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FEED RESTRICTION OF LAYING HENS

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Feed represents the major expense item in the total cost of egg production. With rising feed prices in recent years, producers are looking for new ways to reduce production costs and restore profit margins. Researchers in California, as well as others, have shown that increasing feed efficiency through controlled feed intake may have merit in commercial table egg production. However, limiting feed intake can sometimes decrease rate of production, livability, and egg size. The study reported here is one of a series of experiments condicted to evaluate time-limited feeding (TLF) in southern California, where most egg-type poultry houses are of the open-type design.

Experimental Procedure

Two commercial strains of single-comb White Leghorn chickens were brooded and reared in the mild coastal climate of southern California where the experiment was conducted. At 24 weeks of age the pullets were placed in a California open-type house at a density rate of 3 birds per 30.5 x 45.7 cm. (12" x 18") cage. The cages were oriented in a single row on each side of the house with a double row of back-to-back cages in the center. Feed troughs located at the front of each cage provided 10.2 cm. (4") of feeder space per bird. Continuous-flow type V-trough waterers ran the length of each row at the rear of the cages.

Three feeding treatments were imposed on each strain. The first treatment consisted of three 1-hour (3-1HR) feeding periods per day (7:00-8:00 a.m., 1:00-2:00 p.m., and 7:00-8:00 p.m.). The second treatment allowed feeding activity during two 2-hour (2-2HR) periods per day (7:00-9:00 a.m. and 7:00-9:00 p.m.). The third treatment served as a control, permitting *ad libitum* feeding. Access to the feed troughs was controlled mechanically by a plywood lid hinged to the front of the feed trough. Time clocks, set according to the prescribed treatments, triggered the hydraulic-ram and cable system that opened or closed the lids.

Two conventional lay rations were fed during the test in accordance with seasonal temperature changes (Table 1). Rations for all treatment groups were isocaloric and isonitrogenous.

Table 1. Selected parameters of the experimental ration

Ingredients	Winter	Summer
M.E. (kcal/kg)	2,756	2,695
Crude protein (%)	16.0	17.0
Methionine (%)	0.32	0.34
Meth + cystine (%)	0.56	0.59
Lysine (%)	0.64	0.68
Calcium (%)	3.70	3.70
Phosphorus (%)	0.60	0.60

The experimental design, consisting of three feeding regimens and two strains, was a randomized complete block with six blocks. Each treatment replicate consisted of 24 birds in an 8-cage section, for a total of 864 hens.

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Data collections began in February when the hens were 24 weeks of age and continued through two lay cycles. Egg production and mortality were tabulated daily; feed consumption was sampled for a 24-hour period every 2 weeks; and egg weight, shell thickness, and body weight were sampled monthly. All data were summarized into 28-day periods for analysis. The first lay cycle was ended by a forced molt at 64 weeks of age by removing the feed for 10 days, after which the normal lay ration was reinstated. The hens had water at all times during the molt period. Duration of this experiment was 84 weeks, ending in August of the second year.

Results

Laying performance during the first lay cycle is given in Table 2. Strain A consumed significantly more feed than Strain B, but treatment effects on feed intake, relative to ad libitum groups, were similar. During the first lay cycle, average feed intake reductions (relative to ad libitum control feed intake) of 11 percent and 8 percent were achieved by the 3-1HR and 2-2HR feeding treatments, respectively. Feed efficiency was significantly improved by TLF within Strain B only. Body weight gain (not shown in Table 2) was directly related to feed consumption and was significantly reduced by TLF within both strains throughout the experiment.

Unusually high, but non-treatment related, mortality occurred during the first lay cycle, especially among Strain A birds. The cause was not determined.

No significant differences among feeding regimens were detected in hen-day or hen-housed egg production within either of the two strains. Strain A, however, laid significantly fewer eggs than Strain B (hen-housed basis), largely because of the higher mortality within Strain A.

Trends toward lowered egg size and thicker shells among restricted groups were observed within both strains but became statistically significant within Strain A only.

Table 3 gives the performance results of the second lay cycle. Again, total feed consumption was lowered by TLF and, on the average, Strain A consumed more feed than Strain B.

For both strains the 3-1HR and 2-2HR limitation programs allowed statistically the same feed consumption while significantly improving feed efficiency. The 3-1HR and 2-2HR treatments caused average feed intake reductions during the second lay cycle of 12 percent and 10 percent, respectively.

As in the first lay cycle, mortality was not treatment related. Higher than normal mortality continued through the second lay cycle.

Rate of egg production was not significantly affected by TLF. Although there were no significant strain-by-treatment interactions detected, it is interesting to note that restricted birds of Strain B laid at numerically higher rates than their ad libitum control, while restricted birds of Strain A laid at numerically lower rates than their control.

Trends toward lowered egg size and increased shell thickness due to TLF were observed. The shell thickness increase reached levels of significance within both strains, whereas decreased egg size was significant only within Strain B.

Discussion

Although egg production was not significantly lowered by the TLF programs, egg size and shell thickness were altered. Egg size appeared to be closely related to feed intake in that it decreased when feed intake was limited. As egg size declined, shell thickness increased in most cases. This may be due in part to a shell thickness-egg size relationship that may exist where calcium deposition remains constant: as egg size increases, a thinner shell results.

