

THE USE OF SELECTED LOCAL INGREDIENTS FOR PIG RATIONS IN THE TERRITORY OF PAPUA AND NEW GUINEA

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ABSTRACT.

A soybean/maize 14 per cent. crude protein pig ration gave higher weight gains in pigs than a ration based on cooked sweet potato, with added soybean or meat meal, with a total crude protein content of 16 per cent. or 8 per cent., or a sweet potato ration without protein supplements, containing 4 per cent. crude protein.

Sorghum based rations supplemented mainly with passionfruit seed and copra in varying proportions produced significantly higher weight gains than a sorghum/meat meal ration with the same crude protein level.

The substitution of peanut hay (2.5 to 20 per cent.) for part of the sorghum ration did not produce significantly different weight gains when comparison was made with pigs fed the control soybean/sorghum ration.

Substitution of 10 to 30 per cent. sago for sorghum in pig rations containing peanut hay, fish meal or soybean meal did not affect weight gains. The substitution of meat meal for fish, however, produced significantly lower gains. Fifty per cent. sago was substituted with similar results.

INTRODUCTION.

PIGS in developing countries are usually permitted to scavenge for food and are fed food scraps and peelings. Much of this material is high in water and carbohydrate, and low in protein. This is one of the reasons why the animals grow very slowly and rarely reach prime condition.

On the other hand, attempts are being made to rear relatively large numbers of pigs on intensive or semi-intensive systems. Such schemes using imported feeds cannot hope to compete, as far as cost is concerned, with those utilizing local materials. Attempts have been made to supplement imported pig feeds with some local materials.

The major feed ingredients used in the experiments reported here consisted of sago, sweet potato (kau kau), peanut hay, passionfruit seed and copra meal. These ingredients were supplemented with either soybean meal, meat meal or fish meal for protein.

Sweet potato has been widely used as a pig feed in tropical areas (Calder 1960) for many years. No reference can be found in the literature on the use of passionfruit seed or peanut hay.

MATERIALS AND METHODS.

Five feeding experiments were conducted. Experiments 1, 3, 4 and 5 were conducted at the University of Queensland, and Experiment 2 in the Territory of Papua and New Guinea.

The pigs were housed in 36 individual pens measuring 4 ft. by 1 ft. 6 in. with sides 2 ft. 9 in. high. The floor was constructed of 2 x 1 in. wooden slats with $\frac{3}{4}$ in. space between them, and each pen had an individual galvanized iron feed trough (Plate I). The pens were raised 13 in. above the cement floor and the pigs were watered by low pressure drinking nipples supplied to each pen.

The pigs were fed once daily and offered an amount dependent on their weight. The amount was reduced if any feed was rejected. They were weighed at weekly intervals.

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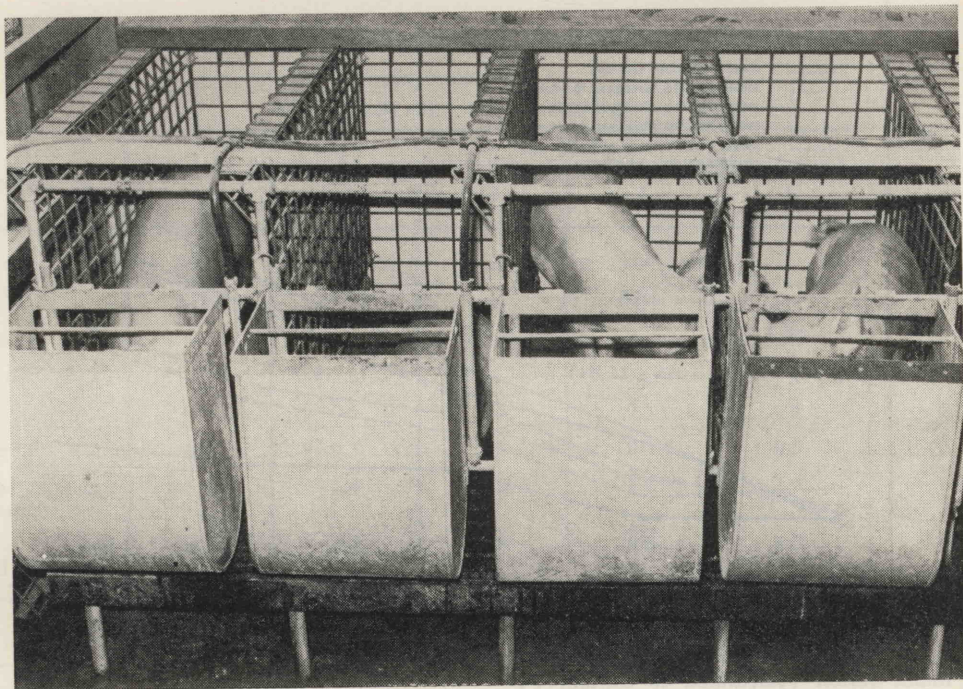


Plate I.—Pens used for all Experiments Conducted at the University of Queensland.

