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Effects of Hen Age and Forced Molting Programs on Egg Quality Traits in Laying Hens

Ali Aygun[1*], Ramazan Yetişir[1]

[1]Faculty of Agriculture, Department of Animal Science, Selcuk University, Konya, 42075, Turkey

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ABSRACT

The aim of this study was to determine the effects of hen age and forced molting programs on egg quality during the postmolt period. The experiment was conducted using 320 Hy-Line W36 hens (63 and 75 week of age) randomly assigned to experimental groups (five replicates of eight hens for each treatment). The experimental design of the study was a 2 × 4 factorial arrangement of a completely randomized design. Eight treatments were compared in a 2 x 4 factorial arrangement with two age treatments (63 and 75 weeks of age) and four forced molting treatments [feed withdrawal (FW), 100% alfalfa (A), 50% alfalfa and 50% oats (AO), and 100% oats (O)]). The respective diet and water were allowed *ad libitum*, and hens were placed on an artificial lighting program of 8L:16D during the 10 d molt period. At 11 d, all hens were fed a layer diet and the lighting program was changed to 16L:8D. Three eggs from each replicate were analyzed for egg quality traits on every two weeks from week 3 to week 36 during the postmolt period. Hen age had no significant effect on egg quality traits in the postmolt period. Molting methods had a significant ($P<0.05$) effect only on egg weight during the postmolt period. The O group had significantly ($P<0.05$) greater egg weight than the FW group. However, there were no significant differences among molting treatments for shape index, specific gravity, shell strength, albumen height and Haugh units during the postmolt period. Our results indicate that hen age did not influence egg quality during the postmolt period. In addition, as a non-feed withdrawal method, especially the O program can be used successfully for forced molting.

1. Introduction

Molting is a natural phenomenon in birds during which body weight loss, a decrease in feed consumption, and cessation of laying occur (Yousaf and Chaudhry 2008). There are several forced molting methods. Feed withdrawal has been widely used in recent years due to the ease of application, as well as economical and acceptable performance (Bell 2003). However, animal rights groups have recently been pressing for an end to forced molting by feed withdrawal, claiming that feed withdrawal is highly stressful to the hen.

For this reason, researchers have examined alternative forced molting methods to feed withdrawal. These methods included high zinc concentrations (Alodan and Mashaly 1999; Bar et al. 2003; Sarica et at. 1996), low sodium concentrations (Berry and Brake 1985), wheat middlings (Biggs et al. 2003), barley (Onbasilar and Erol 2007), cottonseed meats (Davis et al. 2002), jojoba meal (Vermaut et al. 1997), alfalfa (Donalson et al. 2005; Landers et al. 2005a; Mcreynolds et al. 2006; Aygun and Olgun 2010), and oats (Kocak et al. 1980; Yetisir et al. 1985; Tona et al. 2002; Aygun and Yetisir 2009), which have been successfully used to induce molting. The feedstuffs used for alternative induced molting methods usually contain insoluble plant fiber and low energy (alfalfa, cottonseed, grape pomace, and wheat middlings).

Alfalfa is very high in crude fiber (20-24%), has a moderate protein level (17-20 %) and a low metabolizable energy (ME) value (1200-1600 kcal/kg) (NRC,

* Corresponding author email: aaygun@selcuk.edu.tr

1994), whereas oats contain insoluble high fiber (10-11%) and moderate energy (2500 kcal/kg) (NRC, 1994). For this reason, it may be used for alternative induced molting.

Egg quality is important for commercial egg producers. As the hen age increases, egg weight also increases while shell strength, shell thickness, albumen height and Haugh units decrease (Akbas et al. 1996; Fletcher et al. 1981). The aim of this study was to determine the effects of hen age and forced molting programs on egg quality during the postmolt period.

