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Utilization of Cassava Meal (*Manihot Esculanta* Crantz) in Swine Feeding

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Abstract : The two feeding trials conducted with growing and finishing swine on the use of cassava meal indicate that the HCN free cassava meal could be used successfully as a substitute for maize upto 40% of the ration. However, the unprocessed cassava meal depressed both growth rate and food efficiency. Also, the scouring of swine experienced with the feeding of unprocessed cassava meal could be prevented completely by detoxifying it. The cassava based diets reduced carcass recovery percentages slightly ; though statistically non-significant. The data here was not conclusive as only one animal was used per treatment for carcass analysis. However, the cassava meal did not alter backfat thickness in the HCN-free ration but the unprocessed meal caused an adverse effect on the backfat thickness, indicating that HCN interferes with energy utilization also.

1. Introduction

The necessity to spare cereal grains for human consumption has made it essential to evaluate other sources of energy supplements for animal feeding. Cassava (*Manihot esculanta* Crantz) is one such product that requires investigations.

Studies on Cassava as an energy supplement for swine have begun in the early part of this century. However, the results reported on the use of Cassava in swine rations were not consistent. Maner[11] reported that the maximum level of Cassava that could be utilized by swine was 40 per cent. Work reported from Nigeria[14] indicates that growing and finishing swine could effectively use 40 and 55 per cent Cassava respectively, when incorporated into their rations. Several other authors[4,7] have reported that Cassava could be successfully used upto 60 per cent in swine rations. Further, Aumaitre[2] has found Cassava to be a better source of energy supplement for wine, than maize, wheat, oats and barley.

However, other authors have reported that Cassava caused retardation of growth in swine, as its level was increased in rations.[3,10,18] It has been suggested that hydrocyanic acid (HCN) could be the cause of the growth inhibitory effect in Cassava.[9]

Hence, the studies reported here were undertaken in the Department of Animal Husbandry, University of Sri Lanka, Peradeniya Campus, to evaluate whether the growth inhibitory effects of Cassava was due to the presence of HCN. This was done by feeding Cassava meal with and without HCN to growing and finishing swine.

2. Experimental

Cassava meal was prepared from fresh Cassava tubers, chopped into slices of about quarter of an inch in thickness, by drying in a Unitherm Oven at 100°C for 8 hours and grinding the dried material. HCN was eliminated from dried Cassava chips by using the dry-soak-dry method suggested by Rajaguru.[16] Chemical composition of the Cassava meal used are reported in Table 1.

TABLE 1. Chemical Composition of Cassava Meal

Dry matter %	86.30
Crude Protein %	2.60
Crude Fibre %	1.75
Ether Extract %	0.04
Ash %	1.50
Nitrogen free Extract %	80.41

Two experiments using cross-bred swine were conducted utilizing the same facilities and experimental procedures. Animals of each treatment were housed in separate pens and water was supplied *ad libitum*. They were fed twice a day. Intake capacity of feed in each group was judged by the amount consumed within the first half an hour of feeding and based on this, feeding amounts were adjusted at weekly intervals. The rations were fed in a wet form.

Experiment 1.

18 cross-bred swine comprising 15 males and 3 females were randomly alloted to three treatments on the basis of sex and weight. They were around 60 days of age and had an average weight of 10.56 kg at the time of initial selection.

The first experimental ration contained 35% unprocessed Cassava meal. The second experimental ration contained 35% Cassava meal treated to fully eliminate HCN. These two rations were compared with a maize-based control ration. All three rations were balanced to carry nutrients recommended for growing swine by the National Research Council of U.S.A.[13] The composition of rations is shown in Table 2.

This experiment was conducted for five weeks and weekly weight gains and daily feed consumptions were recorded. Feed efficiency was calculated by using the following formula,

$$\text{Feed efficiency} = \frac{\text{Average feed Consumption}}{\text{Average Weight Gain}}$$

TABLE 2. Percentage composition of Rations for Growing Swine

	Maize	Cassava	Coconut poonac	Gingelly poonac	Rice Bran	Fish Meal	Bone Meal	Zoodry*
Control	35	—	30	5	20	8	2	0.25
35% HCN free Cassava Meal	—	35	35	5	14	10	1	0.25
35% Unprocessed† Cassava Meal	—	35	35	5	14	10	1	0.25

*Vitamin and Mineral supplement.

