# EFFECTS OF METHIONINE–SUPPLEMENTED CASSAVA MEAL DIETS ON PERFORMANCE AND CARCASS CHARACTERISTICS AND SOME ORGAN WEIGHTS OF GROWING–FINISHING PIGS[1] /

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**Resumen**

*En este estudio se empleó niveles de 0%, 15%, 30% y 45% de harina de yuca (CM), en raciones balanceadas para cerdos en crecimiento y acabado de cerdos. La harina de yuca se preparó a partir de trozos de yuca fresca seca al sol.*

*Las raciones para cerdos de 8.7 kg de peso hasta el momento del destace se complementaron con 0.05% DL de metionina. La ganancia de peso más alta se logró con la dieta del 30% de CM. Todas las raciones que contenían harina de yuca indujeron con crecimiento más acelerado que aquellas a base de maíz, aunque también contenían niveles más elevados de harina de pescado. La canal y las mediciones hechas de ciertos órganos no se vieron afectadas significativamente por las raciones. La ración con 45% de CM produjo canales con menor contenido de grasa. Los cerdos en crecimiento utilizaron las raciones con altos niveles de harina de yuca más eficientemente que los cerdos en acabado, los cuales ganaron más con raciones bajas en CM.*

## Introduction

Replacement of cereals by cassava meal (CM) in the diet of growing-finishing pigs has produced conflicting results.

Kok and Robeiro (9) have observed enhanced liveweight gain, feed intake and feed efficiency by feeding cassava based diets, while other authors (2, 14) reported depressed gain, feed intake and feed efficiency in pigs fed cassava supplemented diets.

Effects of dietary cassava on carcass quality have been variable. Some investigators (9, 11, 14) observed increased fat deposition and reduced loin eye area as a result of feeding cassava-based rations to finishing pigs. However, others authors (5, 12) did not obtain any deleterious effects of dietary cassava on carcass characteristics.

Processing techniques of cassava meal, vitamin and mineral imbalance and the methionine content of cassava-based rations have been implicated as possible causes of variations in response (13, 10). This study was undertaken to obtain more information on growth response and carcass performance of growing-finishing pigs fed methionine-supplemented cassava meal diets.

## Materials and methods

### Cassava processing

Cassava tubers used in this study were of the bitter variety. Lifted roots were purchased from local farmers around Ile-Ife. Soil was shaken off the roots which were then carefully peeled. The pulp was

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sliced into thin flakes which were sun-dried on concrete floors with constant turning until the moisture content was about 12%. The dry flakes were ground in a Bentall hammer mill and the resulting cassava meal stored in jute bags until used. The proximate analysis, gross energy and hydrocyannic acid contents of cassava meal appear on Table 1. Moisture, nitrogen, ether extracts, crude fibre and ash were analysed by the methods of the Association of Official Analytical Chemists (4). Gross energy was determined using a Gallenkamp ballistic bomb calorimeter. HCN content was determined by both the picric acid and cyanobromide methods (16, 3).

Table 1. Proximate, HCN and energy contents of cassava meal.

| | Content in air dry basis (%) | |
|---|---|---|
| Moisture | 12.24 | |
| Ether extracts | 1.23 | |
| Crude fibre | 1 84 | |
| Crude protein (N x 6.25) | 2 12 | |
| Ash | 3.05 | |
| NFE | 79.52 | |
| HCN (mg/kg) | 232 | (wet pulp) |
| HCN (mg/kg) | 75 | (dry meal) |
| Gross energy (kcal/kg) | 4160 | |
| Digestible energy (kcal/kg)[1] | 3650 | |