2. Material and Methods

A total of 320 Hy-Line W36 laying hens (63 and 75 week of age) were obtained from the Research and Application Farm at the Faculty of Agriculture at Selcuk University (Konya, Turkey). Hens were housed four hens per cage (500 cm^2/hen), and two weeks were allowed for acclimation. During this time, the hens were fed a layer diet (15% CP, 2800 kcal of ME/kg), and the photoperiod was 16L:8D. After acclimation, the hens were randomly assigned to experimental groups (five replicates of eight hens for each treatment). The experimental design of the study was a 2 × 4 factorial arrangement of a completely randomized design. Eight treatments were compared in a 2 x 4 factorial arrangement with two age treatments (63 and 75 weeks of age) and four forced molting treatments [feed withdrawal (FW), 100% alfalfa (A), 50% alfalfa and 50% oats (AO), and 100% oats (O)]). The respective diet and water were allowed *ad libitum*, and hens were placed on an artificial lighting program of 8L:16D during the 10 d molting period. At 11 d, all hens were fed a layer diet (15% CP, 2800 kcal of ME/kg) and the lighting program was changed to 16L:8D.

Three eggs from each replicate were analyzed for egg quality traits every two weeks from week 3 to week 36 during the postmolt period. All eggs were collected over a 24 h period. Prior to the measurement of egg quality, the eggs were stored for 1 d at room temperature (20±2 °C).

Egg weight was measured using an electronic digital balance and was recorded to the nearest 0.01 g. The length and width of eggs were measured with a micrometer caliper (accuracy 0.01 mm, Mitutoyo Corp., Japan). Egg shape index was calculated using the formula: egg shape index = (egg width / egg length) * 100 (Sarica and Erensayin 2009). Specific gravity was estimated by Archimedes' method (Wells 1968). Shell strength (kg) was measured with an Egg Force Reader (06-UM-001, Version B, Orka Food Tech. Ltd., Hong Kong, China). The height of the albumen was measured using an Egg Analyzer (05-UM-001, Version B, Orka Food Tech. Ltd.). The Haugh units were calculated from albumen height and egg weight using the following formula: Haugh unit = 100 log ($H + 7.57 - 1.7W^{0.37}$), where H is the albumen height (mm) and W is the weight of the egg (g) (Haugh 1937).

2.1. Statistical Analysis

Egg weight, shape index, specific gravity, shell strength, albumen height and Haugh units were analyzed using a general linear model (GLM). The least significant difference (LSD) test was applied to detect statistically significant differences between groups. All data are expressed as least square means. All analyses were carried out using Minitab (version 14, Minitab Inc., State College, PA).

3. Results and Discussion

The effects of hen age and forced molting programs on egg weight, shape index, specific gravity, shell strength, albumen height and Haugh units are shown in Table 1.

Hen age had no significant effect on egg weight in the postmolt period. However, there were significant ($P<0.05$) differences between forced molting programs for egg weight in the postmolt period. The O group (67.07 g) had significantly ($P<0.05$) greater egg weight than FW group (65.43 g), but was not significantly different from the A (66.37 g) and AO (66.03 g) groups in the postmolt period. On the other hand, there were no significant differences between the FW (65.43 g) and A (66.37 g) groups for egg weight in the postmolt period. This result agrees with the findings of Landers et al. (2005a) and Aygun and Olgun (2010), who reported that egg weights from hens molted using alfalfa were not significantly different from FW hens. On the other hand, Donalson et al. (2005) reported that egg weights were significantly ($P<0.05$) greater for FW (70.05 g) when compared with alfalfa (67.74 g) treatment. However, Landers et al. (2005b) reported that alfalfa group eggs (64.07 g) were significantly heavier ($P<0.05$) than feed deprived group eggs (59.03 g). There were no significant differences in egg weight among the molting programs during the postmolt period (Sarica et al. 1996; Petek et al. 2008; Wu et al. 2008).

No significant differences in the shape index were observed between 63 weeks (76.16%) and 75 weeks of age (76.62) in the postmolt period. Similarly, there were no significant differences among the FW (76.58%), A (76.27%), AO (76.51%) and O (76.21%) groups. Sarica et al. (1996) reported that no significant differences in the shape index were observed among molting programs during the postmolt period. However, Petek et al. (2008) stated that a significantly higher shape index was found in the barley group compared with the alfalfa molting group. The standard egg of a hen has a shape index of 74% (Romanoff and Romanoff 1949; Senkoylu 2001; Sarica and Erensayın 2009) with values ranging from 63.1 to 81.7 % (Romanoff and Romanoff 1949).

