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Nutritional evaluation of cassava (*Manihot esculenta* crantz) peel in the diet of weaner pigs

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Abstract

Four isocaloric and isonitrogenous weaner diets for pigs in which maize was progressively replaced with 0,5,10 and 15% of fermented and sundried cassava peel meal (CPM) were formulated. The four treatment diets 1,2,3 and 4 were fed to twenty-four weaner pigs averaging 5.64 ± 0.09kg at eight weeks of age for 56 days. Results showed that there was a progressive decline (P< 0.05) in average daily gain (kg) and protein efficiency ratio as the level of CPM in the diets increased. Pigs performance in terms of these parameters was the same for the control, 5 or 10% CPM diets (P> 0.05). Significant difference (P< 0.05) only showed up when CPM was fed at 15% level. Pigs on the 10% CPM diet had significantly (P< 0.05) better feed conversion ratio and feed cost /kg gain. Haematological examination revealed that the effect of treatments on packed cell volume, red blood cells, white blood cells, neutrophils and monocyte levels were significant (P< 0.05). The results revealed that CPM could replace 10% of maize in a diet for weaner Pigs.

Key words: Cassava Peel meal, weaner pigs, performance, haematological values.

Introduction

The search for alternative feeding –stuffs for monogastric animals (especially pig and poultry) has challenged Animal Nutritionists in Nigeria since the past two decades. This search is necessitated by the high cost of the conventional feeding – stuffs, which are also in high demand by humans. Cassava (*Manihot esculenta* Crantz) has remained a staple carbohydrate source for most families in parts of southern Nigeria. The potential of cassava peel as an energy source in pig ration has not been extensively exploited as whole cassava root meal (Ikurior and Onuh, 1996). This may be due to among other reasons, the occurrence of higher levels of cyanogenic glucosides and higher fibre content in the peel then in the root (Gomez *et al.*; 1982 Oke, 1969; Oyenuga and Amazigo, 1957). These components have both been associated with reduced growth rates and feed efficiency in pigs (Hutagalung, 1972). This notwithstanding hundreds of tonnes of cassava peel are produced when cassava root is processed into various products for human consumption, livestock feed or industrial use. Onyimonyi (2002) observed that cassava peel amounts for between 14 and 18 per cent of the weight of cassava tuber. It follows that with an estimated annual production figure of 36 million metric tonnes of cassava tubers from Nigeria; 5 to 7 million metric tonnes of cassava peel will result when these tubers are processed. There is therefore an urgent need to recyle these waste into usable animal protein. Earlier investigations revealed that when adequately processed (Okeke *et al.*, 1985) cassava peel has replaced substantial proportions of maize in swine rations (Obioha and Anikwe, 1982; Obioha *et al.*, 1985). It has also been reported that cassava peel could replace 20 per cent of maize in a pig grower diet without any deleterious effect on performance, carcass, organ and

pathological characteristics (Onyimonyi and Okeke, 2004).

The present study was aimed at evaluating the feeding value of cassava peel for weaner pigs in a humid tropical environment.

Materials and Methods

Cassava peel was collected from cassava processing plants in Nsukka town, Enugu State. The fresh peel was put in jute bags and allowed to ferment for two days after which they were sundried for seven days. The peel was then milled and included at 0, 5, 10 and 15% of the diet to replace equivalent proportion of maize. The diets were formulated to contain 18% crude protein and 2800kcalME/kg (Table 1). There was methionine supplementation at 0.25% in all the diets. Twenty-four Large White X Landrace weaner pigs averaging 5.64 $\pm$ 0.09 kg at eight weeks of age were used for the experiments. The pigs were randomly allocated to four treatments according to weight, litter mates and sex with three replicates per treatment and two pigs per replicate. The trial lasted for 56 days. Feeding was done twice daily at 8.00h and 16.00h. Pigs were fed 4% of their average body weight as ration per replicate. The diets were mixed with water before feeding to control dustiness at a ratio of 1:2. Pigs were weighed individually at the start of the trial and subsequently on a weekly basis.

