the world where it is grown, increased proportions of the produced cassava are being used particularly in non-ruminant animal feeding. The Thailand export of cassava chips mostly to the European Community has increased from 150,000 tonnes in 1968 to 6 million tonnes in two decades. According to Central Bank of Nigeria, Annual Report and Statement of Accounts for the year ended December, 1993, cassava production in Nigeria has increased from 17.4 million tonnes in 1989 to 22.3 million tonnes in 1993. The corresponding increase in maize production within the same period was from 5 million tonnes to 6.9 million tonnes. The produced maize is competed for by brewers of beer, flour mill processors and direct human consumption, with hardly any left for livestock feeding. The livestock sector would obviously be better off utilizing cassava products as energy feeds in Nigeria. Exchange of information on the use of cassava products in livestock feeding has increased during this period (Nestle and Graham, 1977; Gohl, 1981). In the tropics where most of the world's cassava is grown, much is being done to obtain information on how best cassava products would be utilized in animal feeding (Oke, 1978; Walker 1983). Cassava is much lower in protein content, and its protein is of poorer quality, than the cereal grains it replaces in the diets, causing protein deficiencies in such diets which are expensive to balance. Microbial fermentation has been used to substantially improve the protein content of cassava (Gray and Abou-El-Seoud, 1966; Reade and Gregory, 1975; Varghese *et al.*, 1977) and such fermented products have been reported to be promisory in pig feeding (Hutagalung and Tan, 1976).

Cassava root meal (CRM) has been used as basic material for the preservation of brewers yeast slurry in an on-going study (Ikurior, 1991, unpublished). When the mixture was

compared with maize and cassava root meal alone in diets for weaner-grower pigs it was observed that the mixture reduced dietary cost significantly; feed utilization was improved with the overall reduced cost of pig liveweight gain. Animal feeding studies involving growing-finishings pigs (Martynov *et al.*, 1985) and lactating cows (Steckley *et al.* 1979) portray brewers yeast as a valuable alternative protein material. The present study aimed at observing the effects of replacing dietary maize with cassava root meal alone, or its mixture with brewers yeast slurry on performance and carcass characteristics of growing--finishing pigs.

MATERIALS AND METHODS

Cassava root meal (CRM) was prepared by chipping whole fresh cassava roots, sun-drying the chips for 3 - 4 days and thereafter milling them for storage in polythene bags. Brewers yeast slurry (BYS) was obtained from Benue Breweries Ltd., Makurdi in 50L screw-top plastic containers, and immediately sampled for determination of dry matter and crude protein. Within approximately one hour of its collection, the BYS was mixed with CRM at 1:1 ratio w/w, and the mixture sun-dried to moisture content of less than 10 percent. The dried mixture was sampled for analysis, then stored in polythene bags until incorporated in the test diet.

Dietary Treatments

Three diets were formulated and coded I, II and III. Diet I was a maize-based control; diets II and III contained respectively, CRM solely and CRM-BYS mixture, which in each case replaced all the maize in I. Cooked, sun-dried full-fat soyabean supplied the major portion of protein for all diets. All diets were

TABLE 1: PROXIMATE CHEMICAL COMPOSITION[a] OF MAJOR FEED INGREDIENTS USED IN THE STUDY

Material	DM %	Crude Protein	Crude Fibre	Ether Extract	Ash	NFE[b]
			% of DM			
Maize	89.00	9.70	3.03	4.12	2.08	81.07
Soyabean	90.20	42.15	5.12	17.88	3.87	30.98
Cassava root meal	92.24	2.40	3.54	0.60	2.80	90.66
CRM/BYS mixture	91.42	9.20	3.75	0.75	3.55	83.28
Brewers dried grains	90.60	27.17	14.91	5.80	4.00	48.12
Rice husks	92.50	4.80	35.90	1.58	11.03	46.69

[a] Values represent means of five determinations
[b] NFE = Nitrogen-free extract.

