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Dietary Self–Selection by Laying Hens Offered Choices of Feed

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ABSTRAK

Satu kajian pemberian makanan jangka pendek telah dijalankan dengan ayam penelur dengan tiga perlakuan (T1-T3). Tiga perlakuan makanan tersebut ialah makanan ayam penelur komersial (T1, satu-pilihan), makanan ayam penelur komersial dan grit cengkerang tiram (T2, dua-pilihan) dan campuran jagung, campuran mil kacang soya dan grit cengkerang tiram (T3, tiga-pilihan) dengan menggunakan 20 ekor ayam untuk satu perlakuan. Kajian ini juga melibatkan pemerhatian ke atas tiga jangka masa pemberian makanan iaitu dari 0800-1200 tgh., 1200-1600 ptg. dan 1600-0800 pagi. Makanan dan air minuman disediakan secara ad libitum. *Ayam diberikan 15 jam cahaya. Pengambilan makanan, tenaga dan protein adalah ketara tingginya untuk makanan ayam komersial dan adalah rendah bagi makanan dua perlakuan yang lain. Pengambilan kalsium adalah ketara rendahnya bagi perlakuan satu-pilihan dan tiga-pilihan. Bagi semua perlakuan, ayam lebih memakan makanan pada waktu jangka masa 1600-0800 pagi (40.8-45.8% makanan dimakan), iaitu pada waktu lewat petang dan awal pagi. Pengambilan makanan adalah lebih kurang sama (26.2-29.7% makanan dimakan) bagi jangka masa antara 0800-1200 tgh. dengan 1200-1600 ptg. Pengeluaran telur, berat keseluruhan telur dan tukaran makanan adalah ketara baiknya untuk perlakuan dua-pilihan dan tiga-pilihan dibandingkan dengan perlakuan satu-pilihan. Tidak ada perbezaan daripada segi berat telur di antara ketiga-tiga perlakuan.*

ABSTRACT

A short term dietary self-selection experiment (28 days) was conducted with laying hens fed three treatments (T1-T3) consisting of a commercially available layer feed (T1, single choice), commercially available layer feed and oyster shell grit offered separately (T2, two choices) and a corn mixture, soyabean meal mixture and oyster shell grit offered separately (T3, three choices). Measurement of feed intake was divided into three feeding periods, from 0800-1200h, 1200-1600h and 1600-0800h. Feed and water were available ad libitum. *Hens were raised under 15 hour photoperiod. Feed, energy and protein intakes were significantly greater on the commercial diet and lower in the other two treatments. Calcium intake was significantly lower on the single choice and three-choice diets. In all treatments, the hens tended to consume more feed during the period between 1600-0800h (40.8-45.8% feed consumed), that is very late in the evening and very early in the morning. Similar amounts of feed (26.2-29.7% of feed consumed) were consumed between 0800-1200h and 1200-1600h. Egg production, egg mass and feed conversion were significantly better on the two and three-choice diets as compared to the single diet. There was no difference in egg weight among the three treatments.*

INTRODUCTION

Hens have the ability to discriminate between feeds on the basis of different contents of major nutrients. Dietary selection by laying hens maybe involved with the bird's requirement for different nutrients at specific times of the day

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(Emmans 1977). It is widely accepted that laying hens consume energy in excess of daily metabolic requirements when offered high energy complete diets (Morris 1968; Summers and Leeson 1976). This overconsumption, maybe due, in part to the hen's requirement for specific nutrients according to the stage of egg formation. Part of this pattern is due to the specific appetite for calcium related to the period of shell calcification (Hughes 1972; Mongin and Sauveur 1974).

If all hens in a laying flock could be offered a feed which just met their nutrient requirements, there would be a considerable saving in both nutrients and cost (Emmans 1978; Hughes 1984; Cowan (*et al.*) 1978; Leeson and Summers 1978, 1979). An effective system of dietary self-selection is more likely to be found with a clearer understanding of the way in which hens react to being given access to two or more feeds, and the feeding period when there is a higher intake of feed. Therefore, a short term feeding trial (28 days) was conducted to study the nutrient intakes and performance of laying hens when offered choices of feeds.

MATERIALS AND METHODS

Sixty hens of medium body weight, brown egg laying strain (Dekalb Amber Link), 40 weeks of age were randomly allocated to three treatments (T1-T3). The treatments (T1-T3) and feed ingredients offered free choice are given in Table 1. A commercially prepared diet which was offered to hens in treatments 1 and 2 had the following nutrient composition: 11.9 MJ/kg metabolizable energy (ME), 16% crude protein and 3.25% calcium. The composition and calculated analysis of nutrients in diets for treatment 3 is given in Table 2. The commercial feed and also the corn mixture and soybean meal mixture, which are sources of energy and protein, respectively, were offered in mash form. Feed and water were available *ad libitum*. All the hens were provided with individual feed containers. The hens were housed in individual battery cages in an open-sided, covered shed. The hens were given 15 hours photoperiod and 3 hours supplementary lighting was provided at dusk (1830h).

