CASSAVA MEAL AND CASSAVA PEEL MEAL FOR GROWING AND FINISHING PIGS[1] /

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Resumen

Se probó la inclusión de 0%, 30%, 45% y 60% de tubérculos de yuca medidos (CM) y secados al sol en raciones de cerdos en crecimiento. En adición se probó el efecto de adiciones 15% y 30% de CM más 15% y 20% de cáscara de yuca medida (CPM) en raciones de acabado de cerdos Large White y Locales. Los cerdos en crecimiento que recibieron la ración con substitutos crecieron ligeramente más rápido y fueron ligeramente eficientes en convertir alimento que los cerdos con la dieta control, aunque las diferencias no fueron significativas. El acabado de cerdos a base de dietas con CM = CPM fue bajo aunque la velocidad de crecimiento y la eficiencia de conversión de alimento no se alteró en forma significativa. La combinación 15% CM = 20% CPM fue consistentemente superior aunque no significativamente, a las demás raciones. En términos generales los cerdos Large White utilizaron CM mejor que los cerdos locales, los últimos emplearon CPM con mayor eficiencia. La canal de los cerdos testigos obtuvo un valor de calidad más alto que la de cerdos alimentados con raciones sustituidas. Debido a su mayor digestibilidad, CM superó el efecto sobre este parámetro de las mezclas CM-CPM.

Introduction

The replacement of cereals with cassava meal in the diet of growing-finishing pigs has been widely studied. Kok and Ribeiro (6) observed enhanced liveweight gain, feed intake and efficiency but noted increased fat deposition and reduced loin eye area in pigs fed cassava based rations. Peixoto (12) reported depressed gain, feed intake and efficiency, but also higher fat deposition and decreased loin eye area. More recent reports have shown that cassava may fully replace cereals without any deleterious effects on live performances when diets are properly balanced (4, 7, 8). However, Sonaiya *et al.* (16), feeding methionine supplemented cassava meal diets to pigs at three stages of growth, concluded that higher levels of cassava meal fed to finishers increased fat deposition due to the higher digestible energy intake.

Diluting the digestible energy of the finishing rations with fibrous feedstuffs should result in leaner carcasses. Rice bran has been used as a diluent (9) and cassava peel meal is very similar in proximate composition to rice bran. The steady rise in the amount of cassava tubers peeled for human and livestock consumption, industrial starch production and fermentation is rapidly increasing the quantity of cassava peels available. Inclusion of up to 15% cassava peel meal in corn based finishing diets improved growth rate and carcass quality (15).

This is a report of experiments designed to study the effect of cassava meal in the growing rations and

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cassava meal plus cassava peel meal in the finishing rations.

Materials and methods

Five experimental rations containing 0% , 15% , 30% , 45% and 60% sun-dried, ground cassava tubers (CM) were formulated for the growing phase (Table 1). Finishing rations contained 15% and 30% CM + 15% and 20% sun-dried, ground cassava peel (CPM) in a 2^2 factorial treatment to give four substituted rations while the control ration did not contain either of the test ingredients (Table 2). Attempts were made to balance the rations by the inclusion of palm oil and feed grade methionine and lysine to arrive at isocaloric and isonitrogenous rations.

The rations were analysed for proximate composition. Energy digestibility was evaluated with pair fed pigs on each treatment in a metabolism study. Gross energy of feed, feces and urine was determined in a Gallenkamp ballistic bomb calorimeter. Urine was freeze-dried overnight in a Virtis freeze dryer after shell freezing with alcohol in a Virtis shell freezer. Hydrocyannic acid concentration in CM and CPM was measured on a Beckmann atomic absorption spectrophotometer at 515 mn using KCN solution as a standard (18).

Eighty pigs (40 Large Whites and 40 Locals) were allocated, 16 pigs per treatment, on the basis of sex, breed and weight such that the average individual weight in all treatments was 8.7 kg. Pigs were group-fed the growing rations until they attained an average of 40 kg liveweight. They were then put on the finishing rations until they attained average slaughter weight of 60 kg (75 kg for Large White, 45 kg for Locals). Feed was supplied at a controlled rate of 1.5-2 kg/pig/day. Water was always available. All pigs were slaughtered and hot carcass measurements taken as previously described (16) except for loin eye area which was measured on loins chilled for 24 hr at 5°C.

Table 1. Composition of cassava meal grower's rations.

