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UTILIZATION OF GRAIN BARLEY AND ALFALFA MEAL AS ALTERNATIVE MOULT INDUCTION PROGRAMMES FOR LAYING HENS: BODY WEIGHT LOSSES AND EGG PRODUCTION TRAITS

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Summary

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A total of 54 Lohman, brown egg laying hens, older than 70 weeks of age, were used in this study. The hens were randomly divided into two treatment groups and a control group (in total 18 experimental units with 3 hens each; 473 cm^2 per bird). The hens in the first treatment group were fed 100% grain barley ration, while the second group received 100% alfalfa meal. The control group of hens received a commercial layer feed. The respective diets and water were allowed *ad libitum*, and the animals were housed in natural light during the 10-day moulting programme. The body weight changes of hens in the groups, moult and post-moult egg production, egg size, and mortality were determined. The most significant body weight loss (19.54%) occurred in the alfalfa fed hens, while in grain barley fed hens the lost was calculated as 17.54% at the end of moulting period. Significant differences were found for egg production and cracked egg percentage between non-moult control and moulting treatment groups. There were no significant differences between moult and post-moult average periods egg weights and mortality rates in all groups. Based on the results of the study, grain barley appeared to be the best alternative to non-feed removal moulting methods.

Key words: alfalfa meal, egg production, grain barley, laying hens, moulting

INTRODUCTION

The forced moulting of laying hens is an economic practice (McDaniel & Aske, 2000) extensively employed by Turkish egg producers in order to reduce costs and maximize profits (Petek, 2001). Most commercial forced-moulting programmes entail food withdrawal for different periods (Ruszler, 1996; Narahari, 2001). Forced moulting may be economically beneficial, but its inhumane practices also raise difficult ethical questions. The stress of feed withdrawal leads to immune suppression (Alodan & Mashaly, 1999), and results in increased flock susceptibility to *Salmonella* (in particular *Salmonella Enteritidis*) infection (Barbour *et al*., 2004; Kubena *et al*., 2005). It is also detrimental to the skeletal integrity of hens (Mazzuco & Hester, 2005). These difficulties and consumer pressure has resulted in non-fasting moulting procedures, which provide laying hens with access to feed during moult (Koelkebeck & Anderson, 2007). Feed withdrawal is banned in Europe, and is rarely practiced in the USA or Canada (Hester, 2005).

"Non-fasting" or "non-feed removal" methods for moulting laying hens are new to commercial egg industry. Previous data suggest that alfalfa can potentially be combined with layer ration to limit *Salmonella Enteritidis* infection and still induce a moult comparable with feed withdrawal (McReynolds *et al*., 2006). McCovan *et al*. (2006) suggest that non-fast induced moulting treatments provide an effective method for inducing moulting in hens and improving their well-being by minimizing discomfort due to food deprivation.

Some non-feed removal methods have been previously studied (Biggs *et al.,* 2003; 2004; Donalson *et al.* 2005; Landers *et al.* 2005a, 2005b), but none of them was found suitable for use in commercial programs due to inconsistent results. Considering these facts, we investigated whether grain barley and alfalfa meal would effectively induce moulting and also monitored their influence on egg production and quality in the early phase (first 10 weeks) of the second cycle of egg production (Petek *et al.*, 2008). The influence of non-feed removal moulting methods on the weight of ovary, oviduct and skeletal quality of hens was examined too (Yildiz & Alpay, 2008).

The aims of this research were to examine the body weight losses of hens subjected to non-feed removal moulting programmes by feeding grain barley and alfalfa meal and to monitor egg production under moulting and early post-moult period.

MATERIALS AND METHODS

Moulting Procedure

Fifty-four Lohman Brown laying hens older than 70 weeks of age were housed in traditional battery cages (six replicate groups of 3 hens each, 473 cm^2 per bird). The hens were provided *ad libitum* access to a complete layer ration and water for a period of 2 weeks to ensure that all hens were healthy and in active production. After the acclimatization was complete, all birds were randomly divided into three groups and they were allowed *ad libitum* access to water and their respective diets during the moulting period. The hens in the first and second treatment groups were fed complete grain barley and alfalfa meal rations, respectively. Hens in the non-moult control group were fed layer ration. The moulting programme lasted for 10 days. Afterwards, the animals were allowed *ad libitum* access to a complete layer ration and water until the end of cycle (ten weeks). Light was reduced to 10 h (only natural light) during the 10-day moulting programme. A lighting programme of 16 h light/8 h dark was used in the post-moult laying period.

Parameters

Individual body weights of hens in each group were measured at days 0, 3, 5, 7, 9 of moulting and at 1-week intervals until post-moult day 36. Egg production performance was measured for 10 weeks following initiation of feed removal. Egg production and feed consumption values were recorded on daily and biweekly basis from the beginning to the end of the experiment, including the moulting period. Mortality was recorded on "per group basis" as it occurred. Egg weights were weekly measured on all eggs collected in a 1-day period. Egg production and feed intake of the hens in the groups were calculated on the basis of number of hens at the beginning of experiment (hen-housed) as previously described (North & Bell, 1990).

Statistical Analysis

Results for all the traits measured are expressed as mean values ± SEM. Data were analyzed by analysis of variance procedures. Duncan test was used to determine significant differences among treatment means (Snedecor & Cochran, 1989). Statistical analysis was performed using SPSS v. 13.00 (2004). Significance implied a probability value of $P < 0.05$.

