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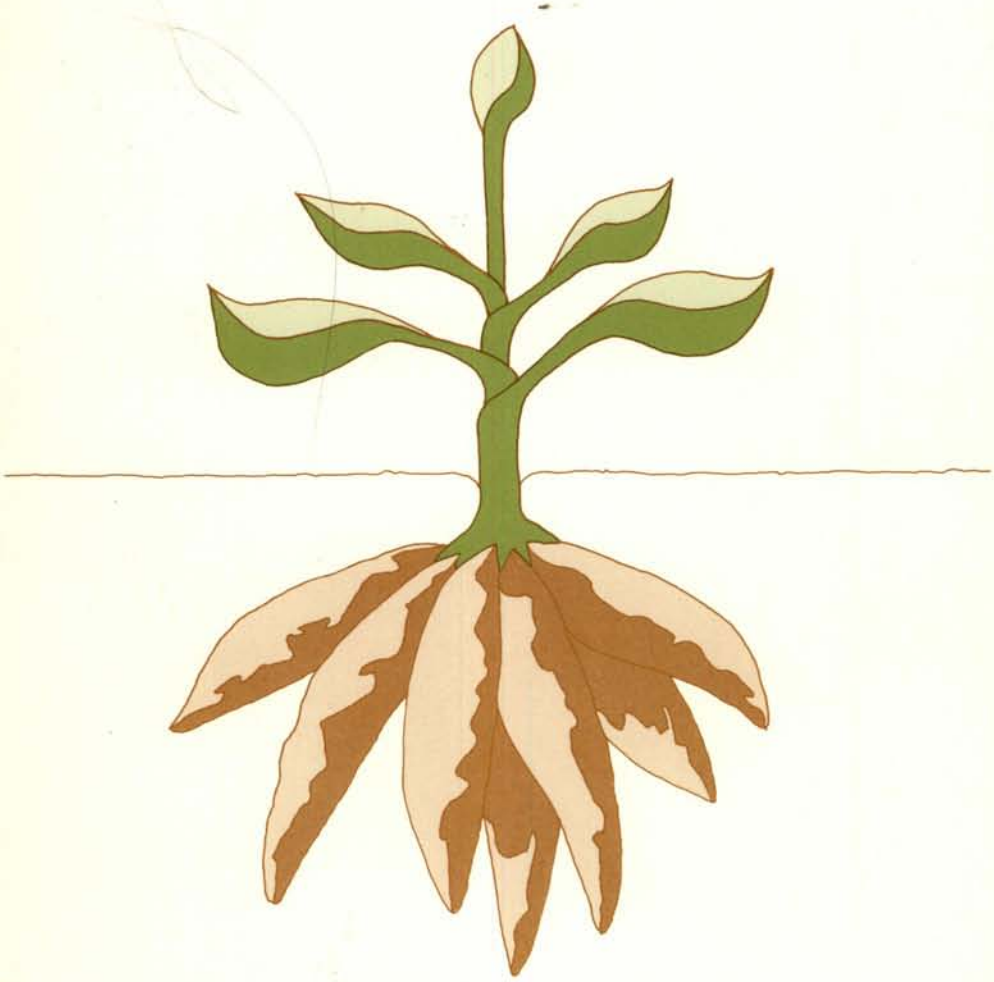
# edings of the Fourth Symposium of the ıational Society for Tropical Root Crops

## Held at CIAT, Cali, Colombia, 1-7 August 1976

Edited by James Cock, Reginald MacIntyre, and Michael Graham



The International Society for Tropical Root Crops in collaboration with
Centro Internacional de Agricultura Tropical
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# Utilization of Cassava-Based Diets in Swine Feeding

## Guillermo G. Gómez, Carlos Camacho, and Jerome H. Maner[1]

A swine feeding program based on diets with high levels (60–70%) of sweet cassava meal plus soybean meal as the protein source, without methionine supplementation but adequately supplemented with vitamins and minerals, was used experimentally throughout the animals' lifetime. The experimental results were compared with those obtained in a control diet based on common maize and soybean meal.

The gilts fed cassava meal gained weight more slowly during the growing-finishing periods and gained less weight during pregestation and gestation. Nevertheless, they gained weight subsequently, in lactation, whereas the gilts in the control group lost weight during this period.