TABLE 2: PERCENTAGE COMPOSITION OF THE TEST DIETS

Ingredients	Dietary Treatment		
	I	II	III
Maize	55.0	-	-
CRM	-	52.0	-
CRM/BYS[a]	-	-	60.0
Full-fat soyabean	20.0	28.0	20.0
Dried brewers grain	10.0	10.0	10.0
Rice husks	10.0	5.0	5.0
Bone meal	2.5	2.5	2.5
Mineral-vitamin-premix[b]	2.0	2.0	2.0
Salt (NaCl)	0.5	0.5	0.5
Zinc oxide[c]	+	+	+

[a] Mixture (air-dry basis) contained 9.2% CP, 85.6% CRM, 14.4% BYS.

[b] Containing per kg: 200000 IU vitamin A; 30000 IU vitamin D3; 60IU vitamin E; 40mg pyridoxin; 30mg niacin; 0.5mg iron; 8mg folic acid; 2mg selenium; 6g choline chloride; 0.16g vitamin B_{12}; 2.5g antioxidant; 1.6g manganese; 1.2g zinc; 1.2g iodine, 0.2g cobalt. Containing 18% calcium, 5% phosphorus; 4% available phosporus; 9% protein; 1.1% lysine, 0.9% methonine; 3% salt; 4.5% fibre.

[c] Zinc oxide was added to supply 100ppm zinc.

TABLE 3: PROXIMATE CHEMICAL COMPOSITION OF THE TEST DIETS (% DM)

Parameter	Dietary Treatments I	II	III
Dry matter	90.5	91.2	91.4
Crude protein	18.1	17.5	17.8
Crude fibre	7.08	6.55	6.62
Ether extract	5.50	4.80	5.50
Ash	4.46	5.1	5.12
NFE[a]	69.96	69.75	69.16
Calcium %[b]	0.99	1.11	1.10
Phosphorus,%[b]	0.56	0.57	0.56
Lysine, %[b]	0.79	0.91	0.98
Methionine + cystine, %[b]	0.52	0.46	0.47
Metabolisable energy, Kcal/kg[b]	3222.0	3332.0	3202

[a] Nitrogen-free extract, obtained by subtracting the sum of values for CP, CF. EE, Ash from 100.

[b] Calculated values from, The Nutrient Master Plan Table of nutrients feed ingredients by Pfizer Livestock Feeds PLC and from values published by Jurgens (1978).

TABLE 4: REPLACEMENT OF DIETARY MAIZE WITH CASSAVA ROOT MEAL ALONE OR MIXED WITH BREWER'S YEAST SLURRY FOR GROWING-FINISHING PIGS: COST OF TEST DIETS.

Ingredient	Price[a]/ Tonne ₦	Contribution to Cost of Diet (₦/tonne) I	II	III
Maize	7,500.00	4125.0	-	-
Cassava Root Meal	3,600.00	-	1872.0	-
Cassava Root meal-Yeast Slurry mixture	-	-	-	1849.0
Full-fat Soyabeans	7,500.00	1500.0	2100.0	1500.0
Dried Brewer's Grain	1,000.00	100.00	100.0	100.0
Rice Husk	250.00	25.0	12.5	12.5
Bone Meal	2,000.00	50.00	50.00	50.00
Vitamin-Mineral Premix	80.00/kg	16.0	16.0	16.0
Salt	4,000.00	20.0	20.0	20.0
Zinc Oxide	300/kg	37.4	37.4	37.4
Cost of Diet (₦/tonne)		5873.4	4207.5	3584.9

[a] Operating prices in Benue State during the first quarter of 1993.

balanced for protein and energy. The percent composition of the test diets is presented in Table 1 while their proximate chemical composition, determined according to A.O.A.C. (1984) official methods appears in Table 2. The diets were costed (Table 3), using prevailing market prices of the feed ingredients in Benue State, Nigeria during the first quarter of 1993.