1 Obtained from G. E. value by the combined methods of Drennan and Maguire (6) and King and Taverner (8)

### Treatments

Four experimental rations containing 0%, 15%, 30% and 45% CM were formulated (Table 2). With increasing levels of cassava, yellow maize, groundnut cake, fish meal and brewers' waste were adjusted in an attempt to keep the rations both isocaloric and isonitrogenous. The fish meal level was doubled in cassava diets to assure 16% crude protein level and reduce the variability that may be due to allocation of different levels of this high quality supplement. This made the cassava diets more comparable to each other than to the control. The level of brewers' waste was increased to ensure adequate fibre in the diets and forestall the incidence of diarrhea that may be caused by the finely powdered meal. Levels of 0.1% and 0.2% methionine have been used to supplement cassava diets without any toxicity symptoms in pigs (1). A level of 0.05% D L methionine was intuitively chosen bearing in mind the high cost of this high grade methionine and the use of 0.5% palm oil, which also aids in the detoxification of HCN (12). Other nutrients were optimal but there was a decreasing trend in ether extracts of the rations with increasing levels of cassava meal. This led to the dusty nature of cassava substituted rations.

Table 2. Composition of experimental rations (%air dry basis).

| | Cassava levels (%) | | | |
|---|---|---|---|---|
| | 0 | 15 | 30 | 45 |
| Yellow maize | 72 5 | 54.5 | 33.4 | 13 0 |
| Cassava meal | 0.0 | 15.0 | 30.0 | 45.0 |
| Groundnut cake | 6.5 | 5.0 | 8.0 | 10.0 |
| Fish meal | 2.0 | 4.4 | 4.0 | 4.4 |
| Brewer' waste | 15.4 | 17.5 | 21.0 | 24.0 |
| Palm oil | 0.5 | 0 5 | 0.5 | 0.5 |
| Dicalcium phosphate | 2 0 | 2.0 | 2 0 | 2.0 |
| Salt | 0 5 | 0.5 | 0.5 | 0.5 |
| Vit-Min premix[1] | 0 5 | 0.5 | 0 5 | 0 5 |
| Antibiotics | 0 05 | 0 05 | 0 05 | 0 05 |
| D. L. Methionine | 0 05 | 0 05 | 0 05 | 0 05 |
| Analysed crude protein (%DM) | 15 5 | 16 5 | 16 0 | 14.4 |
| Analysed gross energy (kcal/kg) | 4168 | 4483 | 4316 | 4208 |
| Calculated digestible energy (kcal/kg)[2] | 3261 | 3273 | 3274 | 3287 |

1 A commercial preparation supplying per kg diet: 10 000 I. U. Vit A, 1333 I. U Vit. $D_3$, 6.7 mg $B_2$, 83.3 I. U $B_3$, 23.3 I. U $B_5$, 0.03 mg $B_{12}$, 833 mg Choline chloride, 16 7 mg Zinc bacitracin, 208 mg antioxidant, 167 mg Iron, 133 mg Manganese, 208 mg Zinc, 125 mg Cooper, 0 83 mg Cobalt and 3 3 mg Iodine

2 Obtained from G. E. values by the combined methods of Drennan and Maguire (6) and King and Taverner (8).

### Animals

Twenty large white pigs weaned at 6 weeks were deworm-ed and then assigned to 4 groups each of 5 pigs on the basis of sex and weight such that the average individual weight in all treatments was 8.7 kg. All pigs were housed in concrete-floored pens equipped with group feeding facilities, in a standard open-sided pig house with asbestos roofing. The pens were washed and disinfected before the start of the experiment and every morning throughout the experimental period. Feed was supplied *ad libitum*. As part of the routine management, pigs were dewormed once a month with Thiprazole and sprayed with Tigal against insects and skin infections.

### Carcass analysis

As the pigs attained an average of 78 kg liveweight they were fasted for 18 hours and were slaughtered, dressed and the carcass split into two longitudinal halves. On the left halves, carcass length, average backfat and loin eye area were determined. The standard practice is to chill carcasses before taking measurements. This was however not possible for technical reasons and the greatest error will be associated with the backfat measurements due to the flabbiness of carcasses but the loin eye area was measured on loins chilled at 5°C for 24 hours. The carcass was cut into: ham between the second and third lumbar vertebrae and perpendicular to the backline; shoulder – between the second and third ribs; loin – separated from the neck and from the belly by making a cut beginning at the tip of the tenderloin following the back curvature. The trotters were separated from both the ham and shoulder. These various cuts were weighed and expressed as percentages of the half carcass. Liver, kidney and muscle samples were taken, weighed and blended with equal volumes of water in a Kenwood Chef blender. Dry matter determinations were made in a forced air oven at 80°C for 72 hours.