†Unprocessed Cassava Meal contained 100 PPM of HCN.

Experiment 2.

Fifteen crossbred castrated males averaging 23.55 kg were randomly assigned to five dietary treatments. A maize based ration, which was formulated to provide the nutrient requirement of finishing swine according to the N.R.C. standards,[13] served as the control. This ration was compared with experimental rations containing 20, 30 and 40 per cent HCN free Cassava meal. A fifth ration containing 40 per cent unprocessed Cassava meal, was included to study the effects of HCN on the performance of finishing swine. All five rations were balanced to be isocaloric and iso-nitrogenous. The composition of these rations is presented in Table 3.

TABLE 3. Percentage composition of Rations for Finishing swine.

	Maize	Cassava	Coconut poonac	Gingelly poonac	Rice Bran	Fish Meal	Bone Meal	Zoo-dry	Methi-onine.
Control	40	—	35	5	14	5	1	0.25	0.25
20% HCN free Cassava Meal	—	20	32	8	33	6	1	0.25	0.25
30% HCN free Cassava Meal	—	30	32	5	23	9	1	0.25	0.25
40% HCN free Cassava Meal	—	40	30	8	11	10	1	0.25	0.25
40% Unprocessed* Cassava Meal	—	40	30	8	11	10	1	0.25	0.25

*Unprocessed Cassava Meal contained 114 PPM HCN.

Weekly weight gains and daily feed consumptions were recorded throughout the experimental period, which lasted nine weeks. At the end of the experiment, one animal was randomly selected from each treatment and was slaughtered after recording the live weight. The dressing percentage was calculated by using dressed weight as a percentage of live weight. Backfat thickness was calculated by averaging the fat thicknesses at first rib, last rib and last lumbar positions. The technique described by Hew and Hutagalung[9] was used in determining carcass composition.

3. Results

Experiment 1.

The performance of growing swine fed Cassava meal rations is presented in Table 4.

TABLE 4. Effect of HCN free and unprocessed cassava meal on rate and efficiency of gain of growing pigs.

	Average initial weight kg	Average final weight kg	Average weight gain kg	Average feed consumption* kg	Average feed efficiency* kg
Control	10.53	17.52	6.99a	23.33	3.34
35% HCN Cassava meal	10.60	18.03	7.43a	23.33	3.14
35% Unprocessed Cassava meal	10.46	16.44	5.98b	22.73	3.79

Statistical significance at 5% level is denoted by different letters.
*Statistically not significant.

There were no significant differences (P 0.05) in average weight gain or feed, conversion of animals fed maize based control ration and those fed on rations containing HCN free Cassava meal. Animals receiving the ration containing unprocessed Cassava meal gained more slowly (P 0.05) than those fed the other two rations.

The feed conversion efficiency of animals fed unprocessed Cassava meal was 13.4% and 20.6% lower than those fed on control and HCN free Cassava meal rations, respectively. However, the differences were not statistically significant.

Experiment 2.

The preference of finishing swine fed different levels of Cassava meal is presented in Table 5.

TABLE 5. Effect of HCN-free and unprocessed Cassava meal on rate and efficiency of gain of finishing swine.

	Average Initial Weight kg	Average Final Weight kg	Average Weight Gain kg	Average Feed Consumption. kg	Average Feed Efficiency* kg
Control	23.48	38.03	14.55a	57.27	3.94a
20% HCN-free Cassava Meal	23.79	36.66	12.88a	57.27	4.45a
30% HCN-free Cassava Meal	23.48	36.81	13.33a	57.27	4.30a
40% HCN-free Cassava Meal	23.33	37.12	13.79a	57.27	4.15a
40% Unprocessed Cassava Meal	23.64	33.03	9.39b	57.27	6.10b

*Statistical significance at 5% level is denoted by different letters.

There were no significant differences (P 0.05) between the performance of animals fed with maize based control ration and those fed with different levels of HCN-free Cassava meal. However, incorporating unprocessed Cassava meal containing HCN into the swine rations resulted in significantly lower (P 0.05) average weight gains and feed conversion efficiency.

Summary of the carcass characteristics of experimental animals is presented in Table 6.

TABLE 6. Effect of Cassava Meal on the Carcass Characteristics of swine.