The pigs used in Experiment 1 were Large Whites purchased from a commercial piggery. Those used in Experiment 2, conducted at Goroka in the Territory of Papua and New Guinea, were Tamworth cross Berkshire, Berkshires and Large Blacks. The animals used in Experiment 3 were Large Whites and two Land-race crossbreds, obtained from a Brisbane sale-yard. In Experiments 4 and 5 the pigs were all Large Whites obtained from a commercial piggery.

The pigs were drafted into groups of approximately equal weight.

The analyses of the feed ingredients are shown in Table 1.

Table 1.—Analysis of Ingredients.
Expressed on an Air Dry Basis.

Ingredient	Crude Protein (%)	Crude Fat (%)	Crude Fibre (%)	Ash (%)
Copra Meal	20	6	14	8
Passionfruit Seed	10.7	25.7	48.4	1.7
Peanut Hay	8.6	4.3	29.8	7.5
Sago	0.6	0.4	0.7	0.5
Sweet Potato	3.9	0.8	2.7	5.1

EXPERIMENT 1.

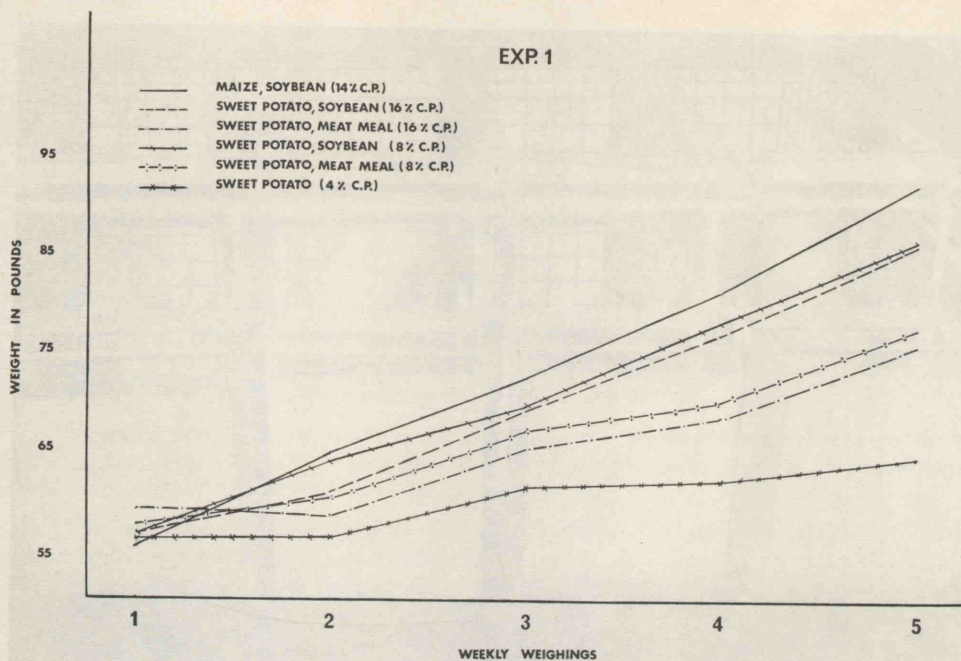
This experiment was designed to measure the effect of feeding wet cooked sweet potato, supplemented by a protein concentrate. The crude protein levels in this experiment were 16, 8 and 4 per cent. The concentrate used in the 16 and 8 per cent. rations was meat meal or soybean meal. Where the rations were isonitrogenous, they were not isocaloric.

The pigs were drafted into groups of six after weighing. They were fed the control ration (Table 2, Group 1) for a period of one week to allow them to become accustomed to their conditions. They were then fed the experimental rations.

The sweet potato used was steam cooked daily until soft for a period of half an hour, and fed wet. It was mixed by hand in the individual troughs with the dry concentrate portion of the ration. The experimental rations were fed for a period of four weeks.

Results and Discussion.

The summary of the mean weights at the conclusion of the feeding trial is given in Table 3. It will be seen that the control group on a



soybean/maize ration (calculated to contain 14 per cent. crude protein) weighed more than any other group, even though two groups were fed rations containing a higher crude protein level. The animals on the sweet potato ration did not consume their allotted amount of sweet potato owing to the high water content. It is suggested that this was the reason for the better performance of the pigs on the soybean/maize ration.

