Effects of a Pre-Molt Calcium and Low-Energy Molt Program on Laying Hen Production Before, During and Post-Molt

A.S. Leaflet R2448

Emily R. Dickey, graduate student; Anna K. Johnson, assistant professor; George Brant, professor; Rob Fitzgerald, graduate student; Ken Stalder, associate professor; Jack Dekkers, professor, Department of Animal Science; Kristjan Bregendahl, Nutritionist, Hy-Line International, Dallas Center, IA

Summary and Implications

The objectives of this study were to compare the production of laying hens when offered a Ca pre-molt treatment and low-energy molt diets versus a traditional feed-withdrawal (FW) before, during, and after an induced molt. A total of 792 Hy-Line W-36 laying hens (85 wk of age, 1.7 ± 0.2 kg), housed 3 per cage, (413 cm^2/hen) were used. Six treatments were compared in a 2 × 3 factorial design with 2 Ca (coarse and fine) pre-molt treatments and 3 molt diets: FW, soybean hulls (SH), and wheat middlings (WM). The Ca pre-molt treatment was defined as the period when the hens received either a combination of fine (0.14 mm in diameter) and coarse (2.27 mm in diameter) $CaCO_3$ or an all-fine $CaCO_3$ mixed into a commercial diet for 1 wk. Both diets were formulated to contain 4.6% Ca, such that only the particle size of the $CaCO_3$ differed between the 2 treatments. Hens had free access to feed and water and had a 24-h photoperiod. The 3 molt diets were applied for a total of 28 d. The hens assigned to the FW molt diet were deprived of feed for 7 d with free access to water followed by 21 d of skip-a-day feeding restricted to 60 g of feed/hen per feeding day. The hens fed the WM and SH molt diets were provided free access to feed and water during the entire 28 d molt period. Lighting was reduced to 8 h for the first 3 wk and was then increased to 12 h at the start of the last week of molt. During the 22 wk post-molt, hens were fed a laying hen diet and lighting was increased by 1 h each week to 16 h. The fine-Ca pre-molt treatment was more effective than the coarse-Ca pre-molt treatment at decreasing egg production during molt and increasing egg production after molt regardless of which molt diet was fed ($P < 0.05$). The FW molt diet resulted in the most complete molt with a greater decrease in egg production during molt ($P < 0.05$). The SH molt diet compared to the WM molt diet was more effective at inducing molt with lower egg production and ovary and oviduct weights during molt ($P < 0.05$), however, the WM molt diet resulted in the highest egg production and body weight post-molt compared to the other 2 molt diets ($P < 0.05$). In conclusion, a fine-Ca pre-molt treatment and a low-energy molt diet containing WM or SH can be useful alternatives to a FW molt.

Introduction

In commercial laying hens, molt is induced to allow for a second laying cycle, extending the productive life of the hen. During molt, egg production ceases and the reproductive tract regresses. Molt has been traditionally induced by a period of feed withdrawal (FW). However, this practice has recently raised concern for the well-being of the laying hen. In addition, industry groups have recommended that after January 1, 2006, producers implement only non-fasting molt programs. Previous research has reported the effectiveness of low-energy diets as alternatives to FW for inducing molt. Additionally, a fine-Ca pre-molt supplement may be effective at inducing molt by decreasing egg production. However, a pre-molt Ca treatment has not been previously examined in combination with an induced molt. Therefore, the objectives of this study were to compare the effects of a Ca pre-molt treatment followed by low-energy molt diets versus a traditional FW during and after an induced molt.

Materials and Methods

Animals and Location: A total of 792 Hy-Line W-36 laying hens (85 wk of age) weighing 1.7 ± 0.2 kg were used in this study. Research was conducted over 29 wk from July 2007 to February 2008 at the Iowa State University Poultry Research Center in Ames, IA. The project was approved by the Iowa State University Animal Care and Use Committee.

Diets, Housing and Husbandry: Laying hens were housed 3 per cage (30.5 cm wide × 40.6 cm deep × 44.5 cm high), providing 413 cm^2/hen. Wire flooring was used in all cages and each cage was equipped with a plastic self-feeder and a nipple drinker. All cages were located in 2 identical, light-controlled fan-ventilated rooms.

Treatments: Six treatments were compared in a 2 × 3 factorial arrangement with 2 Ca (coarse and fine) pre-molt treatments and 3 molt diets: FW, soybean hulls (SH), and wheat middlings (WM). The Ca pre-molt treatment was defined as the period when the hens received either a combination of fine (0.14 mm in diameter) and coarse (2.27 mm in diameter) $CaCO_3$ or an all-fine $CaCO_3$ mixed into a commercial diet for 1 wk. Both diets were formulated to contain 4.6% Ca, such that only the particle size of the $CaCO_3$ differed between the 2 treatments. Hens had free access to feed and water and had a 24-h photoperiod. The 3 molt diets were applied for a total of 28 d. The hens assigned to the FW molt diet were deprived of feed for 7 d with free access to water followed by 21 d of skip-a-day feeding restricted to 60 g of feed/hen per feeding day. The hens fed the WM and SH molt diets were given free access to feed and water during the entire 28 d molt period. Lighting was reduced to 8 h for the first 3 wk and was then increased to 12 h at the start of the last week of molt. During the 22 wk after molt, hens were provided with laying hen diets. This period was divided into the first 2 wk after molt and the following 20 wk according to diet recommendations from the 2007–2008 Hy-Line W-36 commercial management guide. Hens were given free access to feed and water and the lighting was increased by 1 h each week until reaching a 16 h photoperiod.