Experimental Pigs and Their Management

Crossbred grower pigs of about 5 months and weighing approximately 44 kg from Large White, Landrace, Hampshire and Duroc breeds were used in the study. The pigs were alloted in groups of 4 to each of the dietary treatments while balanting for initial weight, litter origin and sex as much as was possible. The pigs were housed in concrete floor pens measuring 2 x 3 metres; they were group-fed the test diets to appetite and had water *ad libitum* during the day. The pigs were fed twice daily, in the morning following the pen washing, and at about 4 pm. There were two replicates with a total of 8 pigs per dietary treatment. Daily feed intake for each group was recorded, from which values, the average daily feed (ADF) was determined. The pigs were weighed weekly and their average daily gain (ADG) determined from the group weekly liveweight gain. Feed per gain ratios were then computed. The feeding lasted 30 days after which two pigs from each group, that is four per treatment, were feed-starved for 18 hours then weighed, slaughtered and

TABLE 5: PERFORMANCE OF GROWER-FINISHER PIGS FED MAIZE, CRM OR CRM/BYS IN DIETS.

Parameter	Dietary Treatments I	II	III	SEM
Number of pigs	8	8	8	
Av. Initial Liveweight (kg)	43.80	44.28	43.81	
Av. Final liveweight (kg)	62.80	62.20	63.12	
Av. daily feed (kg)	2.08	2.07	2.01	0.15NS
Av. daily gain (kg)	0.63	0.60	0.64	0.07NS
Feed/gain ratio	3.31	3.48	3.15	0.25NS
Feed cost/kg liveweight gain (₦)	19.43[a]	14.65[b]	11.28[c]	1.17 *

NS = Not significant (P > .05) *Means with different superscripts differ (P < .05).

TABLE 6: EFFECT OF REPLACING DIETARY 'MAIZE WITH CRM ALONE OR MIXED WITH BYS ON LINEAR CARCASS MEASURES AND ORGAN WEIGHTS OF PIGS SLAUGHTERED AT APPROXIMATELY 63 KG LIVEWEIGHT.

Parameter	Dietary Treatments I	II	III	SEM
Carcass length (cm)	68.00	65.00	67.50	1.41NS
Av. backfat thickness (cm)	2.47	2.75	2.15	0.36NS
Loin eyes area (cm^2)	29.55	28.24	29.25	0.81NS
Kidney fat weight (kg)	0.35	0.40	0.36	0.11NS
Liver (kg)	1.18	1.14	1.17	0.16NS
Heart (kg)	0.33	0.28	0.30	0.10NS
Kidney (kg)	0.14	0.14	0.14	0.02NS
Lungs and trachea (kg)	0.68	0.68	0.69	0.19NS
Spleen (kg)	0.14	0.13	0.13	0.02 NS
Empty stomach (kg)	0.58	0.59	0.59	0.06NS

NS = Not significant (P > .05).

TABLE 7: EFFECT OF REPLACING DIETARY MAIZE WITH CRM ALONE OR MIXED WITH BYS ON THE JOINTED CARCASS PROPORTIONS OF PIGS SLAUGHTERED AT APPROXIMATELY 63 KG LIVEWEIGHT

Parameter	Dietary Treatments I	II	III	SEM
Warm dressing	79.06	78.64	78.29	0.84 NS
Ham (%)	26.56	26.74	26.72	0.19 NS
Loin (%)	19.34	18.94	19.26	0.50 NS
Picnic Shoulder (%)	16.90	16.74	16.86	0.11 NS
Boston butt (%)	13.26	13.92	13.04	0.16 NS
Jowl (%)	7.03	7.12	6.96	0.34 NS
Belly (%)	15.84	16.28	15.88	0.82 NS
Four lean cuts (%)	76.06	75.44	75.88	1.08 NS
Two fat cuts (%)	22.87	23.40	22.84	1.12 NS

NS = Not significant (p > .05).

their carcasses characterized according to procedures described by Ikurior and Fetuga (1988). Tissue dissection and chilling of the carcasses were not carried out in the present study. The data were analysed using the single factor classification design of Steel and Torrie (1980).

