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CARCASS, ORGAN AND PATHOLOGICAL CHARACTERISTICS OF GROWER PIGS FED CASSAVA PEEL MEAL

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ABSTRACT

An experiment was conducted to investigate the effects of replacing maize with Cassava Peel Meal (CPM) on the carcass, organ and pathological characteristics of growing pigs. Twenty-four 16-week old pigs of Landrace x Large White breed were raised on four experimental diets where CPM replaced maize at 0, 10, 20 and 30 percent levels. The diets were formulated to be isonitrogenous and isoenergetic containing 16 % CP and 12.08 MJME/kg. Each diet was fed to a group of six pigs. Results indicated that carcass weight and backfat thickness decreased as level of CPM in the diets increased. Heart, Kidney, Liver and Spleen weights (expressed as percentage of body weight) were significantly higher at the 30 percent level of CPM inclusion. Likewise, Kidney of pigs fed the 30 percent CPM diet showed degeneration, necrosis and dilatation of the tubules. Liver of same pigs had bile duct dilatation, fibrosis and thickening of the interlobular septa. It was concluded that 20 percent of the maize content of the diets of grower pigs can be replaced by CPM without any deleterious effect on the carcass, organ and pathological characteristics.

INTRODUCTION

Cassava (*Manihot esculenta crantz*) Peel is the ultimate waste product of cassava processing. Studies have been conducted using Cassava Peel Meal (CPM) as energy substitute in rations of various species. Omole and Sonaiya (1981) reported that CPM can substitute up to 40 per cent of the diets of rabbits. Obioha *et al* (1984) observed that laying hens performance was not retarded when the diets consisted of 40 percent CPM. Also Obioha *et al* (1985) working on growing-finishing pigs reported that there was a progressive decline in average daily gain, feed efficiency and protein efficiency ratio from the zero CPM diet to the zero maize diet, but these comparisons were not significant. Liver weight and spleen weight (expressed as percentage of body weight) were slightly higher in the CPM diets than the control. Ikurior and Onuh (1996) observed that daily gains of growing pigs fed cassava peel declined significantly ($P < 0.05$) as level of inclusion increased.

The greatest limitation to the use of cassava for livestock feeds is its content of cynogenic glucosides, linamarin and lotaustralin. Toxicity of cassava is caused by hydrocyanic acid (HCN) which is liberated when the glucoside is hydrolyzed by the action of linamarase enzyme. The degree of toxicity depends upon the variety, ecological conditions for growth of the plant, the form of the product being fed and its processing technology (Coursey, 1973). The normal range of HCN in fresh cassava root is 15-400ppm (Rogers, 1963). It has long been established that the Peel contained 5-10 times the Prussic acid content of the pulp (Oyenuga and Amazigo, 1957). Maner (1974) observed that pigs can tolerate 150-200ppm HCN on a fresh basis or 102ppm on a dry matter basis.

Utilization of CPM in animal feed is dependent on effective detoxification mechanisms for the cyanide. In this study, fermentation and sundrying were used to reduce the cyanide to an assumed literature safe level. What is the effect on the carcass, organ and pathological characteristics of growing pigs fed such treated peels? This forms the basic research question which this study seeks to address.

MATERIALS AND METHODS

This study was conducted at the Pig Research and Teaching Unit of the Department of Animal Science, University of Nigeria, Nsukka. Fresh cassava peels were collected from processing plants in Nsukka town and kept in jute bags for two days to ferment. The fermented peels were subsequently sundried on concrete slabs for seven days. The peels were then milled and incorporated into the diets of growing pigs at the rate of 0, 10, 20 and 30 per cent to replace equivalent proportion of maize. The diets were formulated to contain 16 per cent crude protein and 12.08MJME/kg diet (Table 1).

