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EFFECT OF PALM OIL ON THE USE OF CASSAVA PEEL MEAL BY RABBITS

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Two studies were carried out to establish the effect of palm oil on the use of cassava peel meal by rabbits. The results show that without palm oil there was a significant reduction in the rate of gain of rabbits when a level of 30% of cassava peel was exceeded. With palm oil supplementation, the drops in rate of gain and feed efficiency with increasing levels of cassava peel were less than with the unsupplemented diets. Without palm oil, feed intake dropped significantlyabove the 40% level of cassava peel, whereas with the supplemented diets feed intake was not significantly affected even with up to 50% of cassava peel.

With palm oil supplementation serum thiocyanate level remained at about the same level for the animals fed from 0 to 50% levels of cassava peel, while there was a significant increase in the level of urine thiocyanate level. With the unsupplemented diet the reverse was the case. Since urine is a pathway of excretion, it would appear that palm oil supplementation allowed for a higher level of removal of cyanide from the animal body than when no palm oil was fed.

Key words: rabbits, palm oil, *Manihot esculenta*, thiocyanate

The very high cost of conventional ingredients used in Nigeria for animal feeding has led to intensified studies on the use of unconventional feed sources so as to reduce cost of production and increase the availability of animal protein to the Nigerian population. One such feed source is cassava peel. The importance of this feed source will be appreciated the more when it is realised that as at 1971, Nigeria produced about 7.9% of the total cassava in the world (FAO 1971).

Cassava peel meal (CPM) has been investigated as a livestock feed for pigs by Sonaiya and Omole (1977), and Pido and Adeyanju (1978) have recommended 20% as optimal for broilers. Recently Omole and Sonaiya (1981) have reported that the use of CPM could be substantially influenced by other dietary components. A review of the literature shows that palm oil may play an important role in influencing the use of cassava-based diets.Hutagalung (1977) reported improved live performance when pigs fed cassava-based diets had supplementary palm oil in their diet. This improved performance was attributed to increased energy intake of the animals. However Olarewaju & Boszormenyi (1975) noted that commercial gari (fried cassava) fried with palm oil contained a smaller amount of cyanide compared to white gari(fried cassava without palm oil). Also when natives in some parts of Nigeria inadvertently consume the poisonous variety of cassava, the patients are given palm oil orally and this helps to neutralize the effect of the cassava. It would therefore appear that palm oil in cassava-based diets may play some role in detoxifying the cyanide in cassava. Cassava peel meal contains some cyanogenic glucosides, especially linamarin and some lotaustraline and these can give rise to hydrocyanic acid which can reduce animal performance.

This study was therefore carried out to observe the effect of palm oil on the performance of rabbits fed cassava peel based diets.

Materials and Methods

Trial 1: Forty-eight eight week old New Zealand white rabbits averaging 960 g in weight were randomly allotted to six treatment groups of eight rabbits each. The rabbits were fed on the experimental diets (Table 1) containing 0, 10, 20, 30, 40 or 50% levels of CPM. The cassava peel was removed from tubers which were being processed into cassava meal. The peels were sundried on the floor and then ground into a meal using a hammer mill. The composition of the CPM is presented in Table 2.

Table 1:

Percentage composition of experimental diets without palm oil

	Levels of cassava peel (%)					
Ingredients	0	10	20	30	40	50
Maize	62.50	54.00	44.00	34.00	25.00	15.00
Groundnut cake	10.50	13.00	16.00	19.00	22.00	25.00
Fish meal	6.00	6.00	6.00	6.00	6.00	6.00
Brewers dried grain	18.00	14.00	11.00	8.00	4.00	1.00
Cassava peel	0.00	10.00	20.00	30.00	40.00	50.00
Dicalcium Phosphate	1.00	1.00	1.00	1.00	1.00	1.00
Oyster Shell	1.00	1.00	1.00	1.00	1.00	1.00
Salt	0.50	0.50	0.50	0.50	0.50	0.50
Vitamin-mineral mix*	0.25	0.25	0.25	0.25	0.25	0.25
Ofurason **	0.25	0.25	0.25	0.25	0.25	0.25
Analysis (dry matter basis)						
Crude protein (%)	18.19	18.07	18.23	18.39	18.42	18.50
Calcium, calculated (%)	0.84	0.86	0.87	0.89	0.91	0.92
Phosphorus, calculated (%)	0.64	0.65	0.66	0.67	0.68	0.68
Digestible energy (kcal/kg) calculated	3199	3163	3110	3057	3021	2968

*Pfizer product supplying the following per kilogramme of diet: vitamin A, 500 I.U.; D_2, 66 I.U.; E, 10 I.U.; riboflavin, 4.4 mg; B_{12}, 0.01 mg; pantothenic acid, 7.2 mg; nicotinic acid, 20.0 mg; Choline Chloride, 22.0 mg; folic acid, 0.15 mg; Mn, 30.0 mg; I_2, 2.0 mg; Fe, 100.0 mg; Cu, 17.0 mg; and Zn, 50.9 mg.