INGREDIENTS		% Air Dry Basis				
Yellow maize		50.45	31.00	12.00	0.00	0.00
Cassava meal		0.00	15.00	30.00	45.00	60.00
Groundnut cake		20.00	22.30	24.45	26.00	28.30
Fish meal		4.00	4.60	5.50	8.20	8.30
Brewers' dried grain		15.00	16.00	16.40	10.00	0.00
Rice bran		1.50	1.50	1.50	1.40	0.00
Palm oil		5.65	6.20	6.75	6.00	0.00
Dicalcium phosphate		1.50	1.50	1.50	1.50	1.50
Oyster shell		0.50	0.50	0.50	0.50	0.50
Salt		0.50	0.50	0.50	0.50	0.50
Ad-Vit*		0.50	0.50	0.50	0.50	0.50
Methionine		0.15	0.15	0.15	0.15	0.15
Lysine		0.25	0.25	0.25	0.25	0.25
				Calculated Analysis		
Digestible energy (kcal/kg)		3501.60	3503.90	3510.60	3504.50	3281.50
Crude protein	(%)	20.03	20.01	20.03	20.04	19.14
Crude fiber	(%)	3.94	4.09	4.16	3.54	2.60
Ether extracts	(%)	10.21	10.69	11.17	10.27	4.01
Calcium	(%)	0.83	0.89	0.96	1.11	1.11
Phosphorus avail.	(%)	0.50	0.51	0.52	0.59	0.58
Methionine	(%)	0.50	0.50	0.50	0.51	0.49
Cystine	(%)	0.35	0.34	0.34	0.35	0.34
Lysine	(%)	0.99	1.03	1.08	1.17	1.12

* A commercial vitamin-mineral preparation by Pfizer Ltd., Ikeja, Nigeria., supplying per kg diet: 10 000 I.U. Vit A, 1333 I.U. Vit. D_3, 6.7 mgB_2, 83.3 I.U B_3, 23.3 I.U. B_5, 0.03 mgB_{12}, 833 mg Choline chloride, 16.7 mg Zinc bacitracin, 208 mg antioxidant, 167 mg Iron, 133 mg Manganese, 208 mg Zinc, 125 mg Copper, 0.83 mg Cobalt and 3.3 mg Iodine

Table 2. Composition of cassava meal-cassava peel meal rations for finishing pigs.

INGREDIENTS		% Air Dry Basis				
Yellow maize		53.00	27.00	10.00	25.00	8.00
Cassava meal[1]		0.00	15.00	30.00	15.00	30.00
Cassava peel meal[2]		0.00	15.00	15.00	20.00	20.00
Groundnut cake		10.00	10.00	11.00	11.00	11.00
Fish meal		3.00	3.00	4.00	4.00	4.00
Brewers' dried grain		2.00	13.00	15.00	8.00	16.00
Rice bran		27.00	12.00	10.00	12.00	6.00
Palm oil		2.50	2.50	2.50	2.50	2.50
Dicalcium phosphate		0.50	0.50	0.50	0.50	0.50
Oyster shell		0.50	0.50	0.50	0.50	0.50
Salt		0.50	0.50	0.50	0.50	0.50
Ad-Vit		0.50	0.50	0.50	0.50	0.50
Methionine		0.25	0.25	0.25	0.25	0.25
Lysine		0.25	0.25	0.25	0.25	0.25
				Calculated Analysis		
Digestible energy (kcal/kg)		3010.30	3010.30	3006.85	3003.49	3020.02
Crude protein	(%)	14.28	14.18	14.11	14.26	14.14
Crude fiber	(%)	4.76	5.51	5.71	5.59	5.85
Ether extracts	(%)	9.54	7.54	7.28	7.34	6.71
Calcium	(%)	0.52	0.59	0.67	0.65	0.68
Phosphorus avail.	(%)	0.41	0.33	0.34	0.35	0.44
Methionine	(%)	0.55	0.50	0.50	0.50	0.49
Cystine	(%)	0.24	0.21	0.22	0.22	0.21
Lysine	(%)	0.82	0.78	0.85	0.81	0.83

1 HCN content – 75 mg/kg

2 HCN content – 163 mg/kg.

The effects of treatments, breed, and sex were tested. Liveweight and carcass data obtained from the finishing period were also summarised for the two factors (CM and CPM) and tested for main effects and interactions

Results

Effects of cassava meals on daily gain, feed and digestible energy intakes and efficiencies of growing pigs are summarised in Table 3. Pigs receiving increasing levels of CM grew slightly faster and appeared to more efficiently convert feed than pigs on the control diet. Differences were however not significant ($P > 0.05$). In the finishing phase the control diet promoted non-significantly faster growth and better feed efficiency than CM + CPM diets (Table 4). It would appear that 15% CM is superior to 30% CM for growth promotion and efficiency of feed conversion. Similarly, 20% CMP promoted better live performances than 15% CPM and a combination of 15% CM + 20% CPM was consistently but non-significantly superior to other substituted rations in promoting live performances. Energy digestibility values were generally low, did not seem to reflect the level of crude fiber in the rations and did not differ significantly in both growing and finishing phases ($P > 0.05$).