### Records and statistical analysis

Pigs were weighed every two weeks while feed intake was recorded weekly.

Data were subjected to the analysis of variance (15). Treatment means were compared using Duncan's multiple range test (7).

## Results

### General conditions of experimental animals

All pigs were in good health. In the initial stages, pigs found the cassava rations dusty but they quickly adjusted.

### Daily liveweight gain

Results of daily gain of pigs are summarised on Table 3. The whole experimental period was sectioned into 3 phases to identify the effect of cassava meal at various points on the growth curve. The differences in daily rate of gain were not significant ($P > 0.05$) either for the whole period or for the different growing phases. At the initial stages of growth (initial – 20 kg), 45% CM was superior to other dietary treatments. In the second phase (20 kg – 50 kg), 30% CM promoted the fastest growth. Similarly in the finishing phase (50 kg – slaughter), 15% CM diet promoted the fastest rate of gain.

The different levels of fish meal in control as compared with cassava rations appeared to account in part for the superior performances of pigs on the cassava rations.

### Feed intake

Increasing levels of cassava meal produced improved feed intake (Table 3). In the finishing phase, feed intake of pigs fed 30% and 45% CM diets was the same while pigs on 15% CM ration consumed 25% and 21% more feed respectively than pigs fed control or 45% CM diets.

### Feed conversion efficiency

Summaries of feed conversion efficiency expressed as feed/gain are shown on Table 3. Thoughout the experimental period, efficiency was lowest in the control and highest on the 30% CM diet again, probably due to the lower fish meal level in the control. In the second phase, both 30% and 45% CM diets were equally efficient while in the finishing phase 15% and 30% CM diets were more efficient than either the control or 45% CM diets.

### Carcass analysis

Post mortem visual inspection of whole and sliced organs did not show any enlarged thyroid gland, liver or kidney lesions. Dietary cassava did not significantly

Table 3. Effect of cassava meal on growth, feed intake and feed efficiency of pigs.

| | Cassava level (%) | | | | |
|---|---|---|---|---|---|
| | 0 | 15 | 30 | 45 | S.E.[1] |
| Average initial weight (kg) | 8.7 | 8.7 | 8.7 | 8.7 | 1.13 |
| Average final weight (kg) | 72.0 | 76.4 | 84.0 | 78.7 | 8.83 |
| Initial – 20 kg | | | | | |
| Average daily gain (g) | 175 | 203 | 199 | 216 | 17.7 |
| Average daily feed intake (g)* | 827 | 841 | 840 | 856 | |
| Feed/gain** | 4.73 | 4.14 | 4.22 | 3.96 | |
| 20 kg – 50 kg | | | | | |
| Average daily gain (g) | 343 | 388 | 414 | 406 | 42.4 |
| Average daily intake (g) | 1251 | 1247 | 1257 | 1256 | |
| Feed/gain | 3.65 | 3.21 | 3.04 | 3.09 | |
| 50 kg – slaughter | | | | | |
| Average daily gain (g) | 795 | 1123 | 1118 | 903 | 75.41 |
| Average daily intake (g) | 1417 | 1772 | 1465 | 1465 | |
| Feed/gain | 1.78 | 1.58 | 1.31 | 1.62 | |
| Overall summary | | | | | |
| Average daily gain (g) | 391 | 418 | 465 | 432 | 42.8 |
| Average daily intake (g) | 1161 | 1164 | 1168 | 1173 | |
| Feed/gain | 2.97 | 2.78 | 2.51 | 2.71 | |

1 Standar Error.

* and ** It was not possible to obtain individual values because the pigs were group-fed

($P > 0.05$) influence carcass measurments in this study. Dressing percentage was highest with control pigs and lowest with pigs on 30% CM diets where backfat was thickest and loin eye area smallest. The variation in dressing percent within treatments was quite striking. This characteristic is affected by age, time of year, muscling, weight, fill, diseased parts and bruises; out of which only the first two were under our control. The non-correlation between backfat and dressing percent cannot be satisfactorily explained. Increasing CM levels resulted in increased % ham and loin (Table 4). Carcass length did not

