Preliminary Studies with Poultry Rations for the Territory of Papua and New Guinea. II.—Layer Rations with Copra, Sago and Leucaena leucocephala.

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INTRODUCTION.

This work represents the third phase in a study to develop poultry rations using materials indigenous to the Territory. Studies with chicks and developing pullets have been reported by Springhall (1964) *and Springhall and Ross* (1965). *The present study deals with the feeding of high levels of indigenous feedstuffs to laying hens.*

MATERIALS AND METHODS.

TWO hundred and twenty-four, 22-week old White Leghorn x Australorp pullets used in a previous study (Springhall and Ross, 1965) were divided into 16 groups of 14 birds each in the manner shown in *Table* 1. Thus, an equal number of pullets, selected at random, from each grower treatment were fed each experimental layer ration shown in *Table* 3. The housing of the pullets, the source of feed ingredients, and their preparation were the same as previously described. (Springhall and Ross, 1965). In the case of the layer rations, however, coconut oil was added in varying amounts in an attempt to make the rations isocaloric. Since the energy values of several of the ingredients were not known, only a rough estimation of the caloric content could be made. Feed and water were provided *ad libitum* and artificial light was used to extend the total light period to 16 hours.

Egg production for eight calendar months, feed consumption, mortality, and body weight data were recorded. After three months egg production, eggs from each group were broken into petri dishes placed on white paper, and yolk colour measurements were carried out in direct sunlight using a Roche colour index fan. After six months production, hatchability data were collected to obtain a more critical evaluation of the experimental layer rations. At this time all birds were artificially inseminated twice at three-day intervals, and all eggs collected during a six-day period following the second insemination. The insemination was carried out in such a way that semen from each male was used to inseminate one or two hens from each layer treatment, thus obviating the necessity of testing the sperm and insuring that the same number of hens in each treatment group received sperm from the same males. After 17 days incubation the eggs were candled and the infertile eggs removed. Both fertility and hatchability data were calculated.

The data were analysed statistically using the variance analysis (Snedecor, 1956), and the multiple range test (Duncan, 1955 ; Kramer, 1956).

RESULTS AND DISCUSSION.

Table 2 summarizes the egg production for the eight-month experimental period. It is evident from these data that the observed differences are small, and no significant differences were found in the production rate of the birds fed the experimental rations, and those receiving the control ration. It will be noted from *Table* 3, that the control ration was the standard University of Queensland laying ration containing liver meal, lucerne and dried buttermilk in addition to grains and meat meal, while the experimental rations contained approximately 80

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to 85 per cent. of materials available in the Territory. The fact that the experimental rations yielded such good results would indicate a reasonable balance of nutrients. However, egg size as determined by egg weight of birds fed all three experimental rations was significantly smaller than those of hens receiving the control ration, averaging about three grams lighter. Since proteins probably have the greatest influence on egg weight of all dietary constituents, it is possible that either the protein or amino acid levels in the experimental rations was marginal.

There were no significant differences in per cent. fertility of eggs set (*Table* 4) or in hatchability of fertile eggs (*Table* 5) attributable to either grower or layer treatments, confirming the general nutritional adequacy of the experimental diets.

Table 6 summarizes the effect of layer treatment on yolk colour. It is obvious from these data that *L. leucocephala* has a pronounced effect on yolk colour, confirming the observations of Sandoval (1955). While it seems reasonable to expect a further increase in yolk pigmentation when the diet included 10 per cent. of *L. leucocephala*, this was not the case. It may be that the hens have reached the maximum of their ability to transfer the pigments from 5 per cent. of *L. leucocephala* into the yolk. Although vitamin A determinations were not made, it is reasonable to assume a high correlation between yolk pigmentation and vitamin A content (Romanoff and Romanoff, 1949) since *L. leucocephala* is known to be a rich source of carotene (Palafox and Reid, 1964).

The mean body weights of the hens receiving the experimental diets was 2 to 300 grams lower than that of the control group (*Table* 7). The birds receiving the 10 per cent. *L. leucocephala* made significantly lower gains than all other groups, while the birds receiving the copra-sago and 5 per cent. *L. leucocephala* rations gained significantly less than the control birds. This slower rate of gain is most probably related to the energy value of the layer rations which were probably less than the estimated values. Further evidence of this is seen in the feed efficiency data shown in *Table* 8.