Mean values for daily gain, feed intake and feed/kg gain for the two breeds are presented in Tables 5 and 6. Large White pigs made significantly faster gains but non-significantly consumed less feed and converted feed more efficiently than Local pigs. During the growing phase, Local pigs on the control showed the fastest rate of gain as compared with Local pigs on the substituted rations. Large White pigs on 45% CM ration made the fastest gains compared with Large White pigs on other treatments. While differences among Large White pigs were significant, those between Local pigs were not. In the finishing phase, the control diet as well as the 15% + 20% CPM diet promoted the fastest significant rate of gain in

Table 3. Live performances of growing pigs on cassava meal diets.

		Cassava meal levels (%)					
		0	15	30	45	60	SEM[2]
Daily gain	(kg)	0.40	0.48	0.50	0.54	0.48	0.049
Daily feed intake	(kg)	1.40	1.40	1.19	1.40	1.39	0.093
Daily dry matter intake	(kg)	1.25	1.24	1.04	1.21	1.19	0.085
Daily digestible energy intake[1]	(kcal)	2.74	2.81	2.40	2.85	2.70	0.178
Feed/kg gain	(kg)	3.47	2.93	2.40	2.60	2.92	0.406
Digestible energy/kg gain	(kcal)	6.80	5.88	4.85	5.30	5.67	0.729
Dry matter/kg gain	(kg)	3.10	2.59	2.10	2.25	2.50	0.384
Dry matter digestibility	(%)	60.66	56.60	60.10	60.73	61.64	1.950
Energy digestibility	(%)	55.00	55.28	56.10	58.89	59.82	2.196
Determined gross energy	(kcal/kg)	3557	3627	3596	3457	3247	153.62
Determined digestible energy	(kcal/kg)	1956	2005	2017	2036	1942	40.38

1 Obtained from determined de values.

2 Standard error of mean

Table 4. Live performances of finishing pigs fed cassava meal-cassava peel meal diets.

Cassava meal levels	(%)	0	15	30	15	30	SEM[2]
Cassava peel meal levels	(%)	0	15	15	20	20	
Daily gain	(kg)	0.48	0.43	0.43	0.47	0.40	0.028
Daily feed intake	(kg)	1.64	1.64	1.57	1.64	1.58	0.040
Daily dry matter intake	(kg)	1.40	1.39	1.33	1.33	1.34	0.029
Daily digestible energy intake[1]	(kcal)	3.39	3.77	3.55	3.30	3.32	0.200
Feed/kg gain	(kg)	3.40	3.86	3.62	3.46	3.97	0.245
Digestible energy/kg gain	(kcal)	7.03	8.87	8.18	6.96	8.34	0.840
Dry matter/kg gain	(kg)	2.90	3.27	3.06	2.93	3.37	0.208
Dry matter digestibility	(%)	53.27[a]	65.33[bc]	62.71[b]	60.96[b]	70.16[c]	3.210
Energy digestibility	(%)	60.01[a]	68.75[b]	66.44[b]	61.26[a]	67.04[b]	3.827
Determined gross energy	(kcal/kg)	3440[a]	3340[a]	3408[a]	3283[a]	3131[b]	122.10
Determined digestible energy	(kcal/kg)	2064[a]	2286[b]	2264[b]	2011[a]	2099[a]	126.09

1 Based on determined digestible energy of the diets.

a, b, c,: Figures in the same horizontal row bearing the same superscript are not significantly ($P > 0.05$) different.

2 Standard error of mean

Table 5. Live performances of two breeds (large white (LW) and locals (L) pigs) and two sexes (barrows (B) and gilts (G)) fed cassava meal in the growing stage.

		Cassava meal levels (%)									
		0		15		30		45		60	
		LW	L	LW	L	LW	L	LW	L	LW	L
Daily gain	(kg)	0.429	0.377	0.593	0.363	0.636	0.353	0.743	0.332	0.603	0.349
Daily feed intake	(kg)	1.36	1.43	1.36	1.43	1.36	1.01	1.36	1.43	1.36	1.42
Feed/kg gain	(kg)	3.17	3.79	2.29	3.94	2.14	2.86	1.83	4.41	2.26	4.07
Daily gain	(kg)[1]	0.401	0.405	0.529	0.427	0.583	0.406	0.533	0.542	0.394	0.558

1 Barrows and gilts respectivily.

Large White pigs while Local pigs made the fastest non-significant gain on the 30% CM + 15% CPM diet. In general, it appeared that Large White pigs utilised CM better than Local pigs while Local pigs utilised CPM better than Large White pigs.

