FREE-CHOICE FEEDING OF LAYING HENS IN THE HUMID TROPICS

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An experiment was carried out with laying hens on four dietary treatments each of nine birds replicated four times. Free-choice diets consisted of shell grit, a protein source and one of three energy sources: (i) corn (100%), (ii) corn (60%) and cassava (40%), and (iii) corn (94%) and palm oil (6%). The fourth treatment was a commercially-available layer diet.

Feed and energy intakes were significantly higher on the commercial diet and lower on the corn and cassava mixture than on the other treatments. Protein intake was similar (19 g/d) on the four treatments. Shell grit intake tended to be lower on the corn and cassava mixture, although there was a period x treatment interaction.

Egg production and egg weight were similar on the four treatments. Gross efficiency of feed conversion to egg mass and cost of production were much higher on tile commercial diet.

Key words: Malaysia, free-choice feeding, cassava, corn, palm oil, layer performance in the tropics.

Layer diets are often formulated on the assumption that the requirements for essential nutrients remain constant throughout the laying cycle. This may not always be desirable, particularly under conditions of high~ temperature when pattern of feed intake changes markedly within a day, and the peak demand for protein, energy and calcium for example, may occur at different times during the day (Mongin and Sauveur 1979). Moreover it is known that at any one time requirements differ for essential nutrients among individual birds and these are usually related to differences in egg production within a flock.

The method of choice feeding (Emmans 1978) allows birds the opportunity to select nutrients, particularly protein and energy, according to physiological demands. Such selection patterns may allow an insight into the changes in the ratio of these two components that occur over a laying cycle and under tropical conditions.

The object of the present study was to allow groups of layers to select for major dietary components, by presenting them with the sources of energy, protein and calcium in separate feeding troughs.

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Materials and Methods

The experiment was undertaken at Serdang, Malaysia which is a warm humid environment with only small monthly variation in mean dally temperature(32°C) and a high relative humidity (80-100%)

There were four dietary treatments (T1-T4). The energy sources were varied to allow choice of ingredients of different metabolizable energy (ME) and protein contents. Treatment 4 was a commercial layer mash. Treatment composition is given in Table 1. Ingredients were offered in mash form and feeding was ad libitum with free access to water. Artificial lighting was introduced when birds were aged 21 weeks such that morning day light was increased by 30 min/week until a day length of 15 h was achieved and then held constant.

Table 1:

Details of feed ingredients available free-choice, dietary treatments and analysis of ingredients

Dietary treatment	Source (g/kg of feed)			
	Protein supplement		Energy	
T 1	Fishmeal	450	corn	1000
	Soybean meal	450		
	Methionine	2.5		
	Limestone	94		
	Minerals and vitamins	3.5		
T 2	(As for Treatment 1)		corn	600
			cassava	400
T 3	(As for Treatment 1)		corn	940
			palm oil	60
	Commercial diet			

	corn	protein supplement	cassava	palm oil	commercial diet
Calculated analysis					
Crude protein (g/kg)	90	524	25	.0	16
Metabolizable energy (MJ/kg)	14.2	9.9	15.5	36.8	11.9
Cost per tonne (Malaysian dollars)	338	713	284	1100	480

There were 9 birds per group and each bird was housed in an individual battery cage in an open-sided, covered shed. Birds were a medium bodyweight, brown egg laying strain (Dekald Amber-Link). There were four replicate groups per treatment, each group had a common feed trough divided into three compartments and unrestricted access,; to water. Pullets were randomly assigned to cages, and treatment groups at 21 weeks, and most measurements commenced at 23 weeks and continued until 60 weeks of age.

Intakes of the sources of protein, energy and oyster shell grit (37-39% Ca) were determined over time periods of two weeks. Egg production and egg weight were measured daily. Liveweight was determined at least every four weeks.

Data were subjected to an analysis of variance. Differences between treatment means were determined using the Least Significance test.

Results

Results are summarised in Table 2, and statistical analysis of data in Table 3.