The following parameters were measured; daily feed intake (kg), average daily body weight gain (kg), protein efficiency ratio, feed conversion ratio and feed cost/kg gain (N). At the end of the feeding trial blood samples were collected from two pigs per treatment by humane puncture of the tail vein. The blood samples were separately collected using sterile disposable syringes and

Table I: Percentage Composition of the Diets

Ingredients (%)	Dietary Treatments			
	1	2	3	4
Maize	30.0	25.0	20.0	15.0
Maize offal	25.0	25.0	25.0	25.0
Cassava peel	-	5.0	10.0	15.0
Soyabean meal	20.0	20.0	20.0	22.0
Palm kernel cake	20.0	19.0	19.0	17.0
Fish waste	1.0	2.0	2.0	2.0
Bone meal	3.0	3.0	3.0	3.0
Salt	*0.5*	*0.5*	*0.5*	*0.5*
Methionine	0.25	0.25	0.25	0.25
Vitamin mineral premix[a]	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated				
Crude Protein	17.93	17.99	17.79	18.17
Crude fibre	6.03	6.55	7.20	7.65
Energy kcalME/kg	2,762	2,784	2,760	2,784
Cost of diet/tonne (₦)[b]	18,790	17,890	16,990	16,530

Determined analysis

[a] Supplied per kg of diet: 5000 iu Vit. A; 1,000,000 iu Vit. D_3; 800mg Vit E; 400mg Vit K; 1,200mg Vit B_2; 1,000mg Vit. B_5; 4mg Vit. B_{12}; 3000mg Niacin; 4,000mg Vit. C; 112,000mg Chlorine; 24,000mg Mn; 8000mg Fe; 1 ,600mgCu; 18,000mg Zn; 500mg Iodine; 48mg Selenium; Antioxidant (BHT).

[b] Calculated from the prevailing market prices of the feeding stuffs.

needles into bottles containing ethylene diaminetetracetic acid (EDTA) as anticoagulant. The following parameters; haemoglobin concentration (HB), packed cell volume (PCV), red blood cells count (RBC) and white blood cells (WBC) were determined according to the method of Davie and Lewis (1975).

All data were processed and subjected to analysis of variance (ANOVA) in a completely randomized design with linear model as outlined by Steel and Torrie (1980) using a statsgraphic computer package. Significantly different means were separated by methods of Duncan's Multiple Range Test (Duncan, 1955). Proximate analysis of the diets (Table II) was done according to the methods of AOAC (1990). Cyanide contents of the fresh cassava peel and those of the diets were also determined using the methods of Cooke (1978).

Results and Discussion

The result of the performance of pigs in this experiment are presented in Table 3. The effect of the treatments on the average final body weight was significant ($P < 0.05$). The results show a progressive decrease in average final body weight as the level of CPM increased. While pigs on the control diet (0% CPM) had the highest value of 19.17kg which did not differ significantly ($P > 0.05$) from values of 17.83kg and 17.17kg observed for pigs on the 5% CPM and 10% CPM diets, respectively. It did differ significantly ($P < 0.05$) from the value of 15.42kg for pigs on the 15% CPM level. Results show that average daily gain followed the same trend as average final body weight. There was a decline in average daily gain as the level of CPM increased in the diet. Differences among treatments in their effects on rate of gain were significant ($P < 0.05$). Pigs on the control diet had the highest gain of 0.24kg. This value did not differ significantly ($P > 0.05$) from values observed

Table II: Proximate Composition of the Diets (DM Basis) and cassava peel

Composition (%)	Dietary Treatments				
	1	2	3	4	CPM
Crude Protein	19.94	19.50	20.74	20.65	7.5
Ether Extract	7.41	6.68	6.40	6.56	7.81
Crude Fibre	6.35	6.66	8.75	9.75	17.73
Ash	7.89	9.84	12.00	11.63	12.82
N-free Extract	58.40	57.32	47.90	51.41	49.24
HCN(mg/kg)	-	16.20	17.60	24.00	64.0

Table III: Performance of Weaner Pigs fed 0, 5, 10 and 15 percent levels of CPM.

Parameter	Dietary levels of CPM				
	0	5	10	15	SEM
Average Initial Body Weight (kg)	5.70	5.67	5.50	5.67	0.089
Average Daily Intake (kg)	0.48	0.46	0.42	0.42	0.023
Average Final Body Weight (kg)	19.17^{b}	17.83^{b}	17.17^{ab}	15.42^{a}	0.708
Average Daily Gain (kg)	0.24^{b}	0.22^{ab}	0.21^{ab}	0.17^{a}	0.013
Feed Conversion Ratio	2.03^{a}	2.13^{b}	2.03^{a}	2.30^{c}	0.006
Protein Efficiency Ratio	2.51^{b}	2.42^{ab}	2.39^{ab}	2.09^{a}	0.004
Feed Cost/kg Gain (N)	38.20^{a}	38.20^{a}	34.43^{b}	38.07^{a}	0.008