Feed and oyster grit intakes were determined every seven days over a period of 28 days. Feed intake measurements were divided into 3 periods per day and measurements were carried out at 0800h, 1200h and 1600h for two periods of 7 consecutive days, that is, on days 8 to 14 and days 22 to 28, in order to study the daily pattern of feed intake throughout the day. Hens were adapted to the diets 14 days before measurements were made.

Egg production and egg weight were measured daily. All data were subjected to an analysis of variance and differences between means were determined using the Least Significant Test (Steel and Torrie 1980).

TABLE 1
Details of treatments and feed ingredients offered free-choice to laying hens.

Dietary treatment	Source of feed
T1-Single feed	Commercial feed.
T2-Two-choice diet	Commercial feed
	Oyster shell grits.
T3-Three-choice diet	Corn
	Soybean meal
	Oyster shell grits.

TABLE 2
Composition of three-choice diet

Corn mixture		Soybean meal mixture	
Ingredient	%	Ingredient	%
Corn	97.95	Soybean meal	98.25
KH_2PO_4	2.00	KH_2PO_4	1.50
Vitamin and mineral mix.	0.05	Vitamin and mineral mix	0.05
		DL-Methionine	0.20
	100.0		100.0

Calculated Composition:	Corn mixture	Soybean meal mixture
Metabolizable energy (MJ/kg)	13.90	9.95
Crude protein (%)	8.72	41.30
Calcium (%)	0.196	0

RESULTS

Feed intakes of laying hens at the three feeding periods over the 28-day experimental period are given in Table 3. There was a significant

difference ($P<0.05$) in total intake among the three treatments and the three feeding periods for all treatments. A greater percentage of feed (40.8 - 45.8%) was consumed in the evening (after 1600h) and early in the morning (before 0800h) for the three treatments, while percentages of intakes were almost the same (26.2-29.7%) during the period between 0800h to 1600h for all feeds except for soybean meal mixture where the least intake (19.4%) was between 0800-1200h. In terms of oyster shell grit intakes in treatments 2 and 3 respectively, the same pattern was observed whereby a higher percentage (48.4 and 54.1%) was consumed between 1600h to 0800h and there was no significant difference between the periods of 0800-1200h and 1200-1600h.

Table 4 shows the calculated nutrient intakes by laying hens of metabolizable energy, protein, and calcium during the three periods of feeding for the three treatments. There were significant differences in nutrient intakes among the three treatments and also among the three feeding periods for each treatment. A higher ME intake was observed in the 1600-0800h feeding period as compared to the 0800-1200h and 1200-1600h. Similarly the same pattern of intakes was observed for protein and calcium for all treatments.

A summary of total nutrient intake and production characteristics of hens is shown in Table 5. Hens on treatment 1 with only a single feed offered had the highest intakes of feed, ME and protein. Hens with two-choices and three-choices as feeding treatments consumed about the same amount of ME but hens in Treatment 2 had higher intakes of feed and protein as compared to hens on Treatment 3. The highest calcium intake was observed for hens with two-choices (5.67g) followed by hens with single-choice (3.75g) and three-choices (3.65g). There was no difference in egg production between treatments 2 and 3 but hens on treatment 1 had the lowest production. There was no significant difference in egg weight among the three treatments.

DISCUSSION

Hens offered feed and oyster grits or corn, soybean meal and oyster grits separately had

TABLE 3
Pattern of feed intake (g) of laying hens during the three feeding periods as means for a 28-day period[1]

Feed % of Intake	Feeding period			SE	Total Intake
	1600-0800h	0800-1200h	1200-1600h		
Treatment 1:					
Feed (g)	52.8[a]	32.3[c]	30.3[c]	2.74	115.4
% Intake/day	45.8	28.0	26.2		100.0
Treatment 2:					
Feed (g)	41.2[b]	27.7[c]	29.0[c]	1.79	97.9
% Intake/day	42.1	28.3	29.6		94.1
Oyster grits (g)	3.3[a]	1.2[d]	1.6[cd]	0.66	6.1
% Intake/day	54.1	19.7	26.2		5.9
Treatment 3:					
Corn (g)	28.5[a]	20.6[b]	20.7[b]	1.54	69.8
% Intake/day	40.8	29.5	29.7		70.6
Soybean meal (g)	8.1[a]	3.8[b]	7.7[a]	0.78	19.6
% Intake/day	41.3	19.4	39.3		19.8
Oyster grits (g)	4.6[a]	2.5[b]	2.4[b]	0.29	9.5
% Intake/day	48.4	26.3	25.3		9.6

[a-d]Values in a row and column (of same variable) with different superscripts are significantly different ($P<0.05$).
[1]Values are means of 20 hens.

