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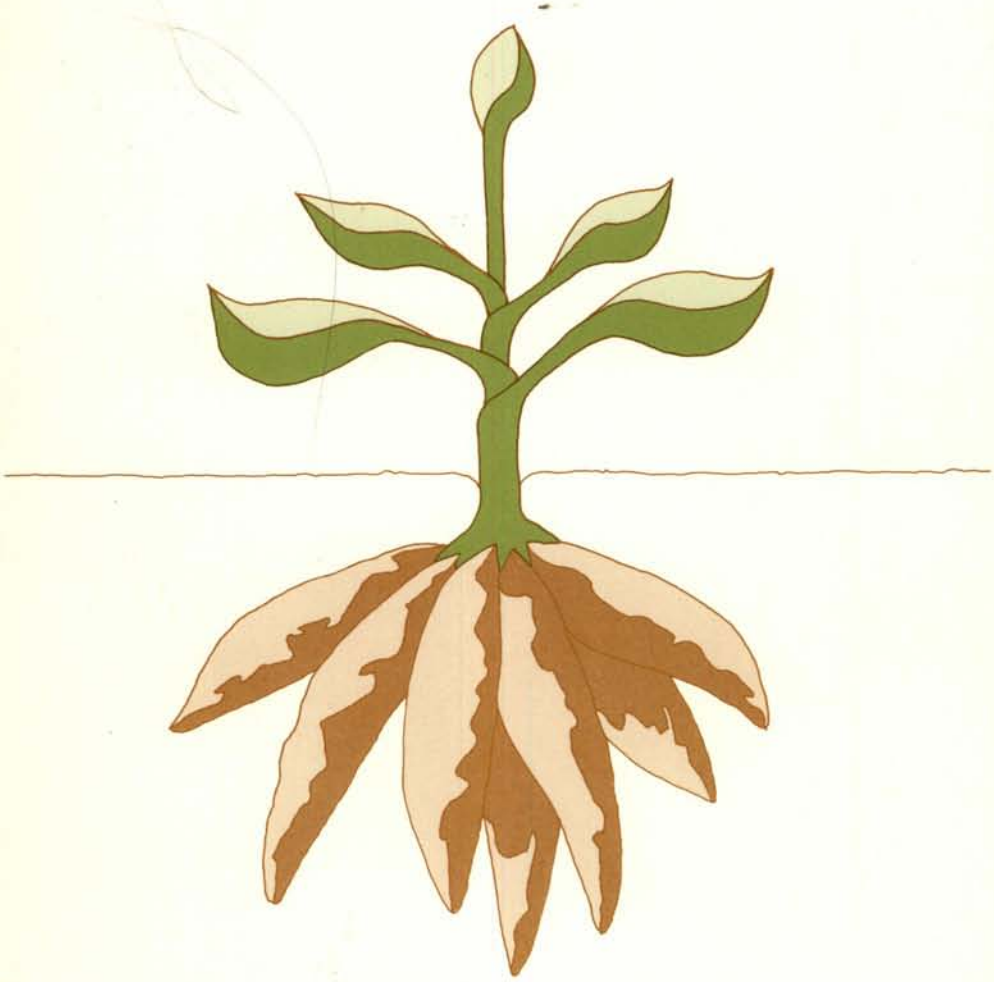
Held at CIAT, Cali, Colombia, 1-7 August 1976

Edited by James Cock, Reginald MacIntyre, and Michael Graham



The International Society for Tropical Root Crops in collaboration with
Centro Internacional de Agricultura Tropical
International Development Research Centre
United States Agency for International Development

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PROCEEDINGS

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FOURTH SYMPOSIUM

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Use of Cassava as a Food Supplement for Broiler Chicks

Sarote Khajarern and Jowaman M. Khajarern

Two experiments were conducted to determine the substitutional value of cassava for corn in broiler rations. One-day-old Arbor Acres broiler chicks were used. In the first experiment, no significant differences in body weight gain and feed conversion were noted for chicks receiving 0, 7.5, 15, 22.5 and 30% substituted cassava pellets. However, in experiment 2, significantly poorer body weight gain and feed conversion ($p < 0.05$) were noted during 1–5 weeks of age when the rations contained 0, 10, 20, 30, 40 and 50% cassava root meal. It was also noted that body weight gain was not depressed until the rations contained more than 30% cassava root meal. The ability of chicks to utilize cassava root meal increased with age. Results indicated that, during 5–9 weeks of age and 1–9 weeks of age, there were no significant differences observed on body weight gain and feed conversion when the concentration of cassava root meal increased in the rations. Limiting factors in maximum replacement and economic feasibility in substituting cassava products for corn were: fibre and protein contents; prices of cassava compared to those of fish meal and soybean meal.