The 16 per cent. crude protein ration containing soybean, produced a higher weight gain than a comparable ration containing meat meal. This may have been due to the great variation and inconsistencies occurring during the manufacture of meat meal, or to the higher levels of calcium, causing a growth depression similar to that occurring in poultry (McDonald and Solvyns 1964). The pattern was repeated for the 8 per cent. protein rations.

As anticipated, the group receiving sweet potato without a protein supplement did not grow as well as any of the other groups. The crude protein level of the ration was 4 per cent., being that provided by sweet potato tubers alone. Where sweet potato is fed to pigs it is recommended that the crude protein level of the ration be adjusted accordingly.

EXPERIMENT 2.

Materials and Methods.

Sixty pigs were weighed and drafted into 12 groups so that all groups weighed approximately the same. They were housed in groups of five, not in individual pens. Each house had an outside concrete run attached.

The rations fed are shown in Table 4. The premix used was identical to that shown in Table 2 except for the addition of the antioxidant B.H.T. (butylated hydroxytoluene) at the rate of 4 oz. per ton, to those rations containing passionfruit seed. The passionfruit seed was ground in a mincer every two days and the B.H.T. added.

The *Leucaena* leaves were stripped from the petioles and sun-dried. The sweet potato tops were rolled into bunches, sliced, then sun-dried. The sorghum was hammermilled before being included in the ration.

This experiment was designed to ascertain the effect of varying levels of passionfruit seed and copra meal using a large number of local ingredients.

The amounts of soybean meal and sorghum were adjusted to keep the protein levels constant.

The pigs were fed once daily.

Table 2.—Rations based on Soybean Meal, Meat Meal and Sweet Potato.

Experiment 1.
All quantities expressed as percentages.

Ingredient	Group					
	1	2	3	4	5	6
Maize	84.4	....	....	....	....	....
Soybean	12.8	26.33	....	8.95	....	....
Meat meal ....	....	....	26.33	....	8.95	....
Sweet potato ....	....	70.87 (177)	70.87 (177)	88.25 (220)	88.25 (220)	97.2 (243)
Salt	0.5	0.5	0.5	0.5	0.5	0.5
Limestone	0.3	0.3	0.3	0.3	0.3	0.3
Christmas Island phosphate	1.4	1.4	1.4	1.4	1.4	1.4
Vitamin and mineral premix	0.6	0.6	0.6	0.6	0.6	0.6
Total	100	100	100	100	100	100
Calculated crude protein percentage	14%	16%	16%	8%	8%	4%

Note 1.—Figures in brackets represent the equivalent quantity as wet weight.

Vitamin and Mineral Premix (Per pound of finished feed)

Vitamin A, 1500 I.U.; Vitamin D, 400 I.U.; Riboflavin, 2 mg; Pantothenic Acid, 4 mg; Niacin, 9 mg; Vitamin B₁₂, 10 ug; Ferrous Sulphate, 160 mg; Copper Sulphate, 5 mg; Manganese Sulphate, 108 mg; Zinc Oxide, 45 mg; Potassium Iodate, 0.25 mg.

Table 3.—Mean Weights of Pigs fed Soybean, Meat Meal and Sweet Potato for a Period of Four Weeks.

Experiment 1.

Group No.	No. of Pigs	Main Ration Ingredients	Crude Protein Percentage	Mean Starting Weight (lb)	Mean Finishing Weight (lb)	Mean Gain (lb)	Feed Conversion Ratios
1	6	Soybean/maize	14	55.4	92.6	37.2	3.0
2	5*	Soybean/sweet potato	16	56.3	86.0	29.7	3.2
3	6	Meat meal/sweet potato	16	59.4	75.5	16.1	6.0
4	6	Soybean/sweet potato	8	57.0	86.5	29.5	6.7
5	6	Meat meal/sweet potato	8	57.6	77.4	19.8	9.9
6	6	Sweet potato	4	56.1	64.5	8.4	41.0

* One pig was removed from the experiment owing to a rectal prolapse.

Note 1. With respect to weight gain, group 2=4, 3=5.

All other differences are significant $P < .01$

2. Feed conversion ratio significance, group 6 $> (1=2=3=4=5)$, $P < .01$.

Results and Discussion.

The results are shown in Table 5. The ration containing meat meal produced significantly lower gains.

Variation of the passionfruit seed and copra meal had no significant effect on performance.

Table 4.—Rations based on Passionfruit Seed, Copra Meal, Soybean Meal, Meat Meal, Leucaena, Sweet Potato Tops and Sorghum.

