Effects of Feeding Low-Density Diets to Hy-Line W-36 Laying Hens on Production and Profitability

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Introduction

The Hy-Line W-36 layer accounts for 70% of all laying hens in the United States. Outside the Midwest United States, low-energy diets are often fed. While low-energy diets may not appear to supply sufficient energy, hens can regulate their feed consumption rate to maintain energy intake. Feeding low-density nutrient diets to laying hens may result in maintaining long-term egg production and egg weight. However, the Hy-Line W-36 strain of laying hen has a limited capability to increase its feed consumption to ensure adequate energy and nutrient intake (especially in hot weather). As a result, low-density diets may result in reduced egg numbers and/or egg weights. Given this background, the hypothesis of this study is that laying hens can respond to low-density diets by increasing feed consumption and thereby maintain energy and nutrient consumption to meet the needs for maximal egg production. Therefore, the objective of this study was to determine the effects of feeding diets of five different nutrient densities to Hy-Line W-36 hens on long-term egg production performance.

Materials and Methods

Four hundred and eighty Hy-Line W-36 pullets (18 wk of age) were placed in cages (61 cm wide x 58.4 cm deep; 445.3 cm^2/hen) and housed 8 hens per cage; with two adjacent cages of 16 hens equaling one replicate. Each replicate (2 side by side cages) was randomly assigned one of five dietary treatments (6 reps/treatment) with the control diet formulated to meet or exceed the recommended energy and nutrient levels in the 2009 Hy-Line W-36 management guide. The dietary treatments (Diets 1-5) were formulated by changing the nutrient densities of the control diet (100% of recommended nutrient density) to 85, 90, 95, 100, and 105% of recommendations, respectively (Table 1). All diets were formulated on a least-cost basis using corn grain, soybean meal, wheat middlings, corn distiller's dried grains with solubles, and/or soybean hulls. The experimental diets were fed in three phases to maximize egg production and egg weights to equal that which is published in the 2009 Hy-Line W-36 management guide. Egg production and mortality were recorded daily and feed consumption was measured every 2 wk. Eggs were collected over a 48-hr period and weighed every 2 wk for determination of egg weight. The experimental design was a randomized complete block design with location within house and initial body weight as blocking criteria. Data were analyzed using the GLM procedure of SAS with dietary treatment and block as independent variables. Treatment effects were evaluated using linear, quadratic, and cubic orthogonal polynomial contrasts. P values ≤ 0.05 were considered significant.

Results

In this study hens fed Diet 1 (85% of control) had to be switched to Diet 4 (control) at 31 wk of age. Thus, the data shown in Tables 2, 3 and 4 are for Diets 2, 3, 4, and 5 only. A significant linear response was seen in hen-day egg production (Table 2) in the third phase of the trial (31-70 wks of age) and in average over the length of the trial (18-70 wks of age), with diets 4 and 5 (100 and 105% nutrient density) having higher egg production than diets 2 and 3 (90 and 95% nutrient density). These differences could be seen starting at 32 wks of age. There was a significant linear increase in egg weight (Table 3) by 1-2 g over phases 2 (27-31 wks of age), 3 (32-70 wks of age), and in average over the length of the trial (18-70 wks of age). Eggs collected from hens fed diet 5 (105% nutrient density) were significantly heavier when compared to eggs laid by hens fed diets 2, 3, and 4 (90, 95, and 100% nutrient density). An increase in nutrient density showed a significant linear response in improved feed efficiency [g egg/g feed] (Table 4). Diet 5 (105% nutrient density) had the highest feed efficiency across all phases, with a peak in phase 2 (27-31 wks of age) of 0.58 g feed/g egg.

Discussion

This study showed that feeding Hy-Line W-36 hens diets with increased nutrient density seem to have a greater effect on egg production in later phases rather than early in the lay cycle. Lesson et al. (2001) saw similar results when birds fed diets with the lowest nutrient density produced the fewest eggs. Their results were significant in the third phase of the lay cycle starting at week 35. Lesson et al. (2001) also saw a trend in reduced egg size when diet nutrient density was reduced. However, their results showed small effects and were only significant at isolated measurements. They similarly reported that a decline in nutrient density showed a decline in feed efficiency. While this trial shared some similar results with that of Lesson et. al. (2001), it is important to take note that Lesson et al. (2001) used Shaver White layers rather than Hy-Line W-36 laying hens. Lesson et al. (2001) had issues with the Shaver White hens over-consuming feed, which is more unlikely to occur with the W-36 (Anderson 2007). The Hy-Line W-36 has a lower feed consumption in comparison to other strains of laying hens.

These results indicate that increasing nutrient density in the diet of a laying hen will increase egg production, egg weight, and feed efficiency. However, these benefits do not take effect in early production and seem to be most effective in later stages of the lay cycle. In addition to the above results, this study showed that if hens in a commercial setting are fed a lower nutrient dense diet than is recommended by the breeder, production performance may be comprised. Thus, the implications of this study to the commercial layer industry suggest that the proper nutrient dense diet should be fed particularly if Hy-Line W-36 hens are used.