** A commercial coccidiostat with nitrofurazone base.

Table 2:

Composition of cassava peel meal

Dry matter (%)	87.9
Crude protein (%)	6.2
Ether extract (%)	10.6
Crude fibre (%)	1.0
Ash (%)	6.8
Nitrogen free extract	63.3
Hydrogen cyanide (mg/kg)	157.4

The animals were housed in groups of four and maintained in cages with wire screen floors raised to a height of 90cm from the concrete floor. Row cages of size 76 cm x 62 cm x 42 cm each were used. Animals were weighed at weekly intervals while daily feed consumption was recorded by the weigh - back technique. Because of group feeding, records of feed intake and efficiency of feed utilization were kept on a cage basis. Feed and water were available ad libitum in all trials.

Urine was collected daily during the last two weeks and daily samples were pooled in a bottle for each treatment. A few millilitres of toluene were added and then the sample was stored in a refrigerator. Two rabbits from each cage, representing four rabbits per treatment, were selected for post mortem studies eight weeks after the commencement of the experiment. Each rabbit was killed by dislocating its neck. The blood from each animal was collected in a tube and centrifuged to separate the serum. The serum and urine thiocyanate levels were determined by the method of Aldridge (1945).

The skin, head, stomach, kidney, kidney fat, intestine, liver, lungs and heart were removed before weighing the warm carcass. The carcass yield was computed from the sum of the carcass and skin weights expressed as a proportion of the final liveweight. The fresh weights of the liver, kidney and kidney fat were also measured.

Trial 2: In a second experiment 5% of the corn fraction of each ration used in Experiment 1, was replaced by substitution with palm oil as shown in Table 3.

Table 3:
Percentage composition of experimental diets with palm oil

	Level of cassava peel (%)					
Ingredients	0	10	20	30	40	50
Maize	57.50	49.00	39.00	29.00	20.00	10.00
Groundnut cake	10.50	13.00	16.00	19.00	22.00	25.00
Fish meal	6.00	6.00	6.00	6.00	6.00	6.00
Oil	5.00	5,00	5.00	5.00	5.00	5.00
Brewers dried grain	18.00	14.00	11.00	8.00	4.00	1.00
Cassava peel	0.00	10.00	20.00	30.00	40.00	50.00
Dicalcium phosphate	1.00	1.00	1.00	1.00	1.00	1.00
Oyster Shell	1.00	1.00	1.00	1.00	1.00	1.00
Salt	0.50	0.50	0.50	0.50	0.50	0.50
Vitamin-mineral mix*	0.25	0.25	0.25	0.25	0.25	0.25
Ofurasen**	0.25	0.25	0.25	0.25	0.25	0.25
Analysis (dry matter basis)						
Crude protein (%)	17.8	17.6	17.9	17.9	18.1	18.1
Calcium, calculated (%)	0.84	0.86	0.87	0.89	0.91	0.92
Phosphorus, calculated (%)	0.64	0.65	0.66	0.67	0.68	0.68
Digestible energy (kcal/kg) calculated	3331	3295	3242	3189	3153	3100

* A vitamin-mineral mix as described in Table 1

** A commercial coccidiostat with nitrofurazone base

In this study forty-eight six week old New Zealand white rabbits averaging 620 g in weight were randomly allotted to the six treatment groups of eight rabbits each. The trial lasted eight weeks and the conduct of the experiment was as in Experiment 1.

All the data collected in the two experiments were statistically analysed by the analysis of variance technique (Steel and Torrie 1960), and Duncan's multiple range test was used to detect differences among means.

Results and Discussion

Feed intake, weight gain and feed:gain ratio: The results are presented in Tables 4 and 5. In the first experiment where there was no palm oil supplementation (Table 4), the rate of gain was not significantly affected

Table 4:

Effects of different levels of cassava peel meal on live, carcass and organ measurements of growing rabbits

	Levels of cassava peel meal (%)						
	0	10	20	30	40	50	± S.E.M.
Average initial wt. (g)	963.7	958.4	956.5	965.5	959.0	968.0	-
Average final wt. (g)	2179.5	2238.0	2208.7	2079.9	1880.2	1611.2	-
Daily feed intake (g)	70.56[ab]	72.89[b]	70.21[ab]	70.84[ab]	68.60[ab]	65.71[a]	3.53
Daily gain (g)	21.71[c]	22.85[c]	22.36[c]	19.90[c]	16.45[b]	11.65[a]	1.71
Feed/g gain (g)	3.25[a]	3.19[a]	3.14[a]	3.56[a]	4.17[b]	5.64[c]	0.30
Liver (% body wt.)	2.95	2.88	3.01	2.93	2.98	2.75	0.18
Kidney (% body wt.)	0.55	0.56	0.61	0.59	0.60	0.60	0.04
Kidney fat (% body wt.)	0.39[a]	0.47[ab]	0.51[ab]	0.54[ab]	0.54[ab]	0.62[b]	0.09
Carcass yield (%)	57.34	55.72	55.49	56.38	57.28	58.66	1.75
Serum thiocyanate (mg/100ml)	1.59[a]	1.60[a]	1.69[abc]	1.71[abc]	1.76[bc]	1.83[c]	0.07
Urine thiocyanate (mg/100ml)	2.92	2.98	3.08	3.14	3.16	3.27	0.19