Experiment 2.					
All quantities expressed as percentages.					
Ingredient	Group				
	7	8	9	10	
Passionfruit seed	....	5	10	15	
Copra meal	....	20	15	10	
Soybean meal	....	5	6	7	
Leucaena leaves	....	2	2	2	
Sweet potato (kau kau) tops	....	5	5	5	
Sorghum	88	61.4	60.4	59.4	
Meat meal	10.4	....	....	....	
Salt	0.5	0.5	0.5	0.5	
Limestone	0.6	0.6	0.6	0.6	
Vitamin and Mineral Mix	0.5	0.5	0.5	0.5	
Total	....	100	100	100	100
Calculated crude protein percentage	14%	14%	14%	14%	

EXPERIMENT 3.

Materials and Methods.

The pigs were housed in individual pens as in Experiment 1. They were all fed a 14 per cent. protein soybean/sorghum ration for a period of four weeks. All pigs were treated with piperazine adipate at the rate of 24 grams per lb. of feed on being housed, and with thia-bendazole (2 grams per pig) four weeks later. They were drafted into six groups of five so that each group's mean weight was approximately equal. Several pigs were not included in the first four week period, as they were suffering from enteritis, which later responded to treatment.

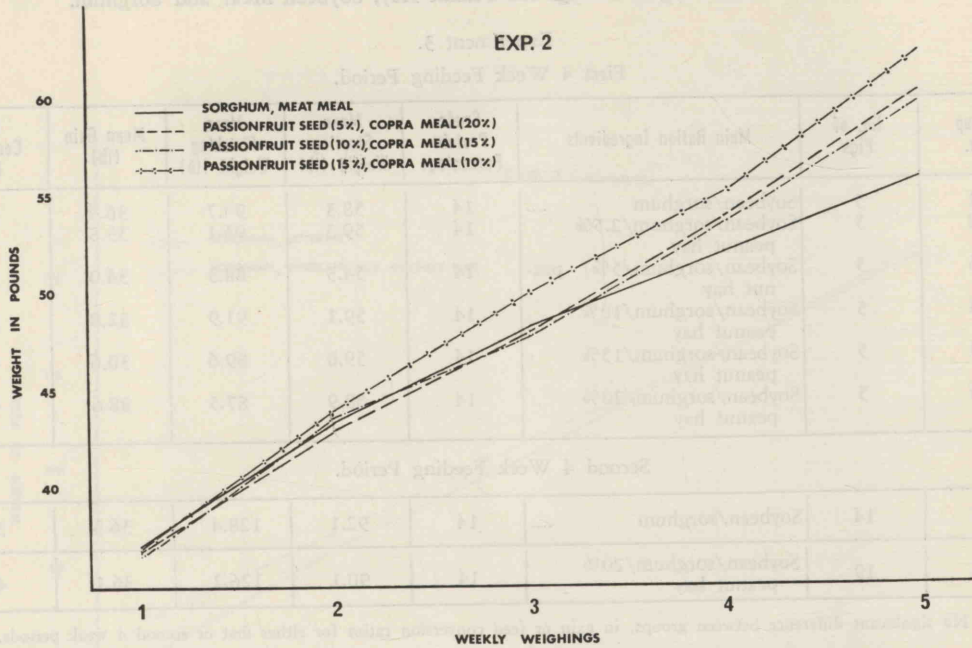
The aim of this experiment was to determine the optimum level of peanut hay.

The experimental rations are shown in Table 6. At the end of four weeks' feeding trial, the pigs were divided into two groups of approximately equivalent weight (14 in control and 19 on 20 per cent. peanut hay). The group previously receiving the control soybean/sorghum ration was kept on that ration during the second four week feeding period. Group 12 was also added to the control (Group 11) for that period. For the second four weeks the control ration was the same, and the second group was fed the ration containing 20 per cent. peanut hay (Group 16).

Table 5.—Mean Weights of Pigs fed Passionfruit Seed, Copra Meal, Soybean Meal, Leucaena, Sweet Potato Tops and Sorghum.

Experiment 2.							
Group No.	No. of Pigs	Main Ration Ingredients	Crude Protein Percentage	Mean Starting Weight (lb)	Mean Finishing Weight (lb)	Mean Gain (lb)	Feed Conversion Ratio
7	14	Meat meal/sorghum	14	37.3	56.1	18.8	4.8
8	15	5% passionfruit seed/20% copra meal/sweet potato	14	37.1	60.5	23.4	5.4
9	15	10% passionfruit seed/15% copra meal/sweet potato	14	36.9	59.9	23.0	4.2
10	15	15% passionfruit seed/10% copra meal/sweet potato	14	37.1	62.5	25.4	3.9

Note 1. With respect to weight gain group 7<(8=9=10), P<.05
group 7<10, P<.01



Results and Discussion.

The results of the first and second four week feeding period are shown in *Table 7*.

There was no significant difference between groups at the end of the first four week feeding

period nor at the conclusion of the final period. It is therefore considered that peanut hay is a useful ingredient for pig rations, and that it can be fed up to levels of 20 per cent. of the total ration. It could act as a substitute for lucerne in tropical areas.