TABLE 4
Daily intakes of energy, protein and calcium of laying hens during the three feeding periods as means for a 28-day period[1]

Nutrient Intakes	Feeding Period			SE	Total Intake
	1600-0800h	0800-1200h	1200-1600h		
Treatment 1:					
ME (kJ)	628[a]	384[c]	361[c]	32.6	1373
Protein (g)	8.45[a]	5.17[d]	4.85[d]	0.43	18.5
Calcium (g)	1.72[b]	1.05[c]	0.98[d]	0.09	3.75
Treatment 2:					
ME (kJ)	490[b]	330[d]	345[d]	21.3	1165
Protein (g)	6.60[b]	4.43[e]	4.64[e]	0.29	15.7
Calcium (g)	2.56[a]	1.34[c]	1.53[bc]	0.24	5.43
Treatment 3:					
ME (kJ)	477[b]	324[d]	365[c]	14.0	1166
Protein (g)	5.84[c]	3.37[e]	4.99[d]	0.03	14.2
Calcium (g)	1.75[c]	0.97[e]	0.93[de]	0.11	3.65

[a-e]Values in a row and column (of same variable) with different superscripts are significantly different (P<0.05).
[1]Values are means of 20 hens.

TABLE 5
Nutrient intakes and production characteristics of laying hens as means for a 28-day period[1]

Parameters	T1 Single choice	T2 Two choices	T3 Three choices	SE
Feed intake (g)	115.4[a]	104.0[b]	98.9[c]	1.8
Commercial feed (g)	115.4[a]	97.9[b]	–	
Corn (g)	–	–	69.8	
Soybean meal (g)	–	–	19.6	
Oyster grits (g)	–	6.1	9.5	
ME intake (kJ)	1373[a]	1165[b]	1166[b]	18
Protein intake (g)	18.5[a]	15.7[b]	14.2[c]	1.2
Calcium intake (g)	3.75[b]	5.43[a]	3.65[c]	0.8
Egg production (%)	64.6[b]	74.4[a]	75.8[a]	1.5
Egg weight (g)	57.2[a]	57.4[a]	57.8[a]	0.8
Egg mass (g)	37.0[b]	42.7[a]	43.8[a]	0.9
Feed conversion ratio (kg feed/ kg egg)	3.12[c]	2.44[b]	2.26[a]	0.1
Feed efficiency (kg egg/kg feed)	0.32[c]	0.41[b]	0.44[a]	0.05

[a-c]Values in a row with different superscripts are significantly different (P<0.05).
[1]Values are means of 20 hens.

lower feed intakes than hens fed single diet, which was a reduction of about 10% and 14.3% respectively as compared to the control offered single choice. This reduction in feed intake was greater than that reported by Leeson and Summers (1978) which was only about 7%. The reduction in feed intake was associated with reduction in energy and protein consumed and an increase in calcium intake, especially for hens on treatment 2. Evidence of an increased feed intake in an apparent attempt to maintain a higher calcium intake has also been reported by Classen and Scott (1982).

The feed intake, ME and protein intakes of the hens for all treatments was greatest in the late evening (1600-2100h) and early morning (0630-0800h). This may have been related to increased requirement for nutrients for egg formation, as it was observed that 48% of the eggs were laid before 1000h, 38% between 1400-1600h and 14% after 1600h. This is similar to the findings by Holcombe *et al.* (1976) where increased intakes of nutrients especially protein were recorded late in the afternoon. The oyster shell grit intake was increased during afternoon and late evening, that is during the feeding period of 1200-1600h and 1600-0800h, which relates to the high calcium requirement for synthesizing shell late at night. This observation is similar to the finding of Smith *et al.* (1972) and Hughes (1972). The high calcium intake in treatment 2, which was about 45% higher than that for treatment 1 was associated with an increase in egg production by 15%. Therefore, a separate feeding of a calcium source influenced egg production as can be seen in treatments 2 and 3 and this would depend on the composition of the complete diet.

Although hens fed on two or three choice diets consumed less feed, they produced a greater egg mass, due to the higher number of eggs produced. This finding is similar to that of Leeson and Summers (1979). Hens practising diet selection also utilised feed more efficiently (0.41 and 0.44) as compared to hens consuming commercial diet only (0.32). This is in agreement with the findings of Leeson and Summers (1979).

In conclusion, the study shows that the ability of hens to regulate their diet is not well defined. When offered calcium separately,hens tend to select a higher calcium intake even when the food offered is high in calcium. When they were offered separate sources of energy, protein and calcium, hens were able to select calcium to meet their requirement with minimum protein and ME intakes to support high egg production. In this study, hens also consumed more feed during the early hours in the morning and late in the evening. This is attributed to their high requirement for energy and protein for egg formation and high calcium intake for calcification and also to the cooler environment during these periods.

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