RESULTS AND DISCUSSION

The performance of the grower-finisher pigs fed the three test diets is summarized in Table 4. After 30 days, the pigs from all groups recorded liveweights of more than 62 kg. Though the pigs fed diet III recorded marginal superiority in performance over I and II, no significant differences ($P > .05$) were observed for all performance parameters among the three diets. For the pig, the balance in the essential amino acids of diets has a profound influence over the voluntary consumption and utilization of its diet. The levels of lysine and methionine, the two most limiting amino acids in pig nutrition, contained in the experimental diets (Table 2) numerically surpass the requirements of growing--finishing pigs (Jurgens, 1978). It may be inferred from this performance that the available portions of these amino acids, along with that of the entire profile were adequate to effect satisfactory growth of the pigs. The cost of the test diets was greatly influenced by the market price of maize, and that of cassava root meal (Table 3). Muller *et al* (1972) found in 9 different experiments that cassava-fed pigs performed as well as, or in some cases, even better than those on maize-based rations, regardless of the low CP content of the cassava-based rations. On the other hand, many of earlier works have reported pig growth depression with increased levels of dietary cassava (Hatagalung, 1977; Oke, 1978). Decreased performance was ascribed to HCN content in cassava, and to the fluffy and dusty nature of high--cassava diets, which depressed feed intake. Excessive ash as well as crude fibre contents of CRM have been reported to decrease the digestibility of the cassava-based rations as a whole (Muller *et al.*, 1974).

The present study data however suggest that at the levels of CRM used and under the defined experimental conditions, these factors apparently did not adversely affect pig performance. The inclusion of BYS, an industrial waste material in the diet which also contained CRM as the energy source, substantially reduced the amount of full-fat soyabean, and thus cost of the diet relative to that containing CRM alone. The feed cost per kg liveweight gain was therefore an interplay between the dietary cost and utilization efficiency. Significant ($P < .05$) reductions in feed cost/kg liveweight gain were recorded as CRM, and more so, as its mixture with BYS replaced maize in the diets.

The linear carcass measures (Table 5) did not differ significantly ($P > .05$) among the test diets, though pigs fed the CRM diet (II) had somewhat fattier carcasses. The tissues of the pigs fed diet II had been deposited on shorter body frames, i.e. the carcass length was about 3cm shorter than that of either of the other two diets. Furthermore, diet II contained somewhat higher metabolizable energy than the other two diets, most probably due to its higher content of full-fat soyabean.

The organ weights (Table 5) and the jointed carcass proportions (Table 6) were unaffected ($P > .05$) by dietary treatments; Values for the measured parameters were comparable with those reported elsewhere for similar weight pigs (Ikurior and Fetuga, 1985; Ikurior *et al.*, 1993). The lean growth of pigs in the present study was good as the percentages of four lean cuts in the carcasses were above 75.

Since lean growth in pigs has been related to the availability of dietary amino acids in proper amounts and proportions as explained by Ikurior *et al* (1993), and and to the overall nutrient balance of diet, the diets under discussion in the present study would appear to have met optimal pig lean growth conditions. For the pig production industry, this is most welcome because the value- based marketing systems for pigs are strongly related to high lean carcasses (Akridge *et al.*, 1990). According to Gu *et al* (1991) lean gain reflects the increase in revenue with each

increment in liveweight gain, and lean feed efficiency reflects the revenue per unit of feed consumed. That the cheaper CRM replaced all of the maize in the diet without any discernible adverse effect on the performance and carcass score of pigs manifests the important role being advocated for cassava in non-ruminant feeding as the energy source. When combined with full-fat soyabean in the manner shown in the present study, cassava root meal significantly reduced the cost of lean tissue deposition of the pigs relative to the combination with maize in diet of similar protein content. Brewers yeast slurry mixture with CRM further significantly ($P < .05$) reduced the cost of liveweight gain in the pigs, with a clear overall advantage on both CRM alone and maize. Brewers yeast slurry is a rich source of protein, amino acids and vitamins (Hough *et al.*, 1982). Its preservation in the manner described would appear to present a useful alternative feed material in pig nutrition with a positive impact on production efficiency and profitability.

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