In the growing phase, barrows made the fastest gain on the 30% CM diet while gilts had the best growth rate on the 60% CM diet (Table 5). In the finishing phase, 30% CM + 15% CPM mixture promoted the fastest rate of gain in barrows while gilts made the greatest daily gain on the control (Table 6). All differences were not significant. Gilts appeared more sensitive to changes in diet composition but at higher levels of substitution seemed to utilise both CM and CMP better than barrows.

Carcasses of control pigs had significantly higher dressing values than those of pigs on substituted rations (Table 7). Pigs on substituted rations did not differ significantly in dressing value. Carcass length, backfat, loin eye area, lean cuts percent and fresh liver and kidney weights were not significantly different and did not seem to be influenced by the experimental treatments.

Large White carcasses were significantly superior to Locals' in dressing, length, backfat and loin area (Table 8). Lean cuts percent was not significantly different. Dressing value was highest in Large Whites on the control and decreased with increasing substitution of CM and CPM. Differences between the substituted rations were not significant. Dressing value was non-significantly improved in Locals with increasing substitution. Backfat increased in both breeds with increasing substitution while loin eye area decreased in Large White carcasses but increased in Local carcasses with increasing substitution.

Barrows had non-significantly longer carcasses with thicker backfats than gilts and increasing substitution tended to increase both length and backfat equally in barrows and gilts (Table 9). Sex did not seem to have any effect on the carcass characteristics of pigs on this experiment. This would suggest that

Table 6. Live performances of large white and local pigs; barrows and gilts fed cassava meal-cassava peel meal rations in the finishing stage (40 kg – Slaughter).

Cassava meal levels (%)		0		15		30		15		30	
Cassava peel meal levels (%)		0		15		15		20		20	
		LW	L	LW	L	LW	L	LW	L	LW	L
Daily gain	(kg)	0.686	0.273	0.535	0.266	0.513	0.283	0.674	0.268	0.536	0.236
Daily feed intake	(kg)	1.36	1.92	1.36	1.92	1.36	1.77	1.36	1.92	1.36	1.80
Feed/kg gain	(kg)	1.98	7.03	2.54	7.22	2.65	6.25	2.02	7.16	2.54	7.63
Daily gain	(kg)[1]	0.474	0.485	0.466	0.400	0.456	0.407	0.419	0.525	0.368	0.424

1 Barrows and gilts respectivily.

Table 7. Carcass data of pigs fed cassava meal-cassava peel meal rations.

Cassava meal levels (%)		0	15	30	15	30	SEM[1]
Cassava peel meal levels (%)		0	15	15	20	20	
Dressing	(%)	75.05[a]	69.53[b]	69.25[b]	68.17[b]	69.67[b]	1.68
Carcass length	(cm)	67.94	70.01	68.38	67.38	68.13	0.99
Backfat average	(cm)	2.52	2.61	2.70	2.72	2.63	0.08
Loin area	(cm^2)	21.09	18.49	19.02	18.22	18.83	1.14
Lean cuts	(%)	75.18	74.41	74.12	75.66	76.23	0.87
Fresh liver weight	(g)	971	1170	1111.5	975	899.5	111.44
Fresh kidney weight	(g)	165.5	164.5	173.5	179.0	158.0	8.21

1 Standard error of mean.

a, b: Figures in the same row bearing the same superscript are not significantly ($P > 0.05$) different.

Table 8. Carcass data of large white and local pigs fed cassava meal-cassava peel meal rations.

Cassava meal levels (%)		0		15		30		15		30	
Cassava peel meal levels (%)		0		15		15		20		20	
		LW	L	LW	L	LW	L	LW	L	LW	L
Dressing	(%)	87.59	62.50	77.70	61.35	75.20	63.29	72.67	63.67	74.02	65.32
Carcass length	(cm)	75.75	60.13	77.63	62.38	76.50	60.25	73.50	61.25	75.25	61.00
Average backfat	(cm)	2.33	2.71	2.39	2.82	2.47	2.92	2.55	2.88	2.38	2.88
Loin area	(cm^2)	29.60	12.57	22.74	14.23	21.91	16.13	22.55	13.89	23.52	14.13
Lean cuts	(%)	75.65	74.70	74.97	73.84	75.20	73.04	73.87	77.45	73.27	79.19
Fresh liver weight	(g)	1067	875	1165	1175	1135	1088	1004	945	981	818
Fresh kidney weight	(g)	163	168	156	173	157	190	168	190	143	173

Table 9. Carcass data of barrows and gilts fed cassava meal-cassava peel meal rations.