Table 6.—Composition of Rations based on Peanut Hay, Soybean Meal and Sorghum.
 Experiment 3.
 All quantities expressed as percentages.

Ingredient	Group					
	11	12	13	14	15	16
Peanut hay ....	....	2.5	5.0	10.0	15.0	20.0
Sorghum	84.8	82.3	79.8	74.8	69.8	64.8
Soybean meal	12.8	12.8	12.8	12.8	12.8	12.8
Salt	0.5	0.5	0.5	0.5	0.5	0.5
Limestone	0.3	0.3	0.3	0.3	0.3	0.3
Christmas Island phosphate	1.4	1.4	1.4	1.4	1.4	1.4
Vitamin and mineral premix	0.2	0.2	0.2	0.2	0.2	0.2
Total	100	100	100	100	100	100
Calculated crude protein percentage	14	14	14	14	14	14

Table 7.—Mean Weights of Pigs fed Peanut Hay, Soybean Meal and Sorghum.

Experiment 3.

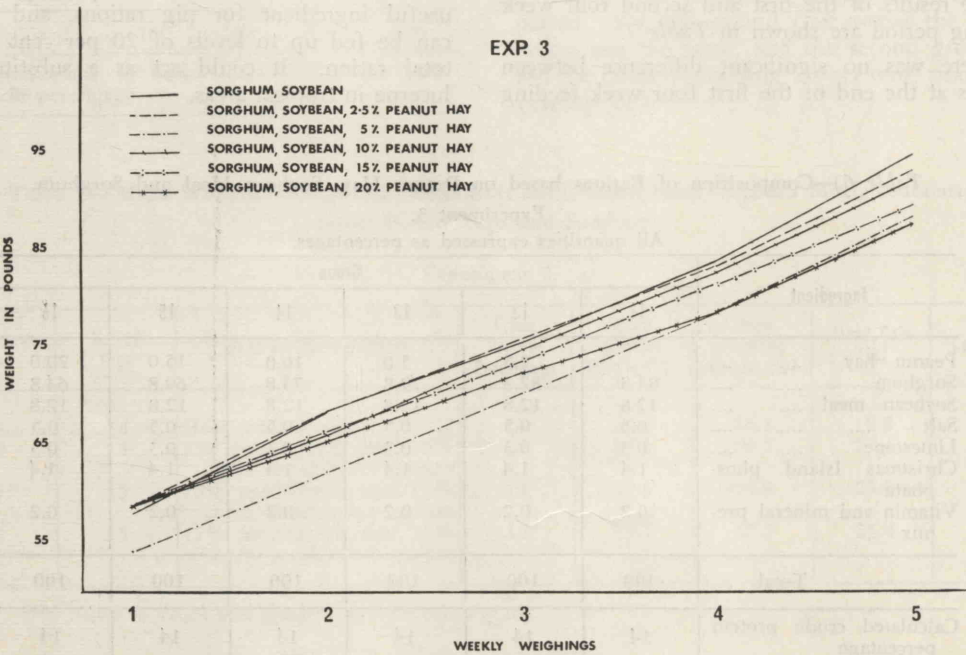
First 4 Week Feeding Period.

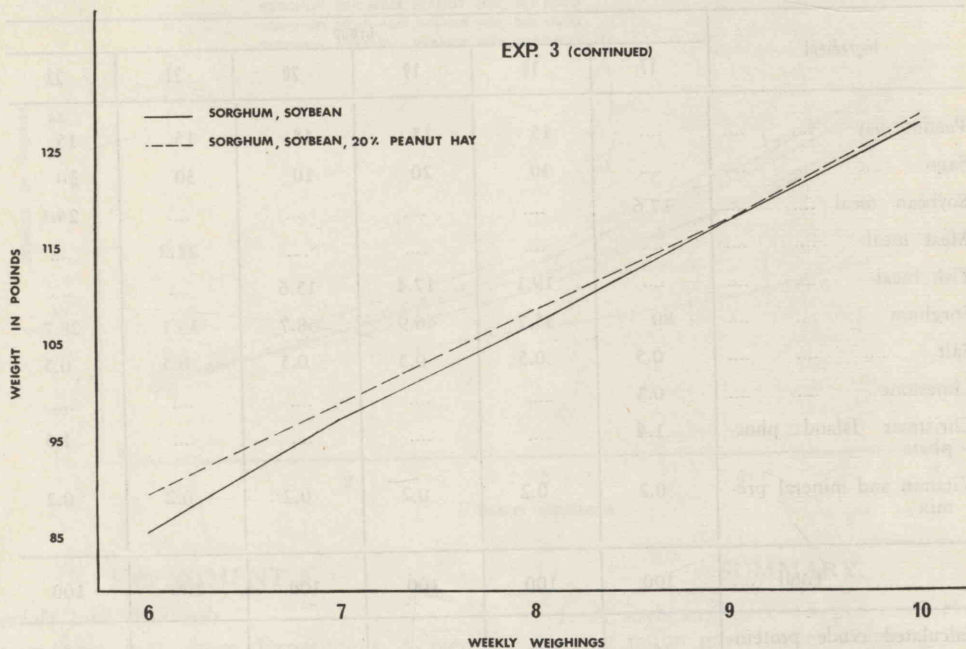
Group No.	No. of Pigs	Main Ration Ingredients	Crude Protein Percentage	Mean Starting Weight (lb)	Mean Finishing Weight (lb)	Mean Gain (lb)	Feed Conversion Ratio
11	5	Soybean/sorghum	14	58.3	94.7	36.4	3.0
12	5	Soybean/sorghum/2.5% peanut hay	14	59.3	93.1	33.8	3.3
13	5	Soybean/sorghum/5% peanut hay	14	54.3	88.3	34.0	3.2
14	5	Soybean/sorghum/10% peanut hay	14	59.1	91.9	32.8	3.4
15	5	Soybean/sorghum/15% peanut hay	14	59.0	89.6	30.6	4.0
16	5	Soybean/sorghum/20% peanut hay	14	58.9	87.5	28.6	4.4