a,b,c, Values in each row with a common letter or with no letter are not significantly different ($P < 0.05$)

until the 30% level of CPM was exceeded. After this level there was a significant ($P < 0.05$) reduction in growth rate. There was a similar trend for the values of the amount of feed required for a unit weight of gain (feed conversion efficiency). The kidney fat as a percentage of body weight increased as the level of CPM fed increased. The level of CPM fed did not, however, significantly affect the liver, kidney or carcass yield . The decreasing performance noted with increasing level of CPM might have been due to the increasing level of hydrocyanic acid consumed with the higher levels of CPM in the diet. Supporting evidence for this theory is the significant ($P < 0.05$) increase of serum thiocyanate levels with increasing levels of CPM in the diet.

With the feeding of the same quantity of palm oil at all levels of CPM in Experiment 2, some changes were noted in the performance of the animals (Table 5). Without palm oil in Experiment 1, feed intake value significant ly ($P < 0.05$) dropped when the 40% level of CPM was exceeded. With palm oil supplementation, feed intake value was not significantly affected even with up to 50% level of CPM in the diet.

With palm oil supplemented diets, the trends associated with the rate of gain and amount of feed required per unit of gain were the same as with the unsupplemented diet. However, the differences in daily gain between the 40 and 50% levels of CPM were 3.40 g and 4.80 g for supplemented and unsupplemented diets respectively. With respect to the amount of feed required per gram of gain, the difference between the 40 and 50% levels of CPM was 0.72 g for the oil-supplemented diet and 1.47g for the unsupplemented diet. Oil supplementation therefore permitted a better utilization of CPM.

Table 5:

Effects of different levels of cassava peel meal and supplementary palm oil on live and carcass measurements of growing rabbits

	Levels of cassava peel meal (%)						
	0	10	20	30	40	50	+ S.E.M
Average initial wt. (g)	617.5	615.8	620.1	622.4	624.5	621.7	-
Average final wt. (g)	1942.5	1969.3	1955.7	1933.9	1663.9	1470.7	-
Daily feed intake (g)	73.11	75.17	72.50	75.18	71.84	69.63	3.04
Daily gain (g)	23.66[c]	24.17[c]	23.85[c]	23.42[c]	18.56[b]	15.16[a]	1.69
Feed/g gain (g)	3.09[a]	3.11[a]	3.04[a]	3.21[a]	3.87[b]	4.59[c]	0.31
Liver (% body wt.)	3.27	2.83	3.01	2.95	3.05	3.07	0.19
Kidney (% body wt.)	0.62	0.62	0.59	0.64	0.60	0.58	0.04
Kidney fat (% body wt.)	0.52	0.53	0.57	0.55	0.49	0.51	0.05
Carcass yield (%)	56.63	57.77	57.86	58.45	59.17	55.64	1.98
Serum thiocyanate (mg/100ml)	1.56	1.58	1.57	1.54	1.57	1.53	0.05
Urine thiocyanate (mg/100ml)	2.87[a]	2.98[a]	3.15[ab]	3.19[ab]	3.37[ab]	3.46[b]	0.22

a,b,c, Values in each row with a common letter or with no letter are not significantly different (P∠0.0

Serum and urine thiocyanate levels: With the feeding of palm oil in Experiment 2, the serum thiocyanate level remained about the same level in the animals fed from 0 to 50% levels of CPM, while there was a significant increase in the level of urine thiocyanate as the level of CPM fed alone increased from 0 to 50%. With the unsupplemented diet in Experiment 1, the reverse was the case. The serum thiocyanate level increased as the level of CPM increased while the urine thiocyanate level was not significantly affected. Since urine is the pathway of excretion, it would appear from the results that palm oil supplementation allowed for a higher level of removal of cyanide from the body.

Hutagalung (1977) had attributed the improved performance observed with feeding of palm oil in cassava-based diets to the increased energy intake of the animals. In Experiment 2 of this study the level of palm oil was kept the same at all levels of CPM and the rations which had the zero and low levels of CPM had slightly higher energy levels that the rations which had the higher levels of CPM. It would therefore appear from this study that palm oil played some role in reducing the effect of the cyanide contained in the CPM feed. Recent reports by Fomunyam et al (1981) have shown that the rate of hydrolysis of the cyanogenic glucosides in cassava to produce the poisonous hydrogen cyanide is greatly reduced with palm oil. They have therefore suggested that in animals fed cassava-based diets supplemented with palm oil, the delay in decomposition may prevent absorption of the cyanogenic glucosides.

While the amount of CPM which was tolerated by the rabbits in both the supplemented and unsupplemented diets appeared to be the 30% level, the results show that palm oil feeding reduced the level of serum thiocyanate and increased detoxification of hydrogen cyanide contained in the cassava peel. It may be necessary to feed higher levels of palm oil as suggested by the work of Olarewaju and Boszormenyi (1975) in order for the animals to tolerate the higher levels of cassava peel.

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