Production Parameters: Egg production was recorded daily. Eggs collected over a 24-h period were saved for weight determination every week and egg mass was calculated as egg production × egg weight. Feed consumption and body weight were recorded weekly until 4 wk after molt when these measures were recorded once every 3 wk. Feed utilization was calculated as grams of egg mass divided by grams of feed consumed. Egg specific gravity, egg components, and Haugh units were measured at various points before, during, and after molt on eggs collected over a 24-h period.

Statistical Analysis: The experimental design was a randomized complete block design with treatments in a 2 × 3 factorial arrangement with 2 Ca pre-molt treatments and 3 molt diets. The experimental unit was the cage (n = 264) containing 3 hens. The baseline model included treatment and block (based on initial body weight and cage location within the barn; 1 to 44). During the Ca pre-molt treatment, Ca treatment and block were used in the model. During and post-molt, the model included Ca pre-molt treatment, molt diet, the 2-way interaction of these, and block. Egg weight was included as a covariate due to a difference during the baseline period. The effect of the Ca pre-molt treatment was assessed using the main effect of the Ca treatment from the ANOVA table, whereas the effect of the molt diet was assessed by Fisher's least significant difference. A $P < 0.05$ was considered significant.

Results and Discussion

Pre-molt calcium treatment: None of the production parameters differed during the 1-wk Ca pre-molt treatment.

During molt: The Ca pre-molt treatments did not affect feed consumption, body weight, or egg weight, but the coarse-Ca pre-molt treatment resulted in higher ($P < 0.001$) egg production and feed utilization, and lower egg mass compared to laying hens allocated to the fine-Ca pre-molt treatment. Hens assigned to the FW molt diet had the lowest egg production, feed consumption, and egg mass during molt and hens fed the WM molt diet had the highest egg production and feed consumption and the lowest feed utilization ($P < 0.05$; Table 1).

Post-molt: The fine- and coarse-Ca pre-molt treatments had no effect ($P > 0.05$) on egg production, feed consumption, or body weight during the first 2 wk post-molt which suggests there are no immediate effects when returning to production. However, hens fed the fine-Ca pre-molt treatment had higher egg production, egg mass, and feed consumption during the following 20 wk post-molt ($P < 0.05$) compared to the coarse-Ca pre-molt treatment which suggests it was more effective at increasing production long-term after the molt period. Hens fed the WM molt diet had higher egg production and body weight compared to hens fed the other 2 molt diets during the first 2 wk post-molt, but egg production, egg weight, and egg mass did not differ ($P > 0.05$) during the following 20 wk post-molt. This increase in egg production and body weight in hens fed the WM molt diet immediately following molt can be explained by the incomplete drop in egg production and body weight during the molt period. The treatments did not differ in egg components, specific gravity, or Haugh units ($P > 0.05$) during the last 20 wk post-molt which suggests the treatments are comparable in their effects on egg quality post-molt.

Conclusions: In conclusion, a fine-Ca pre-molt treatment was more effective at inducing molt compared to the coarse-Ca pre-molt treatment due to lower egg production during molt and higher egg production post-molt. The FW molt diet resulted in the most complete molt with the lowest egg production during molt. The SH molt diet was more effective at inducing molt when compared to the WM molt diet measured by a greater decrease in egg production and body weight during the molt period. Therefore, these low-energy diets, particularly SH, can be useful alternatives to a FW molt.

Acknowledgements

We would like to thank the Midwest Poultry Research Program, the Iowa Egg Council, and ILC Resources for their financial support. Additionally, we would like to acknowledge ADM, Evonik Degussa Corporation, DSM Nutrition, Feed Energy Company, ILC Resources, and Sparboe Farms for in-kind contributions. We are grateful to the personnel in the Bregendahl and Johnson laboratories and we thank Jeff Tjelta and Bill Larson at the Iowa State University Poultry Science Research Center for their cooperation and support.

Table 1. Effects of treatments during the molt period on production of the laying hen[1].

	Treatments							
	Calcium pre-molt[2]		Molt diets[3]				*P*- values	
Measures	**Coarse**	**Fine**	**FW**	**SH**	**WM**	**SEM**	**Ca**	**Molt**
Feed consumption, g/d	36.7	36.0	26.1[a]	34.0[b]	48.9[c]	0.95	0.37	< 0.001
Feed utilization, g:g	0.691	0.557	0.713[a]	0.701[a]	0.457[b]	0.02	< 0.001	< 0.001
Body weight, kg	1.39	1.38	1.37[a]	1.35[b]	1.45[c]	0.01	0.19	< 0.001
Egg production, %	10.4	8.41	7.22[a]	8.86[b]	12.1[c]	0.58	< 0.001	< 0.001
Egg weight, g[4]	65.6	65.9	66.0	66.0	65.6	0.49	0.21	0.61
Egg mass, g[4]	19.6	23.0	22.8[a]	24.0[b]	22.9[b]	0.97	< 0.001	0.001

[1]Values are least squares means ± pooled SEM; n = 44.
[2]Calcium was supplied as either a combination of coarse and fine $CaCO_3$ or as an all-fine $CaCO_3$.
[3]Three molt diets were compared: feed withdrawal (FW), soybean hulls (SH), and wheat middlings (WM). The 7 d FW was followed by restricted (60 g/hen) skip-a-day feeding.
[4]Egg weight and egg mass were only measured during the last week of molt due to low egg production.
[a-c]Means without a common superscript differ within a row ($P < 0.05$).