These results suggest that changes in feed intake can contribute to significant changes in egg size and shell

Table 2. Effect of time-limited feeding on laying performance during first lay cycle

Strain/Limitation		Feed Consumption	% Reduction	Mortality Hen-housed	Production Hen-day	Production Hen-housed	Large eggs	Avg. shell thickness	Feed efficiency
		(grams)	(percent)	(percent)	(percent)	(percent)	(percent)	(mm.)	(kg.feed/ kg.egg)
A	Three 1-hour	106c*	12	17.4A*	69.1a	64.2a	77.7b	0.384AB	2.59a
	Two 2-hour	111b	8	9.1B	69.2a	66.0a	79.7ab	0.389A	2.66a
	<u>ad libitum</u>	120a	0	17.4A	72.9a	65.7a	81.8a	0.378B	2.75a
	Mean	112A**		14.6A	70.4a	65.3b**	79.7A	0.384a	2.66a
B	Three 1-hour	101b	10	10.7a	72.6a	68.8a	57.1a	0.381a	2.46B
	Two 2-hour	103b	8	5.0b	70.8a	68.9a	62.4a	0.384a	2.58AB
	<u>ad libitum</u>	112a	0	7.1a	70.2a	67.5a	65.8a	0.378a	2.80A
	Mean	105B		7.6B	71.2a	68.4a	61.8B	0.381a	2.61a

* Duncan's multiple range compares the three limitation treatments for each strain separately. Means with the same capital letter are not significantly different (P > 0.01). Means with the same lower case letter are not significantly different (P > 0.05).

** Strain means with the same capital letter are not significantly different (P > 0.001). Strain means with the same lower case letter are not significantly different (P > 0.05).

Table 3. Effect of time-limited feeding on laying performance during second lay cycle

Strain/Limitation		Feed consumption	% Reduction	Mortality Hen-Housed	Production Hen-day	Production Hen-housed	Large eggs	Avg. shell thickness	Feed efficiency
		(grams)	(percent)	(percent)	(percent)	(percent)	(percent)	(mm.)	(kg.feed/ kg. egg)
A	Three 1-hour	103A*	14	12.5a*	49.3a	36.6b	94.6a	0.389a	3.29ab
	Two 2-hour	107A	11	13.3a	52.8a	44.1a	95.2a	0.384ab	3.14b
	ad libitum	120B	0	12.5a	53.6a	40.6ab	96.5a	0.381b	3.46a
	Mean	110A**		12.8a**	51.9a	40.4B	95.4A	0.385a	3.30A
B	Three 1-hour	98A	10	11.2a	55.6a	45.8a	86.0b	0.384A	2.92b
	Two 2-hour	99A	9	9.0a	54.9a	49.4a	90.4ab	0.386A	2.97b
	ad libitum	109B	0	14.2a	53.7a	45.3a	91.9a	0.371B	3.26a
	Mean	102B		11.5a	54.7a	46.8A	89.4B	0.380b	3.05B

* Duncan's multiple range compares the three limitation treatments for each strain separately. Means with the same capital letter are not significantly different ($P > 0.01$). Means with the same lower case letter are not significantly different ($P > 0.05$).

** Strain means with the same capital letter are not significantly different ($P > 0.001$). Strain means with the same lower case letter are not significantly different ($P > 0.05$).

thickness without significantly altering egg production. Also, egg size and shell thickness may be more sensitive to variations in nutrient intake than average hen-day production, particularly when production rates among groups lack consistency, as was the case in this experiment.

The two strains responded similarly to TLF in terms of feed efficiency, egg size, and shell thickness. The two limitation programs imposed, however, caused greater feed restriction (relative to ad libitum consumption) for Strain A than Strain B. Since both strains were restricted the same number of hours and in the same manner, behavioral differences may exist between the two strains. It is also possible the two restriction programs did not allow sufficient time for Strain A birds to consume the same relative amounts of feed as Strain B. This last possibility might indicate different requirements for feeder space and/or, again, behavioral differences.

Under the conditions of this experiment, both Strain A and B ad libitum-fed control groups overconsumed in terms of energy intake during both lay cycles. This becomes apparent when comparing significant differences in caloric intake between treatment groups of each strain (Table 4) and the lack of any significant differences in rates of egg production (Tables 2 and 3) on a hen-day basis. To the contrary, total protein intake may have been deficient in restrictively fed groups since egg size was significantly lowered in some cases

Table 4. Average metabolizable energy and total protein consumed per hen per day during each of the two lay cycles

Strain/Limitation		First lay cycle M.E.	First lay cycle Protein	Second lay cycle M.E.	Second lay cycle Protein
		(kcal)	(g)	(kcal)	(g)
A	Three 1-hour	289c*	17.6c	282A*	17.9A
	Two 2-hour	301b	18.3b	292A	18.7A
	ad libitum	328a	19.9a	329B	21.4B
	Mean	306A**	18.6A	301A**	19.3A
B	Three 1-hour	275b	16.7b	269A	17.4A
	Two 2-hour	282b	17.1b	272A	17.6A
	ad libitum	306a	18.6a	297B	19.1B
	Mean	288B	17.5B	279B	18.0B

* Duncan's multiple range compares the three limitation treatments for each strain separately. Means with the same capital letter are not significantly different ($P > 0.01$). Means with the same lower case letter are not significantly different ($P > 0.05$).

** Strain means with the same capital letter are not significantly different ($P > 0.001$). Strain means with the same lower case letter are not significantly different ($P > 0.05$).

(Tables 2 and 3). No effort was made in this experiment to adjust total protein in the ration to prevent such deficiencies; however, under commercial applications of feed restriction, protein (and possibly other nutrients) would be added.

The practicality of controlled feeding lies in minimizing unnecessary energy consumption without creating deficiencies in other essential nutrients and without sacrificing performance to the point where economic returns are penalized. Some decrease in egg size, like that occurring in this test, or reduction in rate of lay may result from controlled feeding programs, but these losses may be more than offset by improved feed efficiency. The economic feasibility of restricting energy intake of egg type layers will depend on both performance data and egg-feed price relationships.

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