While there appears to be considerable random variation in feed consumed to produce a dozen eggs between the various grower and layer treatments, the layer means shown in the bottom line indicate poorer feed conversion by the hens receiving either 5 or 10 per cent. of *L. leucocephala* in the ration. It is difficult to determine whether this effect is related to the lower energy value of this feedstuff or to the presence of mimosine, or to the mixture of ingredients used. In any event, the observed differences were not statistically significant.

Laying house mortality is shown in *Table* 9. Since there were originally 14 birds in each treatment group the values shown in the body of the table represent the loss of a maximum of three birds in any one group. While there appears to be no pattern in mortality related to the layer treatments, the data in the right hand column suggests a trend noted previously (Springhall and Ross, 1965) of decreasing mortality associated with delay in sexual maturity. None of these differences, however, was significant.

SUMMARY.

Laying rations containing 80 to 85 per cent. of copra meal, sago, coconut oil and *Leucaena leucocephala* were fed to pullets for an eight-month period. There were no significant differences noted in egg production, feed conversion, fertility, hatchability or mortality. Eggs laid by hens fed the experimental rations were significantly lighter in weight than the controls, and the hens laying these eggs gained significantly less than the control hens.

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APPENDIX.

Table 1.

Distribution of Birds on Laying Rations.

Group.	Ration.	Number of Birds.
Grower Ration 1 (64)	Layer Ration 1	14
	2	14
	3	14
	4	14
Grower Ration 2 (64)	Layer Ration 1	14
	2	14
	3	14
	4	14
Grower Ration 3 (64)	Layer Ration 1	14
	2	14
	3	14
	4	14
Grower Ration 4 (64)	Layer Ration 1	14
	2	14
	3	14
	4	14

Note.—Figures in brackets represent numbers of birds.

Table 2.

Average Egg Production and Egg Weights During Eight Calendar Months of Lay.

Treatment.	Average Egg Production.	Hen Day Rate of Lay.	Egg Weight Grams.
Control	133	53	58.8
Copra-Sago	129	52	55.8
5 per cent. *Leucaena leucocephala*	126	50	55.6
10 per cent. *Leucaena leucocephala*	123	49	55.6

Table 3.

Composition of Layer Rations.

Ingredient.	RATION (QUANTITIES EXPRESSED AS PERCENTAGE).			
	Control.	Copra-Sago.	5 per cent. Leucaena leucocephala.	10 per cent. Leucaena leucocephala.
Meat Meal (50 per cent.)	12	18	15.7	13.3
Liver Meal (65 per cent.)	3			
Lucerne Meal	4			
Buttermilk Powder	5			
Ground Limestone	5	4	5	6
Sorghum Meal	45.5			
Wheat Meal	25			
Leucaena leucocephala			5	10[1]
Copra Meal		30	30	30
Sago		43.75	38.75	33.65
Coconut Oil		3.2	4.5	6
Salt	0.5	0.25	0.25	0.25
Vitamin Mix[2]		0.65	0.65	0.65
Mineral Mix[2]		0.1	0.1	0.1
Premix C[3]	0.02			

Note 1.—302.5 g of $FeSO_4$ dissolved in 1,750 ml of water, were mixed with 10 lb. of *Leucaena leucocephala,* and allowed to stand 7 to 10 days before mixing with the other ingredients.

2. The vitamin premix provided the following per pound of finished feed : Choline chloride 500 mg ; dl methionine 0.908 g ; vitamin B_{12}, 8 mcg ; inositol, 50 mg ; niacin, 32 mg ; vitamin A, 8,125 IU ; vitamin D_3, 1,200 ICU ; thiamin, 12 mg ; ascorbic acid, 10 mg ; menadione sodium bisulphite, 10 mg ; calcium pantothenate, 8 mg ; pyridoxine HCl, 8 mg ; riboflavin, 4 mg ; PABA, 4 mg ; vitamin E, 6 mg ; procaine penicillin, 2.25 mg ; folic acid, 2 mg ; biotin, 0.3 mg.

   Mineral premix provided the following per pound of finished feed : Manganese, 27.2 mg ; zinc, 20.4 mg ; iron, 9.09 mg ; copper, 1.12 mg ; iodine, 0.59 mg ; cobalt, 0.23 mg ; molybdenum, 0.16 mg.