Cassava meal levels (%)		0		15		30		15		30	
Cassava peel meal levels (%)		0		15		15		20		20	
		B	G	B	G	B	G	B	G	B	G
Dressing	(%)	74.97	75.12	72.00	67.05	68.00	70.50	69.86	66.74	68.87	70.48
Carcass length	(cm)	68.50	67.38	71.13	68.88	68.75	68.00	66.63	68.13	69.63	66.63
Average backfat	(cm)	2.56	2.48	2.79	2.43	2.75	2.64	2.80	2.64	2.64	2.62
Loin area	(cm^2)	22.26	19.91	16.76	20.21	20.19	17.84	20.92	15.52	17.97	19.68
Lean cuts	(%)	75.11	75.25	75.22	73.59	73.38	74.86	76.19	75.13	76.23	76.22
Fresh liver weight	(g)	1077	1057	1066	1264	1108	1162	995	1012	1000	962
Fresh kidney weight	(g)	173	158	155	174	177	170	180	178	152	164

barrows, castrated at 4 weeks, had assumed similar body characteristics to gilts by slaughtering time.

All animals were in good health throughout the experiment. This would indicate that the level of HCN contributed to the rations by CM and CPM (11-55 mg/kg feed, which corresponds to an intake of 16.5-82.5 mg HCN/day) was below the lethal dose for pigs which is still undetermined.

Discussion

The results of the growing phase, in line with our earlier observations (16), would indicate that cassava meal may be substituted for corn up to 60% of the total ration without producing any deleterious effects on live and carcass performances. The reports of Kok and Ribeiro (6), Mejia (10), Shimada (13) and Job (5) lend further support to this view. These workers observed that cassava meal up to the 60% level in the diets of pigs promoted similar growth rates and feed efficiencies which were better than the control's.

All experimental rations in the growing phase had similar energy digestibilities which were lower, though not significantly, than dry matter digestibilities. Oyenuga and Fetuga (11), reported high digestibility for dry matter while digestion coefficients for other nutrients in cassava meal were much lower. Chicco *et al.* (3) observed that digestibility was not significantly different among cassava meal treatments. In the finishing phase of our experiment however, energy digestibility was higher than dry matter digestibility. Since the finishing rations included CPM as an energy diluent, the pigs apparently had less feed energy available and, consequently, digestion of feed energy increased. Depression of energy digestibility has been attributed to fibrous feedstuffs: brewer's dried grain (BDG) and *Stylosanthes* (21). However, these fibrous feedstuffs contain very high amounts of crude fiber and are essentially roughages. Cassava peel meal, on the other hand, contains only 10% crude fiber and should be more digestible. Furthermore, it would appear that cassava meal, being more digestible than cassava peel meal, had a promoting effect on the digestibility of CMP – CM mixtures. This would suggest that higher substitutions of CPM can be accompanied by higher levels of CM as shown by the similar dry matter and energy digestibilities of the 15% CM + 15% CPM and 30% CM + 20% CPM mixtures.

The inclusion of up to 60% CM in growing rations and 20% CPM as well as 30% CM in finishing rations will result in considerable savings in feed cost since the market price of maize is about 200% higher than the price of cassava; and the cost of the simple processing of cassava roots required is minimal.

Abstract

Experiments were conducted to study the inclusion of 0% 30%, 45% and 60% sun-dried, ground cassava tubers (CM) in growing rations; and of 15% and 30% CM + 15% and 20% sun-dried, ground cassava peel (CPM) in finishing rations of Large White and Local pigs. Growing pigs receiving substituted rations grew slightly but non-significantly faster and were slightly more efficient in feed conversion than pigs on the control diet. Finishing pigs on CM + CPM diets had slightly depressed but non-significant growth rate and feed efficiencies. A combination of 15% CM + 20% CPM was consistently but non-significantly superior to other substituted rations. Generally, Large White pigs appeared to utilise CM better than Local pigs while Local pigs utilised CPM better than Large White pigs. Carcasses of control pigs had significantly higher dressing values than those of pigs on the substituted rations. Cassava meal, being more digestible than CPM, had a promoting effect on the digestibility of CM–CPM mixtures.

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