Table 4. Carcass measurements of pigs fed cassava meal from growing to finishing.

| | Cassava level (%) | | | | |
|---|---|---|---|---|---|
| | 0 | 15 | 30 | 45 | S.E. |
| Carcass length (cm) | 75.50 | 70.25 | 76.75 | 73.00 | 2.50 |
| Dressing (%) | 75.75 | 74.35 | 70.80 | 73.50 | 7.10 |
| Average fat (cm) | 2.80 | 2.25 | 2.85 | 2.50 | 0.50 |
| Loin area ($cm^2$) | 21.20 | 23.65 | 18.15 | 22.65 | 3.00 |
| Ham and loin (%) | 21.55 | 21.75 | 24.50 | 26.40 | 2.10 |

1 Standar Error.

Table 5. Fresh tissue weights and dry matter content.

| | Cassava level (%)[1] | | | | |
|---|---|---|---|---|---|
| | 0 | 15 | 30 | 45 | S.E.[2] |
| Fresh liver weight (g) | 1357 | 1206 | 1291 | 1375 | 41.92 |
| Fresh kidney weight (g) | 177 | 149 | 186 | 172 | 10.70 |
| Liver dry matter (%) | 73[a] | 78[ab] | 89[c] | 94[d] | 3.60 |
| Kidney dry matter (%) | 67 | 84 | 73 | 73 | 4.10 |
| Muscle dry matter (%) | 48[a] | 54[b] | 39[c] | 43[d] | 1.50 |

1 Figures with the same superscript are not significantly different (P 0.05).

2 Standar Error.

seem to have been responding in any direction to cassava feeding. The shortest pigs on 15% CM dressed well while the longest pigs on 30% CM dressed poorest.

### Tissue weights and dry matter

The percentage dry matter in liver and muscle was significantly influenced by the treatment. Forty-five percent CM diet produced greater dry matter in the liver than all other treatments. Thirty percent CM diet resulted in very low liver dry matter in pigs. Muscle dry matter was highest with 15% CM while 30% CM had the lowest (Table 5). Fresh tissue weights were not signifcantly ($P > 0.05$) different and did not follow any trend. Kidney dry matter was higher in pigs on CM diets but differences were not significant ($P > 0.05$ ).

## Discussion

The results of this study confirm that cassava meal is an acceptable energy source for pigs from weaning to slaughter. Kok and Robeiro (9) obtained consistently faster rate of gain, higher feed efficiency and lower feed cost per kilogram liveweight gain when cassava meal was fed. On the contrary, Aina, Stratman and Tompkins (2) and Peixoto (14) observed depressed rate of gain and lower feed efficiency whenever cassava meal was fed. This could be due to the method of feeding used in these studies where cassava meal was offered separately while other feed ingredients were mixed and offered as a complete supplement with the result that treatment groups differed significantly in protein intake although dry matter intakes were similar. Apprently, pigs ate to satisfy their appetites but the great differences in nutrient content between cassava and maize diets resulted in different rates of gain and efficiency.

The results of various growing phases show an increasing level of performance with decreasing CM. In this study, 45% CM diet promoted the fastest rates of gain and lowest feed/gain ratio in the early stages of growth but in the second phase, 30% CM promoted better growth and feed efficiency than either 45% or 15% CM. Finishing pigs on 15% CM diet showed the fastest rate of gain. This suggests that 15% may be the best level of cassava meal substitution for finishing pigs as it also induced a high dressing percent, low backfat and large loin eye area.

Thirty percent CM, although the most efficiently converted to gain in the finishing period, appeared inferior to 15% CM diet in carcass quality, liver and muscle dry matter. Fifteen percent CM produced high dry matter content in tissues, especially muscle. This could mean that more meat than fat was deposited when this level of cassava meal was fed during the finishing phase. In general, it is interesting to note that well balanced composite cassava meal rations appear similar to maize diets in promoting growth. As growth progresses, it may be advisable to decrease the level of cassava meal incorporated into the diet for better growth and carcass quality.