	Live Weight (kg)	Carcass Weight (kg)	Dressing Percentage (%)	Average Backfat Thickness (mm)
Control	37.73	27.76	73.58	25.50
20% HCN-free Cassava Meal	35.45	24.69	69.65	21.83
30% HCN-free Cassava Meal	34.09	23.81	69.84	24.66
40% HCN-free Cassava Meal	38.18	27.02	70.77	26.33
40% Unprocessed Cassava Meal	30.91	20.74	69.14	17.50

The dressing yield ranged from 69.14 to 73.58 per cent, with animals on control and 40% unprocessed Cassava meal showing the highest and lowest carcass recovery, respectively. Carcass recovery of the animal fed on 40% HCN-free Cassava meal was 3.84% lower than that on the control ration.

Based on the averages of three measurements, animals on 40% HCN-free cassava meal showed backfat thickness comparable to that on the control ration. The lowest backfat thickness was observed with the animal fed on 40% unprocessed Cassava meal, which was 8.83 and 9.66 mm lower than those on 40% HCN-free Cassava meal and control rations respectively.

The results of the proximate analysis of carcasses are shown in Table 7.

TABLE 7. Effect of Cassava Meal on the Chemical Composition of Carcasses.

	Dry Matter %	Crude Protein %	Crude Fat %	Bone Ash %
Control	66.70	35.20	51.04	50.06
20% HCN-free Cassava Meal	60.42	39.10	47.98	49.99
30% HCN-free Cassava Meal	63.09	36.64	53.01	42.88
40% HCN-free Cassava Meal	65.56	35.80	52.61	47.92
40% Unprocessed Cassava Meal	63.56	34.70	48.97	48.76

The treatments appear to have no effect on the moisture, crude protein, crude fat or on the bone ash content of the carcasses. There seems to be an inconsistent individual variation with respect to some nutrients.

4. Discussion

The results of the two trials have shown clearly that Cassava meal, when processed to eliminate HCN, can be used as the main source of energy in both growing and finishing swine without depressing their performances. No depression in growth rate or efficiency of feed conversion was observed in animals fed HCN-free Cassava meal at levels as high as 40 per cent. (Tables 4 and 5). Similar observations have been recorded by many workers.[2,4,7,9,11]

On the other hand, feeding unprocessed Cassava meal caused a marked depression in weight gain and efficiency of feed conversion in both growing and finishing swine, confirming a number of earlier reports.[8,10,18] The results of this study suggest that the HCN present in the unprocessed Cassava meal may be the toxic factor responsible for depressing the performance of animals. This may be due to the interference of HCN with the utilization of vitamin B complex and protein,[17] thus resulting in depressed growth. Also it appears from these experiments that the swine were unable to utilize the energy in Cassava for growth due to the protein imbalance caused by HCN.

In Experiment 1, 50% of the growing swine fed with unprocessed Cassava meal containing 100 PPM HCN developed scour, while those on HCN-free Cassava meal did not show any signs of scouring. Many workers have observed incidence of scouring, when Cassava was fed.[1,10,12,14] None of these workers have used HCN-free Cassava meal in their experiments. The problem of scour caused by unprocessed Cassava meal could be overcome by processing Cassava meal according to the dry-soak-dry techniques described by Rajaguru.[16] HCN therefore, appears to be the contributing factor to scouring. The mechanism by which HCN causes scour in swine is obscure.

When finishing swine, were fed unprocessed Cassava meal containing 114 PPM HCN only mild cases of scouring were observed. It may be possible that finishing swine could tolerate a higher level of HCN than growing swine. However, no evidence of HCN toxicity was observed in both growing and finishing swine suggesting that the levels of HCN present in the unprocessed Cassava meals used in these two experiments could be tolerated by both growing and finishing swine. Coursey[6] reported that 50 to 100 PPM HCN Cassava was moderately poisonous to swine.

The above results suggest that HCN may be the contributing cause for digestive disturbances. The loss in weight gain, when unprocessed Cassava is fed at high levels to swine, may be partly due to low utilization of nutrients due to digestive disturbance. Hence it is essential that all HCN and related glucosides be removed from Cassava before using for swine feeding. HCN-free Cassava meal is well utilized by swine.