Table 1: Percentage Composition of the Experimental Diets

Ingredient (DM Basis)	Dietary Treatment			
	1	2	3	4
Maize	30.00	20.00	10.00	0.00
Maize Offal	25.00	25.00	25.00	25.00
Cassava Peel	0.00	10.00	20.00	30.00
Soyabean Meal	15.00	15.00	16.00	18.00
Palm Kernel Cake	23.00	23.00	22.00	20.00
Local Fish Waste	2.00	2.00	2.00	2.00
Bone Meal	4.00	4.00	4.00	4.00
Salt	0.50	0.50	0.50	0.50
Methionine	0.25	0.25	0.25	0.25
Vit. Min. Premix[a]	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated				
Crude Protein (%)	16.14	16.18	15.79	15.98
Crude Fibre (%)	6.37	7.54	8.74	9.84
Energy (MJ/kg)	12.08	11.90	11.90	12.07

[a]*Supplied per kg of diet: 5,000 iu Vit. A; 1,000,000iu Nit. D_3; 800mg Vit. E; 400g Vit. K; 1,200mg Vit. B_2; 1,000mg Vit. B_3; 4mg Vit. B_{12}; 3,000mg Niacin; 4,000mg Vit. C; 112,000mg Chlorine; 24,000mg Mn; 8,000mg Fe; 1,600mg Cu; 18,000mg Zn; 500mg Iodine; 48mg Selenium; Antioxidant (BHT).*

Twenty four Large White x Landrace Pigs averaging 17.40 ± 0.16kg at 16[th] week of age were used for the trial. The pigs were randomly allocated to four treatments according to weight, sex and litter mates with three replicates per treatment and two pigs per replicate in a completely randomized design. The feeding trial lasted for 56 days. Feeding was done twice daily at 8.00h and 16.00h. Pigs were fed 4 per cent of their average body weight as ration. The peels were thoroughly mixed with water before feeding to control dustiness. Weight of each pig was determined at the start of the trial and subsequently on a weekly basis.

On the 56th day of the feeding trial two pigs per treatment were randomly selected and sacrificed. The liver, kidney, heart and spleen were collected and their weights determined with the help of a sensitive balance. The weights were expressed as percentages of body weight. The organs were also examined for gross pathological changes. Samples of these organs were collected and fixed in 10 per cent saline for a minimum of 24 hours. The samples were processed, embedded with paraffin wax, sectioned and stained with haematoxylin and eosin. The sections were studied under a light microscope. Other parameters determined included:

- Carcass Weight (Kg): This was obtained by totaling the weight of all other parts of sacrificed animals less the weight of the hairs, intestines, blood and intestinal contents.
- Backfat thickness (cm): This was used to estimate the amount of subcutaneous fat content at the 'K' position which is 7.5cm from the midline in line with the last rib (Holness, 1991). Measurement was done using a plastic ruler.
- Loin Eye Area (cm^2): This was measured by first cutting the carcass between the 10th and 11th rib to expose the longissimus dorsi. When properly held in position a tracing paper was placed over the exposed area to completely cover it. A pencil was used to carefully trace the observed rough area. The traces were then retraced on a graph paper and the area measured according to the method of Ugye *et al* (1988).

The proximate composition and cyanide content of the cassava peel and experimental diets were determined by methods of AOAC (1990) (Table 2).

Table 2: Proximate Composition of the CPM and Experimental Diets

Composition (DM Basis)	CPM	0	10	20	30
		Dietary Levels of CPM			
Crude Protein	7.50	17.77	18.54	17.90	18.32
Ether Extract	7.81	7.74	6.42	5.28	5.00
Crude Fibre	17.73	8.48	11.00	12.37	13.86
Ash	12.82	9.40	11.23	10.86	11.84
Nitrogen Free Extract	54.14	56.61	52.78	53.70	50.98
HCN (mg/kg)	64	-	17.00	19.90	30.00

All the data were processed and analyzed according to the procedure for a completely Randomized Design with linear model as outlined by Steel and Torrie (1980). Significantly different means were separated by methods of Duncan's Multiple Range Test (Duncan, 1955).

RESULTS

Table 2 shows the Proximate Composition and Cyanide Content of the cassava peel and the experimental diets. The incremental levels of inclusion of CPM resulted in increases in the Crude fibre, Ash and HCN content of the experimental diets. The determined HCN content of the diets increased from 0mg/kg at the control diet (0% CPM) through 17.0mg/kg at the 10 per cent level of CPM to 30-0mg/kg at the 30 per cent CPM level.

Table 3 shows data on carcass and organ measurements. Differences among treatments in their carcass weight were significant ($P < 0.05$).