Table 2:

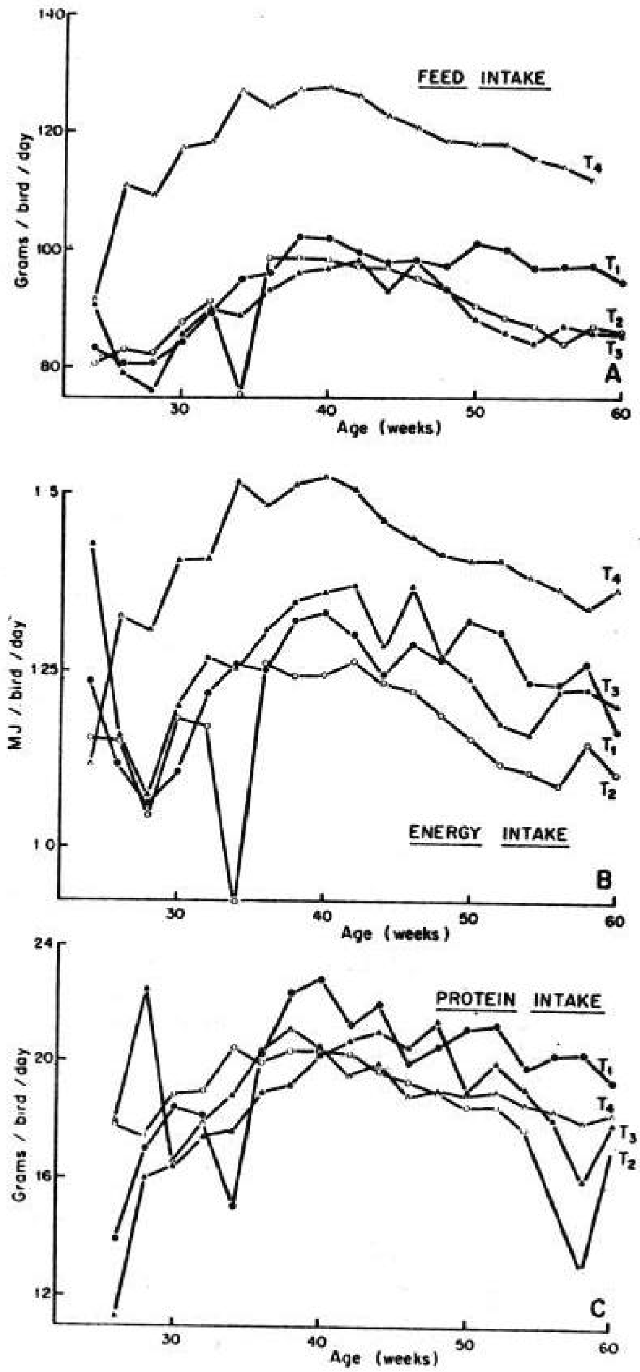
Mean intake and production responses of four groups each of nine hens per treatment

	Corn 1	Corn/cassava 2	Corn/oil 3	Commercial 4	Standard deviation
Feed intake (g/d)	94^{a} [1]	90^{ab}	89^{b}	118^{c}	0.96
Energy intake (MJ/d)	1.23	1.16	1.26	1.40	0.12
Shell grit intake (g/d)	4.1^{a}	3.7^{b}	3.9^{ab}		0.1
Protein supplement					
(% of intake)	26.8^{a}	28.5^{a}	27.6^{a}		0.92
Crude protein intake					
(g/bird/d)	18.9^{a}	19.3^{a}	18.6^{a}	18.7^{a}	0.47
(% feed intake)	20.6^{a}	19.5^{a}	20.5^{a}		0.44
Egg production (%)	60.4^{a}	57.8^{a}	61.6^{a}	60.4^{a}	1.6
Egg weight (g)	56.2^{a}	56.0^{a}	56.6^{a}	57.4^{b}	0.63
Gross efficiency					
(kg feed/kg eggs)	2.56^{a}	2.64^{a}	2.37^{b}	3.15^{c}	0.05
Live weight (g)	1928^{a}	1919^{a}	1992^{a}	1956^{a}	17.4
Weight change (g/bird/14 d)	42^{a}	32^{a}	39^{a}	32^{a}	3.5

[1] Values with the same superscripts (a-c) are not significantly different (P>0.05)

Feed intake was influenced (P<0.001)by treatment, period, and there was a period x treatment interaction (P<0.001), The pattern of intake for each diet is shown in Fig. 1A. During week 34, there was a large but unexplained temporary reduction in intake by birds on treatment 2. Birds on the commercial diet consumed on average, at least 24 g/d of feed more than other treatments. ME intake followed the same pattern as feed intake (Fig. 1B). Energy intake was highest (P<0.0.001)

Figure 1:
Patterns of feed intake (A), of metabolizable energy intake (B), and of protein intake (C) of four groups each of nine birds on the corn and protein supplement (!, T1), the corn + cassava and protein supplement (", T2), corn + palm oil and protein supplement (▴, T3), and the commercial diet (△, T4) during 24 weeks of lay.



on the commercial diet.(T4). Birds adjusted their energy intake by consuming similar amounts of feed energy on the corn (T1) and corn + oil (T3) diets. There was a reduction (P<0.05) in the ME intake of hens on the corn + cassava energy source (T2). This decrease corresponded with a reduced egg production (Table 2).