References

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Table 1. Calculated analysis of experimental diets[1]

Calculated Analysis	Phase 1[2] Diets					Phase 2[3] Diets					Phase 3[4] Diets			
	1	2	3	4	5	1	2	3	4	5	2	3	4	5
Protein, %	19.66	19.89	20.87	21.56	22.62	18.63	18.67	19.15	19.80	20.68	16.94	17.28	17.90	18.31
ME_n, kcal/kg	2750	2817	2884	2950	30.17	2711	2777	2844	2910	2977	2757	2824	2890	2957
Calcium, %	4.24	4.43	4.65	4.88	5.13	3.86	4.04	4.23	4.44	4.68	4.02	4.21	4.42	4.65
Avail. Phos., %	0.53	0.55	0.58	0.61	0.64	0.48	0.51	0.53	0.56	0.58	0.46	0.48	0.51	0.53

[1]Diets 1-5 are 85, 90, 95, 100, and 105% of the control diet (Diet 4), respectively.
[2]Phase 1 diets fed from 18 to 26 wk age.
[3]Phase 2 diets fed from 27 to 31 wk of age.
[4]Phase 3 diets from from 32 to 70 wk of age. At 32 wk of age hens fed Diet 1 were switched to Diet 4.

Table 2. Hen-day egg production [%] of hens fed diets varying in nutrient density[1]

	Diet[2]						P		
Wk of age[3]	Diet 2	Diet 3	Diet 4	Diet 5	SEM	P	Linear	Quadratic	Cubic
18-26	65.630	66.582	68.722	66.038	0.7363	0.3903	0.5794	0.1913	0.3275
27-31	92.748^{b}	94.158^{ab}	96.993^{a}	94.435^{ab}	0.7185	0.1642	0.1830	0.1375	0.2466
32-70	84.283^{b}	83.065^{b}	87.730^{a}	88.622^{a}	0.6806	0.0092	0.0068	0.8875	0.0199
18-70	81.870^{bc}	81.280^{c}	85.983^{a}	84.622^{ab}	0.6413	0.0141	0.0115	0.7071	0.0235

^{a,b}Means within a row with no common superscripts differ significantly ($P<0.05$).
[1]Values are means for 6 replicate groups of 16 hens each.
[2]Diets 2-5 are 90, 95, 100, and 105% of the control (Diet 4).
[3]At 32 wk of age hens fed Diet 1 were switched to Diet 4 (control).

Table 3. Egg weight [g/egg] of hens fed diets varying in nutrient density[1]

	Diet[2]						P		
Wk of age[3]	Diet 2	Diet 3	Diet 4	Diet 5	SEM	P	Linear	Quadratic	Cubic
18-26	51.320	51.500	52.113	51.910	0.3631	0.3187	0.1196	0.5616	0.4003
27-31	56.092[b]	56.285[ab]	56.925[ab]	57.288[a]	0.3723	0.0841	0.0139	0.8057	0.6407
32-70	60.345[b]	61.340[ab]	61.040[b]	62.238[a]	0.3969	0.0253	0.0071	0.7958	0.1264
18-70	58.375[b]	59.152[ab]	59.098[ab]	59.977[a]	0.3750	0.0382	0.0076	0.8847	0.2707

[a,b]Means within a row with no common superscripts differ significantly (*P*<0.05).
[1]Values are means for 6 replicate groups of 16 hens each.
[2]Diets 2-5 are 90, 95, 100, and 105% of the control (Diet 4).
[3]At 32 wk of age hens fed Diet 1 were switched to Diet 4 (control).

Table 4. Feed efficiency [g egg/g feed] of hens fed diets varying in nutrient density[1]

	Diet[2]						P		
Wk of age[3]	Diet 2	Diet 3	Diet 4	Diet 5	SEM	P	Linear	Quadratic	Cubic
18-26	0.4033[b]	0.4083[b]	0.4117[ab]	0.4200[a]	0.3792	0.0291	0.0041	0.6429	0.6781
27-31	0.5500[b]	0.5567[b]	0.5583[b]	0.5750[a]	0.4423	0.0142	0.0027	0.3133	0.3655
32-70	0.4817[b]	0.4917[ab]	0.4933[ab]	0.5033[a]	0.4036	0.0139	0.0020	1.0000	0.3652
18-70	0.4733[c]	0.4817[bc]	0.4867[ab]	0.4950[a]	0.3834	0.0054	0.0006	1.0000	0.6847

[a,b]Means within a row with no common superscripts differ significantly (*P*<0.05).
[1]Values are means for 6 replicate groups of 16 hens each.
[2]Diets 2-5 are 90, 95, 100, and 105% of the control (Diet 4).
[3]At 32 wk of age hens fed Diet 1 were switched to Diet 4 (control).