Carcass weight progressively decreased as level of CPM in the diets increased. Pigs on the control diet (0% CPM) had the highest carcass weight of 28.25kg which differed significantly ($P < 0.05$) from results obtained for the 20 and 30 per cent levels. Likewise, Pigs on the 30% CPM diet had a value of 21.75kg which also differed significantly ($P < 0.05$) from the others. Pigs on the 10 and 20 percent CPM diets did not differ significantly ($P > 0.05$) in their carcass weights. The effect of treatments on loin eye area (LEA) was significant ($P < 0.05$). Pigs on the control diet did not differ significantly ($P > 0.05$) from pigs on the 10 per cent CPM diet in their LEA. They however differed significantly ($P < 0.05$) from pigs on the 30 per cent CPM level. Pigs on the control diet had the highest dressing percentage of 85.00. This differed significantly ($P < 0.05$) from the value of 77.00 obtained for pigs on the 30 per cent level. Backfat thickness decreased with increase in the level of CPM in the diets. Pigs on the control diet had a backfat thickness of 0.50cm which differed significantly from 0.30 and 0.22cm obtained for pigs on the 20 and 30 per cent levels respectively.

Table 3: Carcass and Organ Measurements of grower pigs fed 0, 10, 20, 30 per cent Levels of CPM

Parameter	0	10	20	30	SEM
	Dietary levels of CPM				
Body weight (kg)	33.25^a	31.25^{ab}	30.00^{ab}	28.25^b	0.729
Carcass weight (kg)	28.25^a	25.50^a	24.50^b	21.75^c	0.323
Loin eye area (cm^2)	15.30^a	17.00^{ab}	17.55^b	18.00^b	0.390
Dressing (%)	85.00^a	81.50^a	81.65^{ab}	77.00^b	1.556
Backfat thickness (cm)	0.50^a	0.50^a	0.30^b	0.22^c	0.054
Heart weight*	0.33^a	0.35^a	0.34^a	0.38^b	0.002
Kidney weight*	0.12^a	0.12^a	0.12^a	0.15^b	0.002
Liver weight*	1.87^a	1.79^a	1.88^a	2.05^b	0.032
Spleen weight*	0.11^a	0.11^a	0.11^a	0.19^b	0.001

**Expressed as percentage of body weight.* *[abc]Mean values in a row with different superscript are significantly different ($P < 0.05$).*

Heart weight of pigs on the 30 per cent diet was significantly ($P < 0.05$) different from those of other treatments. The same trend was observed with regard to kidney weight. Significant difference ($P < 0.05$) only showed at the 30 per cent level. Likewise, similar trend was observed for liver and spleen weights. Pigs on the 30 per cent diet had values of 2.05 and 0.19 per cent respectively which differed significantly ($P < 0.05$) from the others.

Pigs fed on the 10 and 20 per cent levels of CPM did not show any lesions along with the control pigs. However, the kidney of pigs fed 30 per cent CPM had degeneration, necrosis and dilatation of the tubules (Plate 1). Kidney of control pigs showed no lesion (Plate 2).

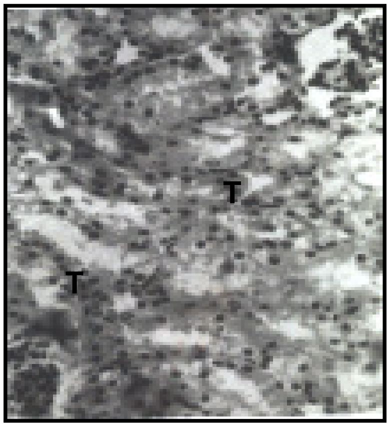

Plate 1: Kidney of Pigs fed 30% CPM showing degeneration necrosis and dilatation of the tubules (T)

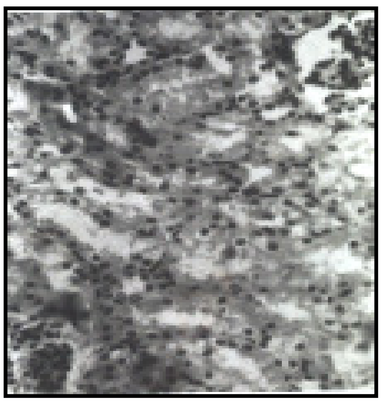

Plate 2: Kidney of control pigs (0% CPM), No lesions

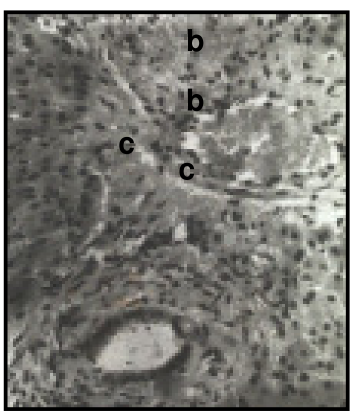

Plate 3: Liver of pigs fed 30% CPM showing bile duct dilatation(c), fibrosis and thickening of the interlobular septa (b)

Bile duct dilatation, hyperplasia of the bile duct epithelial cells, fibrosis and thickening of the interlobular septa were observed in the liver of pigs fed 30 per cent CPM (Plate 3), whereas liver of control pigs showed no lesion (Plate 4).