Table 3:

Results of an analysis of variance of data given in Table 2

	Treatment (T)	Period (P)	P X T.
Feed intake (g/d)	***[1]	***	***
Energy intake (MJ/d)	***	**	***
Shell grit intake (g/d)[2]	(*)	***	NS
Protein supplement[2]			
(% feed intake)	NS	***	**
Protein intake			
(% feed intake)[2]	NS	***	**
(g/bird/d)	NS	***	***
Egg production (%)	NS	***	NS
Egg weight (g)	NS	***	***
Feed cost			
(kg feed/kg eggs)	***	***	NS
Body weight (g)	(*)	***	NS
change (g/2 weeks)	NS	***	NS

[1] NS = not significant (P>0.1), (*) 0.1>P>0.05, ** = P<0.01, *** = P<0.001

[2] Treatments 1-3 only, other analyses treatments 1-4

Shell grit intake tended (0.1>P>0.05) to be influenced by dietary treatment in that intake on treatment 1 was higher (P<0.05) than on the two other free-choice diets. Variation (P<0.001) in grit intake over time is shown in Fig. 2C. Intake on the three free-choice treatments during the first four weeks of lay was higher than thereafter although it appeared to remain higher for treatment 1, except during week 52. Grit intake on treatment 3 remained generally higher than on treatment 2.

Intake of protein supplement was similar for the three free-choice treatments. Although there was an effect of period (P<0.001), and a period x treatment (P<0.001) interaction. This is shown in Fig. 1C. When protein intake (g) was expressed as a percent of feed intake there was an effect of period (P<0.001) and a period x treatment interaction (P<0.01). Mean values over the experiment were the same for the three treatments (Table 2) as was daily protein intake per bird. Again there was a significant effect of period (P<0.001) and a period x treatment interaction (P<0.001).

Egg production appeared to be reduced on treatment 2 but differences between the four treatments were not significant (P>0.05). The only effect (P<0.001) was due to period (Fig. 2A). Egg weight (g) was higher (P<0.05) on treatment 4 than on the other three treatments; it was influenced (P<0.001) by period (Fig. 2B) and there was a treatment x period interaction (P<0.001). Egg mass, although not significantly different between treatments, was lower on treatment 2 than on the other diets.

Mean weight gain (g) per bird during the 36 week period was 341, 305, 346, and 396 on treatments 1, 2, 3 and 4 respectively. Average gain per period of two weeks did not differ among treatments (Table 2) and at 60 weeks of age birds on the four treatments were all close to 2 kg.

Feed costs per kg of eggs was calculated on the basis of the cost of raw ingredients at the commencement of the experiment (November 1978) and the contribution of each ingredient to average feed intake. Feed cost (Malaysian dollars) per kg of egg mass was 1.01, 1.00, 0.99 and 1.51 for treatments 1, 2, 3 and 4 respectively. The commercial diet was 50X more costly than the other diets.