Cassava is Thailand's third major export crop next to rice and corn. More than 90% of the nation's cassava root products, approximately 2.4 million tons, is exported annually. The balance is eaten locally, mainly as flour. The Thai Tapioca Trade Association reported that Thailand exported a total of 1.1 million tons of tapioca pellets during the first 6 months of 1975, valued at 1976 million baht (approximately US$ 100 million), while 55 000 t of tapioca flour (137 million baht, US$ 7 million) was exported during the same period. Meanwhile, there has been a surplus of nearly 100 000 t of tapioca flour since early 1975 that resulted from a cut in imports by Japan of more than 200 000 t in 1973–74 to merely 90 000 t during 1975. Therefore, the economy of cassava growers in Thailand is almost totally dependent on exports.

Cassava root products are sold on the free market in Thailand and prices are totally regulated by supply and demand. Cassava growers sell their fresh root directly to the chip-drying agencies in the field, at the price set by the latter. Cassava chips and pellets are then prepared, and are exported mainly to EEC countries. Since cassava importing countries are limited, more of cassava and its products need

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Table 1. Composition of experimental diets[a] (experiment 1).

Ingredients	% of cassava pelleted in the diets				
	0	7.5	15.0	22.5	30.0
Corn, yellow	30.00	22.50	15.00	7.50	—
Rice bran	25.50	25.00	24.00	23.00	22.00
Fish meal	8.00	9.00	10.50	11.50	13.00
Peanut meal	8.00	8.00	8.00	8.00	8.00
Soybean meal	20.00	20.00	20.00	20.00	20.00
Salt (NaCl)	0.25	0.25	0.25	0.25	0.25
Bone meal	2.00	1.50	1.00	1.00	0.50
Methionine (10%)	2.50	2.50	2.50	2.50	2.50
Dried yeast	1.00	1.00	1.00	1.00	1.00
$MgCO_3$ (18%)	0.75	0.75	0.75	0.75	0.75
Leucaena glauca leaves	2.00	2.00	2.00	2.00	2.00
Cassava pellet	—	7.50	15.00	22.50	30.00
Protein analysis (%)	24.3	25.7	25.1	25.6	25.5
ME (Mcal/kg)	3.24	3.24	3.24	3.23	3.24
Ca (%)	1.13	1.08	1.06	1.12	1.10
P (%)	0.76	0.75	0.70	0.70	0.67

[a]All experimental diets were supplemented with vitamins and minerals as described by NRC (1971).

to be tested for local use as livestock and poultry feedstuff to help the cassava growers, especially in the northeast.

The chemical composition of cassava root meal has a higher level of nitrogen-free extract (82%) than corn (72%) but the level of protein and fat are lower than corn (Olson et al. 1969a). Hutagalung et al. (1973) reported that cassava root meal is low in practically all nutrients including protein (2.3%), fibre (2.7%), ash (1.6%), and fat (1.2%), but it is high in carbohydrate (81.2%). Mineral content is also low, particularly in copper and zinc which could not be detected.

Earlier findings have shown that cassava root meal is a satisfactory replacement for corn in chicks (Enriquez and Ross 1967; Olson et al. 1969b; Muller et al. 1971; Chou and Muller 1972; Hutagalung 1972; and Hutagalung et al. 1973). Muller and Chou (1971) reported that there were no significant differences in growth rate, feed consumption, feed per gain ratios and mortality rate for chicks receiving 0, 20, 30, 40, 50, and 58% cassava pellet. Hutagalung et al. (1973) found similar results to those of Muller and Chou (1971) when they fed broiler diets containing 0, 20, and 40% cassava root meal.

Experimental Procedure and Results

Seven-day-old Arbor Acres mixed sex chicks were used in all experiments. In the course of the preparation period (1–7 days of age) a diet consisting of a blended mixture of all experimental diets was fed. Birds were confined in concrete floor pens using wood-shaving as litter. Light and ventilation were adequately supplied. Feed and water were consumed *ad libitum* in all trials. Daily observations were made to ensure that adequate feed and water were available for each pen. Weight gain and feed consumption were recorded at 4 and 8 weeks of age for experiment 1 and every week for experiment 2. At the end of the experiments the chicks were not fed for 24 h and were then killed. The dressed carcasses were weighed and graded using the Rice and Botsford (1956) and Parnell (1957) system.