The results of this study indicate a reduction in the ability of pigs to utilize high levels of cassava meal with age; but could not demonstrate the superiority of cassava diets over maize diets due to the differing levels of fish meal in the rations.

## Abstract

Cassava meal (CM), prepared from raw cassava flakes by sun drying and grinding, was included in

balanced rations for growing-finishing pigs at 0%, 15%, 30% and 45% levels. 0.05% DL methionine was incorporated into all rations which were fed to pigs from 8.7 kg liveweight till slaughter. The 30% CM diet promoted fastest rate of gain. All the diets containing cassava meal induced faster growth than the corn diets, but they contained higher levels of fish meal. Carcass and organ measurements were not significantly influenced by dietary cassava. The 45% CM diet resulted in leaner carcasses. Growing pigs utilized rations with higher levels of cassava meal more efficiently while finishing pigs made better gains on diets containing lower levels of cassava meal.

**Literature cited**


1. ADEGBOLA, A. A. Methionine as an additive to cassava-based diets. pp. 9-17 in Nestel, B. and Graham, M. (eds.), Cassava as animal feed: proceedings of a workshop held at University of Guelph, April 18-20, 1977. Ottawa, IDRC, 1977.

2. AINA, J. A., STRATMAN, F. W. and TOMPKINS, W. A. The economics and performance of growing finishing swine on maize or maize and cassava as carbohydrate source. Nigeria Agricultural Journal 5:21-23. 1968.

3. ALRIDGE, W. N. A new method for the estimation of microquantities of CN and SCN. Analyst 69:262-265. 1944.

4. ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS. Official methods of analysis A. O. A. C. Washington D. C. 11th ed. 1976.

5. CHOU, K. C. and MULLER, Z. Complete substitution of maize by tapioca in broiler ration. Proc. Australasian Poultry Science Convention, New Zealand. Auckland. pp. 149-160. 1972.

6. DRENNAN, P. and MAGUIRE, M. F. Prediction of the digestible and metabolisable energy content of pig diets from their fibre content. Journal Agricultural Research 9: 197-202. 1979.

7. DUNCAN, D. B. Multiple range and multiple F tests. Biometrica 11:1-42. 1955.

8. KING, R. H. and TAVERNER, M. R. Prediction of the digestible energy in pig diets from analyses of fibre contents. Animal Production 21(3):275-284. 1975.

9. KOK, E. A. and ROBEIRO, G. A. Cassava meal compared with ground maize for feeding pigs. Bio. Indust. Animal Sao Paulo, 1942, Vol. 5(4):86-124 Cited in Nutrition Abstracts & Review. 18:902. 1942.

10. MANER, J. H., BUITRAGO, J. and JIMENEZ, I. Utilization of yuca in swine feeding. Paper presented at the International Symposium on Tropical Root Crops. Trinidad. University of West Indies. 1969.

11. MODEBE, A. N. A preliminary trial on the value of dried cassava (*Mannihot utilissima* Pohl) for pig feeding. Journal of West African Science Association 7(2):127-133. 1963.

12. MULLER, Z., CHOU, K. C. and NAH, K. C. Cassava as a total substitute for cereals in livestock and poultry rations. World Review of Animal Production No. 12: 19-24. 1974.

13. NAH, K. C. and MULLER, Z. Economic tapioca rations for growing-finishing pigs. Proceedings of World Conference on Animal Production. Melbourne, Australia. Vol. 1. pp. 5-17. 1973.

14. PEIXOTO, R. R. Comparison of cassava meal and maize as feeds for growing and fattening pigs. Escola Agronom. Eliseu Maciel Pelotas Brazil 1965 p. 19. Cited in Nutrition Abstracts & Review 38:6023. 1968.

15. STEEL, R. G. D. and TORRIE, J. H. Principles and procedures of statistics. McGraw Hill Book Company, New York. 1960.

16. WOOD, T. The cyanogenic glucoside content of cassava and cassava products. Journal of Science of Food and Agriculture 16:300-304. 1965.