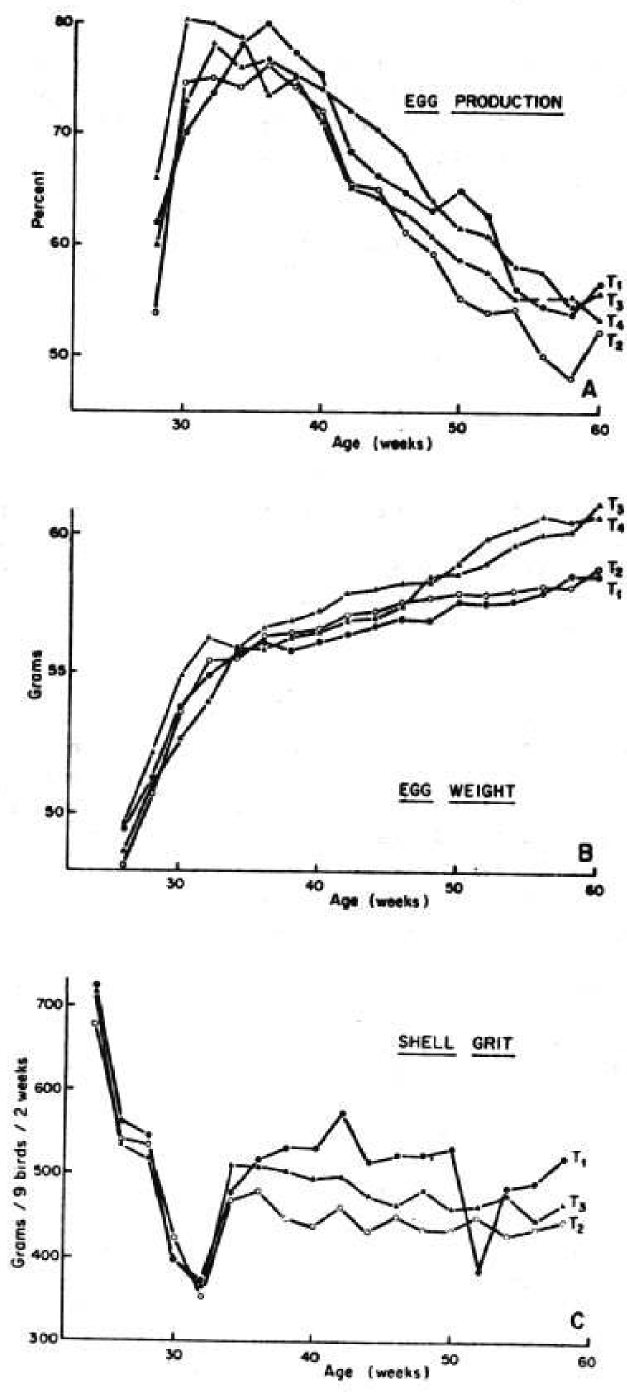
Discussion

Despite differences in ME and crude protein concentrations of the feed sources of energy, it is quite clear that birds tended to select a combination of feed sources to meet a protein need of about 19 g/d. This opportunity allowed birds to lay at a similar rate as that reported by Holcombe et al. (1976). This daily amount of protein is considerably more than 15 g/d recommended by several workers (Smith 1973).

Cassava contains prussic acid which can depress growth rate of chickens at 20-30% of the diet (Scott et al. 1976). This may have been responsible for the reduced energy intake of birds given this feed free choice, and as a consequence a lower egg output. Interestingly when palm oil was added to corn (treatment 3) feed intake was reduced such that energy intake on the two diets (T1 and T3) was similar. On the other hand, birds consumed significantly more of the commercial diet (T4) such that ME intake was increased by at least 11% but protein intake was the same as on other treatments. This additional energy did not effect live weight gain although egg weight increased by 0.8 g/d (Table 2). This suggests that the calculated value of 11.9 MJ ME/kg may have been too high or the availability of ME was lower than on the other treatments. Furthermore even at high temperatures layers appear to have the capacity to consume increasing amounts of a medium-energy diet (T4) to meet their energy needs and maintain maximum egg production. This is contrary to the observations of de Andrade et al. (1977).

Shell grit intake was about 10% greater on treatment 1 than on treatment 2. This higher intake was associated with an increase in egg production of 4%. Since protein intake was similar, this would suggest a real difference in calcium intake although analysis was not undertaken on the calcium contents of corn and cassava. Thus a direct comparison of these data cannot be made with those of Khoo (1977) who found that dwarf hens had similar calcium intakes when birds were given a free-choice of different diets. Leeson and Summers (1979) concluded that birds are able to select diets based on an appetite for calcium.

Figure 2:
Patterns of egg production (A), of egg weight (B) and of shell grit intake (C) of four groups each of nine birds on the corn and protein supplement (!, T1), the corn + cassava and protein supplement (", T2), corn + palm oil and protein supplement (▲, T3), and the commercial diet (△, T4) during 24 weeks of lay.



Although mean egg production of about 60% is by some standards not high it should be remembered that birds producing brown eggs do not normally lay at as high a rate as those producing white eggs. Oh (1979) in a survey of 20 producers in the Selangor area reported a mean rate of lay of 56% end of 65.9% for the flocks at the Universiti Pertanian Malaysia.

It appears that self-selection of feed ingredients by poultry provides a practical method of obtaining the required nutrients for optimum egg production at a substantial economic gain over a complete diet.

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