Neither age nor molting program had a significant effect on specific gravity during the postmolt period. Specific gravity was observed at 63 weeks (1.079) and

75 weeks of age (1.078). On the other hand, specific gravity was determined in the FW (1.079), A (1.079), AO (1.078), and O (1.078) groups. This result agrees with Wu et al. (2008) and Mejia et al. (2010), who stated that there were no significant differences in specific gravity due to molting method. However, Donalson et al. (2005) reported that FW hens (1.077) had significantly higher specific gravity when compared with molted alfalfa hens (1.076).

Table 1
Effects of hen age and molting programs on egg quality traits in the postmolt period

		Egg weight (g)	Shape index (%)	Specific gravity (g/cm^3)	Shell strength (kg)	Albumen height (mm)	Haugh unit
Age (week)	63	66.15	76.16	1.079	3.680	5.60	69.69
	75	66.30	76.62	1.078	3.667	5.71	71.39
SEM		0.26	0.16	0.0004	0.040	0.09	0.87
P- value		>0.05	>0.05	>0.05	>0.05	>0.05	>0.05
Molting Programs	FW	65.43^{b}	76.58	1.079	3.714	5.67	70.99
	A	66.37^{ab}	76.27	1.079	3.706	5.73	70.80
	AO	66.03^{ab}	76.51	1.078	3.631	5.73	71.27
	O	67.07^{a}	76.21	1.078	3.643	5.49	69.09
SEM		0.37	0.23	0.0005	0.056	0.13	1.23
P- value		<0.05	>0.05	>0.05	>0.05	>0.05	>0.05
63 week	FW	65.32	76.56	1.079	3.754	5.58	70.48
	A	65.89	75.79	1.079	3.671	5.74	70.48
	AO	66.00	76.32	1.078	3.641	5.70	70.80
	O	67.41	75.98	1.078	3.656	5.38	66.99
75 week	FW	65.54	76.60	1.078	3.674	5.76	71.49
	A	66.86	76.74	1.079	3.742	5.72	71.12
	AO	66.06	76.71	1.078	3.621	5.76	71.75
	O	66.73	76.44	1.078	3.630	5.60	71.19
SEM		0.52	0.32	0.0007	0.079	0.19	1.74
P- value		>0.05	>0.05	>0.05	>0.05	>0.05	>0.05

FW: Feed withdrawal, A: Alfaalfa, AO: 50% Alfalfa + 50% Oat, O: Oat

It is generally accepted that the specific gravity of an egg is a sufficient estimator of eggshell quality (Ingram et al., 2008). Higher specific gravity values are related to thicker eggshells, a desirable characteristic for the egg industry (De Ketelaere et al. 2002; Keshavarz and Quimby 2002).

Hen age had no significant effect on shell strength during the postmolt period. No significant differences in shell strength were observed among the FW (3.714 kg), A (3.706 kg), AO (3.631 kg), and O (3.643 kg) groups. Similar results were found by other researchers (Donalson et al., 2005; Landers et al. 2005b) who reported that no significant differences were obtained between FW hens and those molted with alfalfa regarding shell breakage in the postmolt period.

Hen age had no significant effect on albumen and Haugh units during the postmolt period. There were no significant differences between molting programs in terms of albumen height, and Haugh units. Landers et al. (2005b) stated that no significant differences were found between the FW and alfalfa groups for albumen height during the postmolt period. There were no significant differences among the molting programs for albumen height in the postmolt period (Sarica et al. 1996; Kucukyilmaz et al. 2003). The results of this study for Haugh units agree with the findings of Donalson et al. (2005), who reported no significant differences with respect to Haugh units following FW and alfalfa molting programs. Previous studies also stated that no significant differences were found among molting programs for Haugh units in the postmolt period (Sarica et al. 1996; Kucukyilmaz et al. 2003; Wu et al. 2007; Wu et al. 2008)

Haugh units are the primary indicator of quality in the egg industry (Biladeau and Keener, 2009); the higher the Haugh unit value, the better the albumen quality in the eggs (Stadelman 1995).

4. Conclusion

The results of this study indicate that hen age dose not influence egg quality during the postmolt period under our experimental conditions. The producer may be prefer to induce molting depend on egg prices and egg quality between 63 and 75 weeks of age without any deterioration in egg quality during the postmolt period. In addition, as non-feed withdrawal methods, especially the O program can be used successfully for forced molting.

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