^{abc} Mean values in a row with different superscript are significantly different ($P < 0.05$)

for pigs on the 5% and 10% CPM diets respectively. However, it differed significantly ($P < 0.05$) from 0.17kg observed for pigs on the 15% CPM diet. Feed conversion ratio (FCR) did not follow any particular trend. Pigs on the control diet had the same value ($P > 0.05$) with pigs on 10% CPM diet. However, they differed significantly ($P < 0.05$) from values obtained for pigs on 5% and 15% CPM diet. There was a progressive decrease in protein efficiency ratio (PER) as level of CPM in the diets increased. Differences among treatments in their effects on PER were significant ($P < 0.05$). Pigs on the control diet had a value of 2.51 which differed significantly from value of 2.01 observed for pigs on the 15% CPM diet. The effect of treatments on feed cost/kg gain was significant ($P < 0.05$). Pigs on the control diet had the highest value of N38.20 which only differed significantly from a value of N34.43 observed for pigs on the 10% CPM diet.

Results indicated that the control diet supported superior final body weight, weight gains, better feed conversion ratio and higher protein efficiency ratio than the test diets. The significant reduction in these parameters as CPM levels increased in the experimental diets may be linked to various factors. Cassava peel has a high crude fibre content, it is very dusty and less palatable. It's been established that high fibre content of a diet has the effect of interfering with nutrient utilization and works synergistically with essential fatty acid deficiency in retarding normal growth (Essien, 1986). Even though there is no agreement among researchers on the optimum level of fibre in pig diets, it is an established nutritional fact that pigs ability to digest dietary fibre is better pronounced as the animal attains maturity. The pigs used in the present study are weaners and may not have developed this ability to digest dietary fibre. This is probable the reason for the decline in performance as level of CPM in the diets increased. This agrees with the report of Pond *et al* (1980) that high dietary fibre depresses apparent digestibility of dry matter and nitrogen, decreases daily body weight and increases feed to gain ratio in growing pigs. It also conforms with the report of Ikurior and Onuh (1996) that daily gains of growing pigs fed cassava peel declined significantly as level of inclusion increased. During the course of this study it was observed that pigs on the CPM based diets spent less time eating and showed the least enthusiasm to receive feed the next morning compared to pigs on the control diet. This partly explains the low feed intake of pigs on the CPM based diets. Maner *et al.* (1969) and Muller *et al.* (1975) observed that crude fibre causes swine ration to become bulky and dusty thereby decreasing feed consumption and inducing irritation of the stomach and respiratory organs. The result obtained in this study agrees with reports of these workers.

The poor performance of pigs at higher levels of CPM inclusion could also be attributed to some intrinsic cassava borne factors which may be related to the residual cyanogenic glucoside. Cyanide had been implicated as a factor increasing faecal and urinary nitrogen excretion and thus causing reductions in nitrogen absorption and retention (Anugwa and Okorie, 1984). This may further explain the poor performances of pigs as level of CPM in the diets increased.

The depressed growth observed in the CPM based diets could also be attributed to the reduction in the utilization of protein. This is supported by the fact that the PER decreased progressively as the level of CPM in the diets increased. The inclusion of CPM in the diets of weaner pigs reduced significantly the cost of production in terms of feed cost/kg gain and thus spares the use of a rather expensive conventional energy source – maize. This reduction in cost is expected

since one of the cardinal objectives of exploiting alternative feeding stuffs is to take advantage of their cheap price and fair proximate composition. It is expected that pigs on the diet with the least feed cost/kg gain (10% CPM levels) will give a higher profit margin. This agrees with the report of Obioha *et al.* (1985) that CPM may support growth performance of pigs at reduced cost.

The effect of treatments on heamatological values of pigs are presented in Table 4. The results show that the effects of treatment on packed cell volume (PCV) was significant (P<0.05). Pig on the control diet had a value of 44.0% which did not differ significantly (P>0.05) from 44.5% observed for pigs on the 5% CPM diet. These, however, differed significantly (P <0.05) from the values of 36.5% and 32.5% observed for pigs on 10% and 15% CPM diets respectively. Increasing the level of CPM in the diets had a significant (P <0.05) effect on the red blood cells (RBC). Pigs on the control diet had the highest value of 8.7($x10^6/mm^3$) which did not differ significantly from values of 8.0($x10^6/mm^3$) and 7.8 ($x10^6/mm^3$) observed for pigs on the 5% and 10% CPM diets respectively. It however differed significantly (P <0.05) from value of 6.85($x10^6/mm^3$) obtained for pigs on the 15% CPM diet.