Second 4 Week Feeding Period.

11	14	Soybean/sorghum	14	92.1	128.4	36.3	3.3
16	19	Soybean/sorghum/20% peanut hay	14	90.1	126.2	36.1	4.1

Note 1. No significant difference between groups, in gain or feed conversion ratios for either first or second 4 week periods.





EXPERIMENT 4.

Materials and Methods.

The pigs were allowed one week to settle into their pens and to become familiar with the feed troughs and drinking nipples. During this period they were all fed a 16 per cent. crude protein ration of soybean meal and sorghum.

Any males were castrated, and thiabendazole was added to the feed (1 gram per pig). This anthelmintic treatment was followed with piperazine adipate four weeks later.

The experimental rations fed for four weeks are shown in Table 8. The control ration (Group 17) was based on soybean meal and sorghum. Three rations contained varying levels of sago, as a grain substitute, with fish meal as the protein source. Two other rations contained

sago at the highest level (30 per cent.), with soybean and meat meal respectively as the protein source (Table 8). All rations were calculated to contain 16 per cent. protein.

Groups of six pigs were used with the exception of Group 21, which had five.

Results and Discussion.

All groups were significantly heavier than the group receiving meat meal (Table 9). There were no significant differences between the mean finishing weights of the other groups.

Variations in sago content from 10 to 30 per cent. did not affect performance. Rations containing fish or soybean meal produced almost identical results, but the ration containing meat meal was inferior as in previous experiments.

Table 8.—Rations based on Sago, Peanut Hay, Soybean Meal, Meat Meal, Fish Meal and Sorghum.

Experiment 4.

All quantities expressed as percentages.

Ingredient	Group					
	17	18	19	20	21	22
Peanut hay ....	....	15	15	15	15	15
Sago ....	....	30	20	10	30	30
Soybean meal	17.6	....	....	....	....	24.1
Meat meal ....	....	....	....	....	21.2	....
Fish meal ....	....	19.1	17.4	15.6	....	....
Sorghum	80	35.2	46.9	58.7	33.1	28.7
Salt	0.5	0.5	0.5	0.5	0.5	0.5
Limestone	0.3	....	....	....	....	....
Christmas Island phosphate	1.4	....	....	....	....	1.5
Vitamin and mineral pre-mix	0.2	0.2	0.2	0.2	0.2	0.2
Total	100	100	100	100	100	100
Calculated crude protein percentage	16	16	16	16	16	16