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The results indicate that the experimental diets with high levels of sweet cassava meal, without methionine supplementation, produced a smaller number of pigs per litter, resulting in lower total weights per litter than normally expected. The quantity of feed required to produce one weaned pig was greater for the cassava group than for the control. The quantities of soybean meal required to balance the total protein was significantly greater in the cassava meal-based diets than in the common maize diets.

Cassava roots are normally used for human nutrition; nevertheless, high percentages of the production of this crop from the principal producing countries (Brazil and Thailand) are used in animal nutrition, especially for swine feeding. It is estimated that more than one third of the cassava produced in Brazil and almost all the cassava exported from Thailand to Europe, especially to Western Germany and Holland, is used for swine feeding (Phillips 1974).

In spite of the relatively abundant experimental evidence available with regard to the utilization of different forms of cassava roots in swine feeding (Maner et al. 1976, Gómez et al. 1976), there is little information on the utilization of cassava meal in high percentages in diets during the entire lifetime of the pig.

In cassava-based diets, the quantity and quality of protein depends primarily on supplementary protein since cassava meal contains an insignificant amount of protein. Experimental work carried out at CIAT with rats and swine (Maner and Gómez 1973, Job 1975, Gómez et al. 1976) has shown that methionine supplementation in diets based on cassava meal and soybean meal improves the protein quality of the diet and also makes the detoxification processes more efficient through a greater excretion of cyanides in the form of thiocyanates in the urine (Maner and Gómez 1973). Relatively high doses of cyanide in diets for gestating rats or gestating sows do not seem to alter reproductive performance of these species (Tewe 1975). On the other hand (Clawson et al. 1963, De Geeter et al. 1972, Pond 1973), swine have a great capacity during reproductive periods (especially gestation) to withstand drastic nutritional limitations without affecting their reproductive performance significantly.

The purpose of this study was to obtain basic information on the utilization of cassava meal as a source of energy and soybean meal as the protein ingredient, without methionine supplementation, by swine throughout the different periods of their life. The experimental results were compared with those obtained from swine fed diets based on common maize and soybean meal, without methionine supplementation.

## Experimental Procedure

A total of 32 recently weaned Yorkshire gilts were preselected and grouped into two lots of 16 pigs each, with an average liveweight of approximately 20 kg. The animals were selected and assigned to each experimental group on the basis of their liveweight and litter. Each experimental lot was divided into four subgroups or replicates of four animals each, and each replicate was housed in a concrete-floored corral during the growing-finishing periods (20–90 kg). During the pregestation and gestation periods, two replicates (8 gilts) were grouped per corral and remained in pastures grazing pangola grass. A few days before the calculated farrowing date, each sow was transferred to the maternity section and placed individually in farrowing stalls. Each sow and her litter remained in these stalls until approximately 2 weeks after farrowing; they were then housed in concrete-floored corrals until weaning of their offspring at 56 days of age.

The experimental diets were supplied in automatic feeders during the growing, finishing, and lactation periods. During pregestation and gestation, the experimental diets were administered in one meal per day and intake was individually controlled. In all cases, drinking water was continually available. The Yorkshire boars used to breed all the gilts in the experiment were fed a diet based on common maize and soybean meal. The total protein calculated ($N \times 6.25$) in the experimental diets was: growing (20–50 kg) 16%; finishing (50–90 kg) 13%; pregestation (90–120 kg) 13%; gestation (breeding-farrowing) 16%; lactation (farrowing-weaning) 16%; and starter diet for baby pigs (10–56 days) 18%. The composition of the experimental diets is presented in Table 1. The cassava meal was prepared from fresh sweet roots (variety Llanera), which were chopped, sun-dried on concrete floors,

Table 1. Utilization of common maize and sweet cassava meal in swine feeding programs. Percentage composition of experimental diets.[a]

| Ingredient (%) | Growing | | Finishing and pregestation | | Gestation and lactation | | Baby pigs starter diet | |
|---|---|---|---|---|---|---|---|---|
| | Common maize | Cassava meal | Common maize | Cassava meal | Common maize | Cassava meal | Common maize | Cassava meal |
| Common maize | 79.5 | — | 87.9 | — | 76.4 | — | 62.5 | — |
| Cassava meal | — | 69.0 | — | 75.9 | — | 67.0 | — | 50.6 |
| Soybean meal | 15.8 | 26.2 | 7.3 | 19.3 | 18.8 | 28.2 | 22.7 | 34.6 |
| Sugar | — | — | — | — | — | — | 10.0 | 10.0 |

[a]All diets contained: 4% bone meal; 0.5% mineral premix; and 0.3% vitamin premix.

and then ground and incorporated in the diets in the form of meal.