Replacing maize by Cassava in swine rations appears to somewhat reduce the dressing yield. The phenomenon is difficult to explain as the rations were iso-caloric and iso-nitrogenous. There were no appreciable differences in the backfat thickness between rations based on maize and processed Cassava. (Table 7). Chou *et al*[5] and Castillo *et al*,[3] also did not find any increase in backfat thickness due to the use of Cassava meal. This is to be expected since the energy content of maize and Cassava appear to be similar. Feeding unprocessed Cassava meal seems to reduce the backfat thickness suggesting that HCN present in the unprocessed Cassava meal may be interfering with the efficiency of energy utilization. However, the carcass data should not be considered conclusive, since only one animal was slaughtered per treatment.

It can be concluded that Cassava meal when well detoxified could be an ideal substitute for maize in swine rations. Also once detoxified it could be safely used upto 40% of the ration as an energy supplement. Since Cassava yields more energy per hectare than any other crop, its use as an energy supplement in swine rations would lower the cost of feed.

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References

1. ARAMBAWELA, W. J., NIEISEN, H. E., DANIELSEN, V., & EGGUM, B. O. (1975). *Effect of replacing barley with tapioca meal at two different levels of feeding. Livestock Prod. Sc.* **2**, (3) : 287.
2. AUMAITRE, A. (1969). *Ann. Zootech.* **18**, (4): 385.
3. CASTILLO, L. A., AGLIBUT, F. B., JAVIER, T. A., GERPACIO, A. L., GARCIA, G. V., FIYUA, R. B. & RAMIN, B. B. (1963). *Camote and cassaya silage as replacement for corn in swine rations. Phil. Agriculturists.* **47**: 460.
4. CHIECO, C. F., GARBATI, S. T., MULLE-HAYE, B., & VECHCHIONACE, H. (1972). *Cassava meal for fattening pigs. Agronomia Tropical (Venezuela)*, **22**, (6) : 599.
5. CHOU, K. C., NAH, K. C., & MULLER, Z. (1973). *Replacement of maize by high level tapioca meal in rations for growing and finishing pigs. Kajian Veteribaire*, **5**. (1): 3.
6. COURSEY, D. G. (1973). *Cassava as food: Toxicity and Technology in chronic cassava toxicity: Proc. interdisciplinary Workshop.* IDRC. 010 3, 27.
7. HANSEN, V., BRESSON, P. S., & JENSEN, A. (1976). *Tapioca meal as feed for bacon pigs. Nut. Abst. & Rev.* **47**, (4): 2129.
8. HENRY, Y. (1971). *Nutritional effects of including purified cellulose in the diet of the growing-finishing swine. Ann. Zootech.* **19**: 117.
9. HEW, V. F., & HUTAGULANG, R. I. (1975). *Utilization of cassava as a carbohydrate source for pigs. Proc. 4th Symb. Ini. Soc. Trop. Root crops.* Ed. by Cook, J., Macintyre, R., and Graham, M. p. 242.
10. HEW, V. F., & HUTAGULANG, R. I. (1972). *The utilization of tapioca meal in swine feeding. Malaysian Agric. Res.* **1**: 124.
11. MANER, J. H. (1973). *Cassava in swine feeding. Proc. first Latin American swine seminar* Centro International De Agricultura Tropical p. 29.
12. MODESE, A. N. A. (1963). *Preliminary trial on the value of dried cassava for pig feeding. J. of W. Africaq Sc. Association.* **7**: 127.
13. N.R.C. (1966). *Nutrient requirements of domestic animals, No. 2, Nutrient requirements of swine.* National Research Council, Washington, D.C.
14. OYENUGA, V. A. (1961). *Nutritive value of cereal and cassava diet for growing and finishing pigs. in Nigeria. Brit. J. of Nutrition.* **15**: 327.
15. OYENUGA, V. A., & OPEKE, L. K. (1957). *The value of cassava in rations for pork and bacon production. W. African. J. Biol. Chem.* **1**: 3.
16. RAJAGURU, A. S. B. (1972/73). *Elimination of hydrocyanic acid from processed manioc chips. J. Nat. Agric. Soc. of Ceyl.* **9/10**: 53.
17. RAJAGURU, A. S. B. (1975). *Problem of HCN in cassava. Agric. Research Seminar Series.* Faculty of Agriculture. University of Sri Lanka. No. 75-7.
18. VELIOSO, L. *et al.* (1965/66). *Partial and total replacement of corn by cassava meal in rations for swine. Boletim De Industrial Animal.* **23/24**: 129.