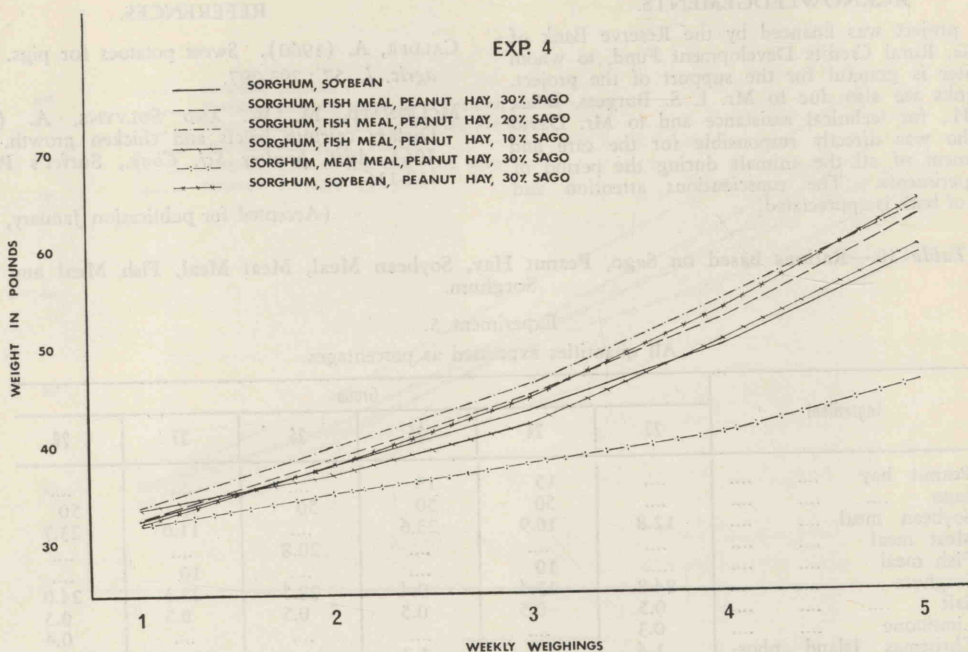
Table 9.—Mean Weights of Pigs fed Sago, Peanut Hay, Soybean Meal, Meat Meal and Sorghum.

Experiment 4.

Group No.	No. of Pigs	Main Ration Ingredients	Crude Protein Percentage	Mean Starting Weight (lb)	Mean Finishing Weight (lb)	Mean Gain (lb)	Feed Conversion Ratio
17	6	Soybean, sorghum	16	33.0	59.7	26.7	2.9
18	6	30% sago, peanut hay, fish meal, sorghum	16	33.1	63.6	30.5	2.5
19	6	20% sago, peanut hay, fish meal, sorghum	16	34.2	68.8	34.6	2.3
20	6	10% sago, peanut hay, fish meal, sorghum	16	33.0	60.3	27.3	2.8
21	5	30% sago, peanut hay, meat meal, sorghum	16	32.0	46.6	14.6	5.0
22	6	30% sago, peanut hay, soybean, sorghum	16	32.9	64.5	31.6	2.3

Note 1. Weight gain—group 21<(17=18=19=20=22) P<.01

2. Feed Conversion—group 21>(17=18=19=20=22) P<.01



EXPERIMENT 5.

Materials and Methods.

Thirty-three pigs from Experiment 4 were arranged into groups of approximately equal weight.

The control ration was based on soybean meal and sorghum. The experimental rations each contained 50 per cent. sago. Two rations contained 15 per cent. peanut hay, one of these contained fish meal. The remaining three rations contained meat meal, fishmeal and soybean meal or soybean meal *per se* as the principal protein source (Table 10).

Results and Discussion.

The group fed the control ration (soybean/sorghum) was not significantly different in finishing weight from those groups receiving 50 per cent. sago and fish meal and soybean meal without peanut hay (Table 11). The addition of 15 per cent. peanut hay in this experiment did depress weight gains when fed with 50 per cent. sago, which is to some extent at variance with the results of Experiment 4. The group receiving 50 per cent. sago with meat meal was similarly depressed.

SUMMARY.

1. A soybean/maize 14 per cent. crude protein pig ration gave higher weight gains in pigs than a ration based on cooked sweet potato, with added soybean or meat meal, with a total crude protein content of 16 per cent. or 8 per cent., or a sweet potato ration without protein supplements, containing 4 per cent. crude protein.

2. Sorghum based rations supplemented mainly with passionfruit seed and copra in varying proportions produced significantly higher weight gains than a sorghum/meat meal ration with the same crude protein level.

3. The substitution of peanut hay (2.5 to 20 per cent.) for part of the sorghum ration did not produce significantly different weight gains when comparison was made with pigs fed the control soybean/sorghum ration.

4. Substitution of 10 to 30 per cent. sago for sorghum in pig rations containing peanut hay, fish meal or soybean meal did not affect weight gains. The substitution of meat meal for fish meal, however, produced significantly lower gains. Fifty per cent. sago was substituted with similar results.

ACKNOWLEDGEMENTS.

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Table 10.—Rations based on Sago, Peanut Hay, Soybean Meal, Meat Meal, Fish Meal and Sorghum.

Experiment 5.
All quantities expressed as percentages.