## Results and Discussion

In spite of the fact that only gilts were involved, daily weight gains (0.77 and 0.71 kg/day) were similar to those reported previously (Maner et al. 1976) for lots of castrated males and females during the growing-finishing periods. Although the principal objective of this experiment was to observe the effects of the diets on reproductive performance of gilts, the results from the growing-finishing periods indicate that there is a significant difference ($p < 0.01$) between daily weight gains of the animals in the two experimental groups. The gilts fed the cassava-based diet gained less weight per day (0.71 kg/day) than those fed the control diet based on common maize (0.77 kg/day), which is reflected in the longer time (1–2 weeks more than the control group) required to reach market weight (approximately 90 kg) and later in a lower average weight per gilt at the time of breeding (118.5 vs 127.6 kg, respectively) when all the animals were practically the same age. Intake of the cassava-based diet (2.30 kg/day) was similar to the consumption of the maize-based diet (2.38 kg/day).

Table 2 gives the reproductive performance of the two experimental groups including liveweight variations of gilts during gestation and lactation periods. The gilts received a limited quantity of the experimental diets during pregestation and gestation, equivalent to approximately 2.0 kg/animal/day during pregestation and 1.8 kg/animal/day during gestation. The gilts fed the maize-based diet had higher total body weight gains (48.3 vs 37.5 kg) and net weight (33.3 vs 27.6 kg) during gestation than the animals fed on the cassava-based diets (Table 2). Nevertheless, the gilts fed cassava meal gained weight during lactation (13.5 kg), whereas the control group lost weight (6.7 kg) during the same period. A greater number of gilts from the group fed cassava meal were pregnant and therefore the litter number was greater for this group; however, the differences were due to factors other than the effects of the experimental diets. Upon making the final selection in the pregestation period, two gilts were eliminated from the control group because of defective teats; in addition, two other gilts from this group were bred, became pregnant, and farrowed much later than the rest of the experimental animals.

The number and weight of offspring at birth from gilts fed cassava-based diets were slightly lower but not significantly different ($p > 0.05$) from the progeny of gilts fed on common maize. When the pigs reached 21 days of age, the number of pigs per litter was significantly different in the two experimental groups; the litters from the cassava group had an average of approximately three pigs less than the control group litters. The average weight of the pigs in both experimental groups was similar throughout the lactation period; average weights at weaning were 15.87 vs 15.70 kg for the common maize and the cassava meal groups, respectively. Nevertheless, as a result of the difference in number of weaned pigs, the gilts fed on common maize produced total litter weights significantly ($p < 0.05$) higher (145.4 vs 103.6 kg) than gilts fed sweet cassava meal (Table 2). Performance of the control group litter was similar to that normally obtained in practice, whereas performance of gilts fed a cassava-based diet was less than expected. Apparently, the smaller number of baby pigs and their reduced weight at birth were the causal

Table 2. Utilization of common maize and cassava meal in swine feeding programs. Experimental results for the gestation and lactation periods.

| | Experimental variables | |
|---|---|---|
| | Common maize | Cassava meal |
| No. of gilts | 10 | 14 |
| Liveweight changes for gilts (kg) | | |
| Weight at breeding | 127.6 | 118.5 |
| Weight on 110th day of gestation | 175.6 | 156.0 |
| Total gain, gestation | 48.3 | 37.5 |
| Postfarrowing weight | 160.6 | 146.1 |
| Net gain, gestation | 33.1 | 27.6 |
| Weight at weaning, 56 days | 153.9 | 159.6 |
| Weight change, lactation | −6.7 | +13.5 |
| Weight change, gestation-lactation | +26.3 | +41.1 |
| Farrowing data | | |
| No. pigs/litter | 10.0 | 8.4 |
| Pig weight (kg) | 1.09 | 0.97 |
| Weaning data | | |
| No. pigs/litter | 9.4 | 6.6 |
| Pig weight (kg) | 15.87 | 15.70 |
| Total litter weight (kg) | 145.4 | 103.6 |

factors for weaning performance.

