BONE QUALITY PARAMETERS OF HENS EVALUATED DURING AND AFTER A SECOND MOLT

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ABSTRACT

In the present study, the effects of alternative molting compared to conventional (feed removal) and nonmolted treatments on bone quality parameters of Hy-Line W-36 hens submitted to a second molt at 142 weeks of age were evaluated. Treatments were, conventional molt (10 days fasting followed by cracked corn for 8 days and pullet developer diet for 10 days) and alternative molting treatments: soy hulls based diet (12% CP, 1455 ME kcal/kg, 1.38% Ca) for 14 days followed by cracked corn for 4 days and pullet developer diet for 10 days, the other three molt regimens consisted of feeding soy hulls during 4, 8 or 12 days followed by 10, 6 or 2 days respectively, of soy hulls based diet and 4 days of cracked corn plus 10 days pullet developer diet. Nonmolted (control) hens were fed laying hen diet. At 143, 146 and 175 weeks of age, birds (n=135, 9 replicates/treatment) were euthanized. The left tibia was retrieved for bone ash. Blood were taken on days 10 and 28 of molt, when birds were 143 and 146 weeks-old, respectively. Bone serum markers evaluated were total calcium (TCa), ionized calcium (iCa), plasma alkaline phosphatase (ALP) and lactate (L). Controls showed higher values for bone ash (37.12%) versus all molted hens at 175 wks. Treatment effect ($P<0.0001$) was observed for TCa, with the controls showing higher values (24.10 and 25.41 mg/dL at 143 and 146 weeks, respectively). For iCa, the lowest value (75mMol/L) was observed in birds submitted to the conventional molt.
KEYWORDS: alternative molt, bone markers, Hy-Line W-36; soy hulls

INTRODUCTION

The total feed withdrawal practice for inducing molt is being criticized considering the welfare of birds during molt. An induced molt using feed removal is a potential factor increasing structural bone loss in older laying hens (Kim et al. 2008). Additionally, the egg industry has been looking for alternative procedures for molting their flocks. One potential procedure is to maintain the birds on a low density diet (low protein and energy and high fiber diet) as a non-feed removal molting regime.

A third egg production cycle may be an option for the industry when the molt practice adopted is based on less aggressive alternatives as the non-fasting methods (conventional molt), considering the concerns of the welfare of laying hens. Recommendations for using these molting protocols should be accompanied by physiological parameters which indicate hen's welfare. In our previous studies (Mazzuco et al., 2009; 2010), similar physiological responses were observed for some blood metabolites and bone parameters in birds submitted to alternative and conventional molting methods.

In the present study, we assess bone ash and selected blood serum metabolites linked to bone quality in laying hens submitted to a second molt at the end of their 2nd laying cycle.

MATERIALS AND METHODS

All animal care procedures (protocol 009/09) were approved by the Brazilian Agricultural Research Corporation's (Embrapa) institutional animal care and use committee. The experiment was conducted at Embrapa's Research Farm facilities, located in Concordia, Santa Catarina State, Brazil.

Four hundred and fifty Hy-Line W-36 hens were housed two per cage (759 cm2/bird) when they were 140 weeks-old and molted at 142 weeks of age when they were assigned to 5 treatments, described on Table 1.

The experiment had a randomized complete block design and consisted of 9 replicates, each of 10 birds. The lighting program was reduced from 16.5 h following the decrease in the natural photoperiod (winter season).

At 143, 146 and 175 weeks of age, 135 hens (9 hens/treatment) were euthanized. The left tibia was retrieved for bone ash. For bone quality measurement, the left tibia was retrieved and cleaned of all tissue. The following bone traits were evaluated: bone ash (g) and bone ash (%). Samples of blood (5mL) were taken on days 10 and 28 of molt, when birds were 143 and 146 weeks-old, respectively. Bone serum markers were evaluated using a commercial kit. The analyzed variables were: total calcium (TCa), ionized calcium (iCa), plasma alkaline phosphatase (ALP) and lactate (L). All data were subjected to ANOVA considering the effects of day of molt, treatment and interactions.