Ingredient	Group					
	23	24	25	26	27	28
Peanut hay ....	....	15	15	....	....	....
Sago ....	....	50	50	50	50	50
Soybean meal	12.8	10.9	23.6	....	11.0	23.7
Meat meal ....	....	....	....	20.8	....	....
Fish meal ....	....	10	....	....	10	....
Sorghum	84.8	13.4	9.4	28.5	28.3	24.0
Salt	0.5	0.5	0.5	0.5	0.5	0.5
Limestone	0.3	....	....	....	....	0.4
Christmas Island phosphate	1.4	....	1.3	....	....	1.2
Vitamin and mineral premix	0.2	0.2	0.2	0.2	0.2	0.2
Total	100	100	100	100	100	100
Calculated crude protein percentage	14	14	14	14	14	14

Table 11.—Mean Weights of Pigs fed on Sago, Peanut Hay, Soybean Meal, Meat Meal and Sorghum.

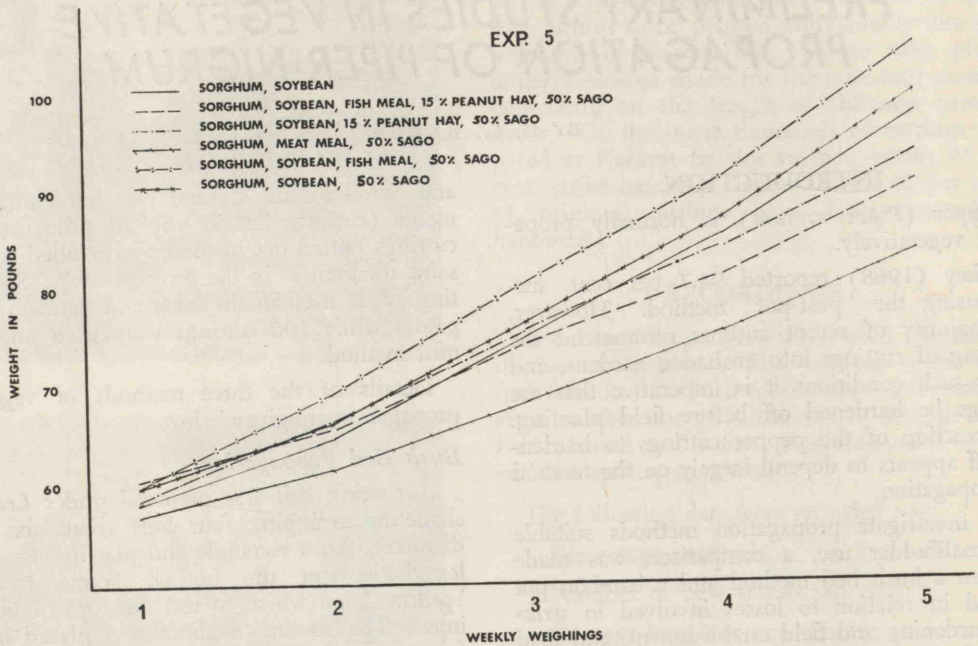
Experiment 5.

Group No.	No. of Pigs	Main Ration Ingredients	Crude Protein Percentage	Mean Starting Weight (lb)	Mean Finishing Weight (lb)	Mean Gain (lb)	Feed Conversion Ratio
23	5	Soybean/sorghum	14	58.3	97.9	39.6	2.9
24	6	Sago, 15% peanut hay, soybean, fish meal, sorghum	14	60.9	90.9	30.0	3.6
25	6	Sago, 15% peanut hay, soybean, sorghum	14	59.0	93.7	34.7	3.2
26	4	Sago, meat meal, sorghum	14	57.0	83.7	26.7	4.0
27	6	Sago, soybean, fish meal, sorghum	14	60.5	105.0	44.5	2.7
28	6	Sago, soybean, sorghum	14	60.1	99.7	39.6	2.9

Note 1. Weight gain, group $(27=28=23) > (24=26)$, $P < .05$
 $(27 > 25)$, $P < .05$

2. Feed conversion differences greater than 0.6 are significant at 5% level

3. Feed conversion differences greater than 0.8 are significant at 1% level



MATERIALS AND METHODS

Prior experiments with various experimental rations had indicated that the best results were obtained by using a ration of 50% sorghum, 50% soybean, and 50% sago. This ration was used in the following experiment:

Three pairs of rats (one pair per treatment) were used. The rats were divided into three groups: (1) control, (2) 50% sorghum, 50% soybean, and (3) 50% sorghum, 50% soybean, and 50% sago.

The rats were divided into three groups: (1) control, (2) 50% sorghum, 50% soybean, and (3) 50% sorghum, 50% soybean, and 50% sago. The rats were divided into three groups: (1) control, (2) 50% sorghum, 50% soybean, and (3) 50% sorghum, 50% soybean, and 50% sago.

The rats were divided into three groups: (1) control, (2) 50% sorghum, 50% soybean, and (3) 50% sorghum, 50% soybean, and 50% sago.