Since the experimental diets supplied similar quantities of crude protein during the different periods, it is assumed that one of the possible factors responsible for the poorer performance of animals fed cassava meal-based diets may be protein quality, principally the adequate supply of sulfur-containing amino acids, particularly methionine. It should be pointed out that the effect of the experimental diets, used in the present study over a prolonged period, significantly affected the results of the growing-finishing periods of the gilts, prior to the reproductive periods. Preliminary results of an ongoing experiment (Gomez et al. unpublished) suggest that the addition of methionine to cassava-based diets during gestation and lactation does not improve reproductive performance significantly when compared to a diet without methionine supplementation. However, it should be pointed out that the ongoing experiment was begun at breeding and not in periods prior to gestation as was the case in this work. More experimental data are necessary to elucidate the factor(s) responsible for inferior reproductive performance in feeding programs for all periods of the pigs' lifetime that are based on the utilization of cassava meal as the source of energy.

The average consumption per animal (gilts) of diets, common maize, cassava meal, and soybean meal is given in Table 3. Diet intake during the growing-finishing as well as during the reproductive periods (pregestation, gestation, and lactation) was similar for both groups. Total starter diet intake for litters was less for those fed the cassava meal-based diet as a result of the significantly lower number of pigs in these litters than in the control group; average intake of starter diet per baby pig was similar for both groups.

Because of the limited protein supplied by cassava meal, the amount of soybean meal needed to balance the total protein quantitatively in these diets was much greater than for the common maize-based diets.

Taking into account only the reproductive periods (pregestation, gestation, and lactation, including the starter diet) and performance during weaning, without including feed for the boar, the quantity of diet required to produce a weaned pig with cassava meal is given in Table 3. Although the quantity of cassava required for these periods was 86.5% that of common maize (532.8 vs 615.7 kg, respectively) (Table 3), the quantity of soybean meal required for cassava meal-based diets was 58.7% more than for the common maize-based diets (197.3 vs 124.3 kg). The data suggest that the obtained performance would affect the production pa-

Table 3. Utilization of common maize and cassava meal in swine feeding. Intake of diets and basic ingredients. SBM = soybean meal.

| | Experimental variable | | | | | |
|---|---|---|---|---|---|---|
| | Common maize (kg) | | | Cassava meal (kg) | | |
| Experimental period | Diet | Common maize | SBM | Diet | Cassava meal | SBM |
| Growing (20–50 kg) | 77.9 | 59.5 | 14.7 | 91.9 | 63.6 | 23.9 |
| Finishing (50–90 kg) | 137.9 | 121.2 | 10.1 | 124.0 | 94.1 | 23.9 |
| Subtotals | 215.8 | 180.7 | 24.8 | 215.9 | 157.7 | 47.8 |
| Pregestation | 230.6 | 202.7 | 16.8 | 217.2 | 164.9 | 41.9 |
| Gestation | 209.9 | 160.4 | 39.5 | 211.0 | 146.0 | 54.9 |
| Lactation | 265.5 | 202.8 | 49.9 | 292.5 | 196.0 | 82.8 |
| Baby pigs starter diet | 79.6 | 49.8 | 18.1 | 51.1 | 25.9 | 17.7 |
| Subtotals | 785.6 | 615.7 | 124.3 | 771.8 | 532.8 | 197.3 |
| Total | 1001.4 | 796.4 | 149.1 | 987.7 | 690.5 | 245.1 |

rameters, and therefore they should be considered in a practical evaluation. The economic evaluation of the experimental data presented is being done at CIAT and will be published later.

The information presented may have limitations and defects characteristic of experimental work of this nature; nevertheless, it is possible to suggest that the utilization of cassava meal in integrated swine feeding programs could result in lower reproductive performance that could unfavourably affect economic possibilities.

Most of the experimental work on the use of cassava meal in swine production refers frequently to partial substitution of cereal grains by cassava meal in relatively limited percentages. In addition, in almost all cases, cassava meal has been used in isolated periods of the life cycle. Apparently the continued use of high percentages of cassava meal makes it possible to observe certain effects that cannot be detected in relatively short-term experiments. The effects may possibly be different when bitter cassava meal is used, because the content of hydrocyanic acid or linamarin is much higher than in sweet cassava. Further studies are required to obtain efficient use of cassava meal in swine feeding programs.

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