Table 1. Experimental treatments

Treat. 1	Full fed (FF) birds
Treat. 2	(Conventional Molt) 10 d fasting plus cracked corn (8 d) and pullet developer diet (16.5% CP, 2960 kcal EM, 3.2% Ca) for 10 d
Treat. 3	Soy hulls based diet: 95% of soy hulls (12% CP, 1454 kcal EM, 1.79% Ca) for 10 d plus a corn based diet (12% CP, 3057 kcal EM, 2% Ca) and pullet developer diet (10 d)
Treat. 4	Soy hulls based diet: 85% of soy hulls (12% CP, 1639 kcal EM, 1.79% Ca) for 10 d plus a corn based diet and pullet developer diet (10 d)
Treat. 5	Soy hulls based diet: 75% of soy hulls (12% CP, 1824 kcal EM, 1.79% Ca) for 10 d plus a corn based diet and pullet developer diet (10 d)

RESULTS AND DISCUSSION

Results from bone ash measurements (Table 2) and bone markers evaluated in the blood (Table 3) indicated no significant treatment by age (day of molt) interaction effect, ($P>0.05$). For ash (g), treatment effect ($P<0.01$) was observed in all ages evaluated with higher values observed for treatment 4 (85% soy hulls based diet) on ages 143 e 175 weeks. Full fed birds (controls) showed higher values of bone ash (37.12%) versus the other molt treatments at 175 weeks of age. Overall, conventional molt and soy hulls based molt diets decreased bone parameters measured by conventional methods. Kim et al. (2008) observed that feed withdrawal and alfalfa molt diets decreased bone qualities measured by conventional methods during the 23 days postmolt. Treatment effect ($P<0.0001$) was observed for total calcium at both ages, when control birds showed higher values compared to the other treatments; for ionized calcium, hens under conventional molt showed the lowest value (0.75mMol/L) when they were 143 weeks-old. Availability of minerals for bone metabolism, undirected measured via plasma bone markers during molt was not apparently affected by the dietary treatments applied during molt. However, a decrease in ionized calcium observed in birds submitted to conventional molt, during its second week of molt (143 weeks of age), shows that the withdrawal of feed negatively affected the circulating levels of the mineral compared to the all other groups. Based on these results, we can infer that molt diets based on soy hulls can limit the adverse physiological effects observed during feed deprivation.

Table 2. Effect of type of molt on bone ash at different ages (means±SEM)

Age (wks)	Treat.1	Treat.2	Treat.3	Treat.4	Treat.5	Pr > F
Ash (g)						
143	2,64±0,12 [b]	2,26±0,08	2,67±0,08	2,70±0,16 [a]	2,43±0,09	0,0571
146	2,65±0,15 [b]	2,29±0,06	2,45±0,07	2,29±0,07 [b]	2,26±0,07	0,1403
175	3,24±0,32[* a]	2,62±0,05	2,68±0,08	2,85±0,16 [a]	2,57±0,09	0,0013
Ash (%)						
143	32,84±0,65 [b]	29,32±0,71[* b]	32,94±0,81	33,86±0,88 [a]	30,77±1,41	0,0089
146	33,50±1,13[* b]	29,33±0,69 [b]	31,01±0,63	29,23±0,35 [b]	29,27±0,72	0,0089
175	37,12±1,93[* a]	33,76±0,68 [a]	34,21±0,96	34,40±1,12 [a]	32,31±0,71	0,0165

*Means differ (P<0,05) by F test between control (T1) and molt treatments

[a,b] Means within columns with no common superscript differ (P<0,05)

Table 3. Effect of type of molt on biochemical markers (means±SEM) of bone metabolism

Age (wks)	Treat.1	Treat.2	Treat.3	Treat.4	Treat.5	Pr > F
Total Calcium (mg/dL)						
143	24,10±1,82*	21,47±1,67	19,44±1,65	19,45±1,60	17,13±0,78	0,0497
146	25,41±2,95*	18,31±1,34	17,87±1,74	15,47±1,15	14,23±1,11	0,0002
Ionized Calcium (mMol/L)						
143	0,82±0,08	0,75±0,04**	0,99±0,05	0,86±0,07	0,87±0,05	0,0268
146	1,29±0,08	1,17±0,02	1,19±0,04	1,16±0,01	1,18±0,02	0,3173
Plasma alkaline phosphatase (U/L)						
143	317± 50	452± 59	341± 35	404± 37	410± 52	0,0848
146	267± 35	228± 20	244± 30	237± 23	244± 19	0,9590
Lactate (Mmol/L)						
143	10,98±0,56	10,85±0,62	9,79±0,38	9,31±0,56	9,69±0,47	0,1672
146	9,59±0,60	10,38±0,62	10,95±0,60	9,54±0,41	10,56±0,54	0,3235

*Treatment effect by F test, P<0.05 (control vs molting treatments)

** Treatment effect by F test, P<0.05 (conventional molt vs alternative molting treatments)

CONCLUSION

Soy hulls based diets can limit some of the adverse effects that accompany feed deprivation during an induced molt on bone integrity, however at the end of the third cycle of production, bone quality was compromised indicated by the reduced bone ash content.

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