Mean corpuscular haemoglobin concentration (MCHC) values increased with increase in CPM level in the diets. Pigs on the control diet had a value of 28.2% which differed significantly (P <0.05) from the value of 36.4% obtained for pigs on 15% CPM diet. The effect of treatments on the mean corpuscular haemoglobin (MCH) was significant (P <0.05). Pigs on the control diet had the highest value of 18.1% which did not differ significantly (P >0.05) from the value of 16.3% obtained for pigs on the 5% CPM diet. Pigs on the 10% and 15% CPM also did not differ (P >0.05) in their values of MCH. Increasing the level of CPM in the diets had a significant effect (P <0.05) on the mean corpuscular value (MCV). Pigs on the control diet had a value of 64.2% which differed significantly (P <0.05) from the other treatments. Likewise pigs on the 5% CPM diet had a value of 55.7% which also differed significantly (P <0.05) from the others. Pigs on the 10% and 15% CPM diets did not differ significantly (P >0.05) in their values of MCV. The white blood cells (WBC) values of pigs on the control diet differed signifi-

Table IV: Haematological values of Weaner pigs fed 0, 5, 10, 15 percent levels of CPM

Parameter	Dietary levels of CPM				
	0	5	10	15	SEM
Hb (g/100ml)	13.05	12.40	12.05	11.83	0.338
PCV (%)	44.00^{c}	44.50^{c}	36.50^{b}	32.50^{a}	0.354
RBC ($x10^6/mm^3$)	8.70^{b}	8.00^{ab}	7.75^{ab}	6.85^{a}	0.269
MCHC (%)	28.18^{a}	29.34^{a}	34.26^{b}	36.43^{b}	0.868
MCH (%)	18.11^{c}	16.33^{bc}	14.38^{a}	15.29^{a}	0.373
MCV (%)	64.24^{c}	55.65^{b}	42.31^{a}	42.08^{a}	1.383
WBC ($x10^3/mm^3$)	25.70^{b}	14.80^{a}	15.45^{a}	26.80^{c}	0.154
Neutrophils (%)	39.00^{b}	38.00^{b}	43.50^{c}	35.00^{a}	0.456
Lymphocytes (%)	55.00^{c}	58.50^{d}	46.00^{a}	50.50^{b}	0.500
Monocytes (%)	6.00^{b}	3.50^{a}	4.00^{ab}	3.50^{a}	0.500
Eosinophils (%)	0.00	0.00	6.50	11.00	0.500

^{abc} Mean values in a row with different superscript are significantly different (P <0.05)

cantly (P<0.05) from the other treatments. Pigs on the 5% and 10% CPM diets did not differ significantly (P >0.05) in their WBC values. A WBC value of 26.8% obtained for pigs on the 15% CPM diet differed significantly (P <0.05) from the other treatments. Pigs on the control diet and 5% CPM diets did not differ in their neutrophil values. But these values differed significantly (P <0.05) from the other treatments. Effect of increasing levels of CPM on lymphocyte values were significant (P <0.05). Pigs on the 5% CPM diet had the highest value of 58.5% and this differed significantly (P <0.05) from the other treatments. Results show that pigs on the control diet had the highest monocyte value of 6.0%. This differed significantly (P <0.05) from values of 3.5% observed for pigs on the 5% and 15% CPM diets respectively. Only pigs on the 10% and 15% diets showed traces of eosinophils in their bloods.

The haematological values examined come within the normal range for pigs as recommended by Coffin (1957). The observed decrease in RBC as the level of CPM in the diets increased could be associated with low quality feed and a possible reduction in protein utilization. It is probable that HCN reacts with haemoglobin to form the non-toxic cyanohaemoglobin. Cyanohaemo-globin although not itself toxic is not an oxygen carrier. The blood cannot function in respiration if too great a percentage of its cells are in the form of cyanohaemoglobin (Clarke and Myra, 1975). Haemoglobin gives red blood cells their property of carrying oxygen and aiding in the transport of CO_2 and other internal secretions and nutrients, like hormones, glucose and other metabolic products. It appears that this combination of HCN with haemoglobin will reduce the ability of red blood cells to transport the digested nutrients and this may manifest in the affected animals as reduced growth. This further explains the decrease in growth rate as level of CPM in the diets increased. Feeding CPM to weaner pigs appears to build up some allergy in the pigs. This is evidenced by the relative increase in the number of eosinophils as the levels of CPM in the diets was increased beyond 10%. Swanson and Reece (1993) had earlier reported that eosinophils are very motile and slightly phagocytic, although their numbers are normally small in circulating blood, they may increase greatly under allergic conditions. Our findings agree with this report.

Conclusion

The result of this study suggest that CPM can replace up to 10% maize in the diets of weaner pigs with no adverse effects on the performance and haematological values of the animals.

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