Experiment 1

After the preparation period, the 127 chicks were randomly distributed into 5 treatments of 12 chicks on the basis of body weight, equalizing both mean weight and weight distribution between the groups. Each experimental diet was fed to duplicate pens of chicks from 1 to 8 weeks of age. The composition of the experimental diets is shown in Table 1. The average weight gain and feed conversion are summarized in Table 2. The effect of increasing graded levels of cassava pellets caused no significant differences on weight gain and feed conversion among comparative treatments. This agrees with the works of Enriquez and Ross (1967), Olson et al. (1969a), Muller et

Table 2. Average weight gain and feed conversion (experiment 1).

Cassava pellet	Average weight gain (g)		Feed conversion (g feed/g gain)	
	1–4 wk	4–8 wk	1–4 wk	4–8 wk
0	423	1019	2.04	2.41
7.5	468	1062	1.98	2.45
15.0	460	1015	2.00	2.57
22.5	476	1035	1.67	2.51
30.0	465	1009	1.87	2.55

Table 3. Composition and calculated analysis of diets (experiment 2).

Constituents	Treatments					
	1	2	3	4	5	6
Ground corn	56.7	42.8	29.5	17.6	6.6	—
Soybean meal (me)	37.0	39.4	41.5	41.0	41.0	33.5
Fish meal	3.0	3.0	3.0	4.5	6.0	11.0
Cassava root meal	—	10.0	20.0	30.0	40.0	50.0
Mineral supplement	2.3	2.3	2.0	1.9	1.4	0.5
Microingredients	1.0	1.0	1.0	1.0	1.0	1.0
Fat (feed grade)	—	1.5	3.0	4.0	4.0	4.0
Calculated Analysis						
Crude protein (%)	22.13	22.15	22.11	22.06	22.38	22.16
Crude fat (%)	5.16	6.28	7.26	7.75	7.39	5.91
Crude fiber (%)	3.34	3.65	3.92	4.13	4.39	3.31
Nitrogen free extract (%)	51.77	50.03	48.72	42.69	45.20	49.58
Ash (%)	6.5	6.91	7.01	7.50	7.53	6.50
ME (Mcal/kg)	2.84	2.83	2.81	2.80	2.77	2.80
Ca (%)	1.05	1.07	0.98	1.06	1.00	1.04
P (%)	0.79	0.78	0.73	0.74	0.71	0.69

al. (1971) and Hutagalung et al. (1973) who showed no significant differences on weight gain and feed conversion with graded levels of cassava root meal in the diets.

Experiment 2

Seven-day-old Arbor Acres mixed sex broiler chicks were used to study the replacement of cassava root meal for corn in broiler rations. After a preparation period, the chicks were randomly divided into six treatments, each treatment subdivided into four replications, each having 25 chicks. The composition of the experimental diets is shown in Table 3.

The summary of the average weight gain and feed conversion is given in Table 4. As was anticipated from the data, there were statistically significant differences for weight gain and feed conversion during 1–5 weeks of age. Increasing levels of cassava root meal in the diet showed a tendency towards poorer weight gain and feed conversion; however, body weight gain was not significantly depressed until the ration contained above 30% cassava root meal. The ability of chicks to utilize cassava root meal increased with age. The results from this experiment indicated that, during 5–9 weeks of age and 1–9 weeks of age, there were no significant differences observed on weight gain and feed conversion when the concentration of cassava root meal increased in the diets. There was, however, a reduction trend in weight gain of chicks fed a diet containing 40 and 50% cassava root meal during 5–9 weeks of age and 1–9 weeks of age, respectively. The decline in gain and poor feed conversion of chicks from feeding high levels of cassava root meal may

Table 4. Average weight gain and feed conversion (experiment 2).

Cassava root meal %	Average weight gain (g)		Feed conversion (g feed/g gain)	
	1–5 wk	5–9 wk	1–5 wk	5–9 wk
0	766a	1002	2.06a	3.16
10	746a	1044	2.10a	3.05
20	761a	1032	2.12a	3.10
30	732a	972	2.15ab	3.19
40	695b	1006	2.23b	3.13
50	714ab	933	2.18ab	3.33

Numbers followed by different letters are significantly different ($p < 0.05$) from other numbers in that column.

be due to physical form, palatability, and nutrient density of the diets. Our results support Hutagalung et al. (1973) who reported that the effect of increasing levels of cassava root meal caused a growth depression and poorer feed conversion, compared to the control diet. Weight gain and feed conversion of chicks fed root diets were not significantly different from those of the basal group, although there was a reduction trend in gain of chicks fed a diet containing 40% cassava root meal.