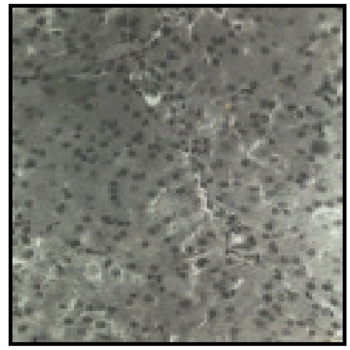

Plate 4: Liver of control pigs with no lesions shown.

DISCUSSION

The results of the proximate composition of fermented and sundried cassava peel obtained in this study are consistent with those reported by Oyenuga (1968) and Okoye (1992) and so support the facts that both the Crude protein and Nitrogen free Extracts contents of cassava peels are similar to those of maize and thus its nutritive value would derive mostly from its CP and NFE fractions. The increases in HCN content as level of CPM in the diets increased was sufficient to cause feed intake depression. This does not agree with the findings of Sitompul (1977) who observed feed intake depression in pigs at 280ppm of HCN.

Results further indicated that carcass weight (kg) and backfat thickness (cm) decreased marginally as the level of CPM in the diet increased. As a general rule, the heavier the animal the higher the yields. Walters (2000) observed that as a rule of thumb, yield in pigs increases by 1 per cent per 10kg live weight and as the weight increases so does the fat content. This trend of decreasing carcass and backfat thickness with decreasing body weight as level of CPM increased observed in the present study agrees with this report. It is also established that the composition of the diet fed to the pigs can certainly change the yield to a significant degree especially through its relationship to gut fill. The decreased carcass and backfat thickness could also be attributed to increase in HCN content as level of CPM in the diets increased. It has been established that cyanide and thiocyanate are selective poisons. In sublethal concentrations, they cause cell death by interfering with oxidative production of energy from glucose, fatty acids and amino acids (Kamalu, 1993). Cyanide inhibits the enzyme cytochrome oxidase thereby preventing the use of 0_2, while thiocyanate inhibits the enzyme fumarase hydratase in the Kreb citric acid cycle (Massey and Alberty, 1954). Intact linamarin in sublethal concentrations inhibits the activity of Na^+-K^+ ATPase (Hill, 1977) and decreases the intracellular K^+ concentration (Philbrick *et al*, 1977) in cardiac tissues. The combined effects of all these are the retarded growth observed with increasing CPM levels and hence the resultant decline in carcass weight and backfat thickness. Feeding high levels of fibre decreases the carcass weight relative to liveweight whereas an opposite effect comes from giving diets with a high nutrient density. This agrees with the finding of Newton and Mahan (1992) that backfat thickness and body fat content increased linearly as feed intake increased. The observed increase in LEA as level of CPM in the diet increased is an indication of the leanness of the pigs on the experimental diets.

This could be partly attributed to the reduced body fat and backfat thickness as level of CPM in the diets increased. This finding is of great practical implication. It follows that feeding CPM to pigs can lead to the production of lean pork. Some persons dislike pork because of its fat content. To this category of persons pork from pigs fed at the level recommended in this study will be preferred.

Organ weights tended to increase as CPM levels increased. This trend may suggest increasing rhodanase activity as HCN ingestion increased. The higher liver activities in detoxifying cyanide may have led to the significant increase in the size of the liver of pigs fed 30 per cent CPM. This explains the lesions found in the liver and kidney of pigs fed the 30 per cent CPM. This agrees with the report of Obioha and Anikwe (1982) that significant difference existed in liver and kidney weights as HCN level rose from 72.93 to 260.53mg/kg.

Conclusion: This study has shown that the replacement of maize with 20 per cent CPM in the diets of growing pigs does not have any negative effect on the carcass, organ and pathological condition of the pigs. It is therefore recommended that growing pigs be fed CPM at this level.

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