3. Premix C contained the following per lb. of mixed feed, vitamin A 3.040 IU, vitamin D_3, 567 ICU, riboflavin 1.13 mg, menadione sodium bisulphite 0.51 mg, calcium pantothenate 1.5 mg, manganous oxide 57.5 mg.

4. All rations were calculated to contain 15 per cent. crude protein.

Table 4.

Per cent. Fertility of Eggs Set.

Grower Treatments.	Layer Treatments.				Total Grower Treatment.
	Copra-Sago.	Control.	5 per cent. Leucaena leucocephala.	10 per cent. Leucaena leucocephala.	
Control	94(36)	94(50)	96(24)	91(45)	94(155)
Copra-Sago	90(42)	77(52)	95(37)	86(44)	87(175)
10 per cent. *Leucaena leucocephala*	90(48)	89(38)	90(42)	94(50)	91(128)
15 per cent. *Leucaena leucocephala*	91(53)	88(42)	88(41)	89(44)	89(180)
Total Layer Treatment	91(179)	87(182)	92(144)	90(183)	688(638)

Note.—Figures in brackets represent number of eggs set.

Table 5.

Percentage Hatchability of Fertile Eggs.

Grower Ration.	Layer Ration.				Total (Grower Treatment).
	Control.	Copra-Sago.	5 per cent. Leucaena leucocephala.	10 per cent. Leucaena leucocephala.	
Control	97(34)	94(47)	91(23)	98(41)	95(145)
Copra-Sago	89(38)	93(40)	89(35)	100(38)	93(151)
10 per cent. *Leucaena leucocephala*	93(43)	88(34)	89(38)	91(47)	91(162)
15 per cent. *Leucaena leucocephala*	90(48)	97(37)	94(36)	85(39)	91(160)
Total (Layer Treatment)	92(163)	93(158)	91(132)	93(165)	92(618)

Note.—Figures in brackets represent number of fertile eggs set.

Table 6.

Yolk Colour Index.

Group.	Treatment.	Number of Eggs Measured.	Colour Index Range.	Mean Colour Index.
1	Control	40	6-7	6.36
2	Copra-Sago	28	2-3	2.22
3	5 per cent. *Leucaena leucocephala*	62	7-8	7.29
4	10 per cent. *Leucaena leucocephala*	20	7-8	7.15

Note.—Group 3 = 4 (N.S.) ; Group 2 < 1, 3, 4, ($P < 0.001$) ; 1 < 3 ($P < 0.01$) ; 1 < 4 ($P < 0.05$).

Table 7.

Mean Body Weights at Start of Experiment and After Six Months of Egg Production.

Treatment.	Initial Body Weight.	After six Months Production.	Mean Gain.
	Grams	Grams	Grams
Control	1,527	2,535	1,008a
Copra-Sago	1,533	2,359	826b
5 per cent. *Leucaena leucocephala*	1,550	2,382	832b
10 per cent. *Leucaena leucocephala*	1,557	2,226	669c

Note.—Figures with different superscripts are significantly different, $P < .05$.

Table 8.

Ratio of Feed Consumption (lb.) per Dozen Eggs for a Period of Six Months.

Grower Rations.	Layer Rations.				Grower Means.
	Control.	Copra-Sago.	5 per cent. Leucaena leucocephala.	10 per cent. Leucaena leucocephala.	
Control	5.63	5.96	6.75	6.68	6.26
Copra-Sago	7.05	6.68	6.25	7.12	6.80
10 per cent. *Leucaena leucocephala*	7.42	6.10	6.51	6.88	6.73
15 per cent. *Leucaena leucocephala*	5.73	6.70	7.34	6.59	6.59
Layer Means	6.46	6.39	6.71	6.82	6.51

Table 9.

Per cent. Mortality During Laying Period.

Grower Rations.	Layer Rations.				Grower Means.
	Control.	Copra-Sago.	5 per cent. Leucaena leucocephala.	10 per cent. Leucaena leucocephala.	
Control	14.3	14.3	14.3	21.4	16.1
Copra-Sago	14.3	7.1	21.4	14.3	14.3
10 per cent. *Leucaena leucocephala*	7.1	21.4	21.4	0	12.5
15 per cent. *Leucaena leucocephala*	7.1	0	21.4	7.1	8.9
Layer Means	10.7	10.7	19.6	10.7	12.9