Only five birds died during the experiments, the cause of death being unrelated to the toxicity of the cassava root meal. Earlier findings show that cassava root meal is a satisfactory replacement for corn in chicks with no evidence of HCN toxicity (Enriquez and Ross 1967; Olson et al. 1969b; Muller et al 1971).

Although much work had been done in feeding cassava root meal to chickens, there was little information available on the influences of cassava diets on carcass quality at time of marketing. There was no indication that different diets containing graded levels of cassava root meal exerted any consistent effect on either carcass grade or dressing percentage of broilers.

Discussion and Conclusion

Graded levels of cassava pellets in broiler diets (experiment 1) caused no significant differences in weight gain and feed conversion during 1–4, 4–8, and 1–8 weeks of age. These results agree with those of Enriquez and Ross (1967), Olson et al. (1969a), Muller et al. (1971), and Hutagalung et al. (1973). Higher graded levels of cassava root meal in the diet (experiment 2), however, depressed weight gain and efficiency of feed conversion during 1–5 weeks of age, although methionine and energy content had been corrected as suggested by other workers (Ross and Enriquez 1969; Hutagalung 1972). The literature shows no general agreement on cassava root meal utilization by chicks. Enriquez and Ross (1967), Olson et al. (1969a), and Muller et al. 1971) showed that cassava root meal was a satisfactory replacement for corn in chicks with no evidence of HCN toxicity. On the other hand, Vogt (1966) concluded that the growth depression was observed when 20 or 30% cassava was fed to broilers.

The ability of chicks to utilize cassava root meal increased with age. Results from experiment 2 indicated that during 5–9 and 1–9 weeks of age there was no significant difference observed in weight gain and feed conversion, when the concentration of cassava root meal in the diet increased.

When the broiler diet was balanced with respect to protein, energy and methionine, cassava products (pellets and root meal), at a level of 30% of the diets, satisfactorily replaced corn during 1–5 weeks of age.

Cassava root meal can fully replace corn at a level of 50% of the diet during 5–9 weeks of age.

The ability of broilers to utilize cassava root meal increased with age.

Graded levels of cassava root meal for replacement of corn did not exert any effect on carcass grade and dressing percentage at 9 weeks of age.

Limiting factors in maximum replacement and economic feasibility of cassava root for corn were fibre and protein content, the prices of cassava and corn, and protein supplements such as fish meal and soybean meal.

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Protein Enrichment of Cassava by Fermentation with Microfungi and the Role of Natural Nitrogenous Supplements

G. Varghese, J. J. Thambirajah, and F. M. Wong[1]

Attempts to produce protein-enriched cassava for animal feed by solid state fermentation with selected local strains of *Rhizopus, Aspergillus,* and *Neurospora* showed that protein levels of the fermented products did not exceed 3%. Because this value is low for animal feed, the ability of natural nitrogenous supplements to increase microbial activity was tested. Supplementation with 35% chicken dung increased protein levels to 8–10.5% and with soybean, groundnut, and pineapple bran at 25%, the protein levels were 40, 10, and 7%, respectively. In combination with chicken dung (12.5 + 12.5%) the protein values varied between 8 and 18% for soybean, 8 and 10% for groundnut, and 5 and 7% for pineapple bran. The results indicated that supplementation increased fermentation efficiency and contributed to higher protein values.

A procedure for solid state fermentation of cassava with natural nitrogenous supplements has been developed as a first stage toward the design of a pilot plant for continuous production of the material.

Due to the increase in price and demand for animal feed by an expanding livestock industry, Malaysia is currently spending more on feed imports. Therefore, there is a need to produce more animal feed locally. It is in this context that cassava may have scope for large scale expansion. The ease by which the crop can be grown from cuttings on a wide range of soil types makes it a crop suitable for immediate expansion. In line with this a number of "estate type" cassava plantings along with processing plants have been recently established in various parts of the country through government-aided schemes.

Nutritionally, cassava tubers provide mainly carbohydrates and some useful amounts of calcium and vitamin C to the diet (Wood 1965). The protein levels are however low and vary according to moisture content and varieties grown. The average is usually in the region of 1.3% (Oke 1968, Sundhagul 1972). However, in Asia and Africa cassava has been traditionally enriched by microbial fermentation.

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