RESULTS

Pre-moult (in the beginning of the moulting programme), moult and post-moult body weights of hens fed the grain barley or alfalfa meal diets and non-moult controls are presented in Table 1. There were no significant differences among the groups with regard to the pre-moult body weight. Both treatment groups exhibited significant differences in percentage body weight lost during the moulting programme. The most significant loss (19.54%) occurred in the alfalfa fed hens, while grain barley fed hens lost 17.54% of their body weight at the end of moulting period. Hens fed layer ration (non-moult controls) gained 1.80% of body mass in the same period.

The results for moult and post-moult period egg production traits are shown in Table 2. Significant differences were found between the non-moult control and moulting treatment groups for egg production and cracked egg percentage. There were no significant differences between moult and post-moult average egg weights and mortality rates in all groups. No sig-

Table 1. Pre-moult, moult and post-moult body weights and cumulative body weight changes in Lohman Brown laying hens, submitted to non-feed removal moulting procedures by feeding either grain barley or alfalfa meal, and in non-moult controls. Data are presented as means ± SEM

Period	Grain barley (n=18)		Alfalfa meal (n=18)		Non-moult control (n=18)	
	Body weight		Body weight		Body weight	
	g	change, %	g	change, %	g	change, %
Pre-moult period,	2024±54		2134±76		2056±39	
Moult period						
day 3	1833±51 [b]	−9.43	1859±65 [b]	−12.88	2056±41 [a]	0.00
day 5	1701±50 [b]	−15.95	1776±64 [b]	−16.77	2080±31 [a]	+1.16
day 7	1681±51 [b]	−16.94	1743±63 [b]	−18.32	2100±43 [a]	+2.14
day 9	1675±50 [b]	−17.24	1717±56 [b]	−19.54	2093±38 [a]	+1.80
Post-moult period						
day 15	1983±37 [b]	−2.02	2065±67 [ab]	−3.23	2184±35 [a]	+6.22
day 22	2100±42	+3.75	2221±67	+4.07	2202±40	+7.10
day 29	2113±44	+4.39	2241±91	+5.01	2221±35	+8.02
day 36	2154±47	+6.42	2245±98	+5.20	2245±38	+9.19

Values with different superscript (a, b) within rows differ significantly at P<0.05.

Table 2. Molt and post-molt egg production traits in Lohman Brown laying hens, submitted to non-feed removal moulting procedures by feeding either grain barley or alfalfa meal, and in non-moult control. Data are presented as means ± SEM

Parameter	Period	Grain barley (n=18)	Alfalfa meal (n=18)	Non-moult control (n=18)
Egg production, %	Moult	$15.20{\pm}1.15^{b}$	$27.30{\pm}2.11^{b}$	$61.60{\pm}1.41^{a}$
	Post-moult	$55.40{\pm}1.89^{b}$	$47.00{\pm}1.88^{b}$	$67.26{\pm}1.31^{a}$
Cracked eggs, %	Moult	$24.24{\pm}0.99^{a}$	$40.00{\pm}0.88^{a}$	$5.07{\pm}1.87^{b}$
	Post-moult	$6.11{\pm}1.01^{b}$	$14.63{\pm}1.31^{a}$	$5.17{\pm}2.18^{b}$
Average egg weight, g	Moult	76.07±3.91	75.41±2.56	75.65±1.87
	Post-moult	78.11±5.67	75.13±4.76	73.44±3.22
Cumulative mortality, %	Moult	5.55	5.55	0.00
	Post-moult	5.55	5.55	0.00
Daily feed intake, g	Moult	not evaluated	not evaluated	not evaluated
	Post-moult	125.43±3.55	110.34±4.25	115.14±3.89

Values with different superscript (a, b) within rows differ significantly at P<0.05.

nificant differences were found for post-moult daily feed consumption in all groups.

DISCUSSION

The goals of a successful moult are 1) about 20–25% body weight loss, 2) cessation of lay long enough for total regression of the reproductive tract, and 3) acceptable and persistent second cycle performance (Scheideler & Beck, 2002). In this study, the hens in the two moulting treatment groups exhibited inadequate body weight losses probably due to improper palatability effects of novel diet. Total body weight of moulted hens at the end of moulting period decreased significantly to 17.24 and 19.54% of the initial body weight for grain barley and alfalfa meal groups, respectively. Grain barley treatment resulted in lower body weight loss than alfalfa meal treatment.

Hens in the treatment groups did not leave lay as quickly in this study compared to the traditional fasting moult (Ruszler, 1996; Scheideler & Beck, 2002). The grain barley and alfalfa moulting treatments resulted in no total cessation of egg production within the 10-day moulting period. The moult hen-housed egg production in all groups was 15.20, 27.30, and 61.60% for grain barley, alfalfa meal and control groups, whereas the 10-week post-moult hen-housed egg production was 55.40, 47.00, and 67.26% in the groups, respectively. The best post-moult egg production in moulting group occurred after grain barley treatment. Unmoulted hens fed layer ration had a significantly higher level of moult and post-moult egg production than hens moulted by either grain barley or alfalfa meal. This may stem from low body weight loss in the moulting groups because weight loss is closely associated with reproductive tract regression and egg production was negatively correlated to body weight loss (Buhr & Cunningham, 1994). Achieving adequate weight loss and cessation of lay will probably take longer in a non-feed removal moulting programme than in the traditional fasting moult programme.

Egg breakage was markedly increased by inducing moult in both treatment groups due to dietary imbalance of a particular nutrient or nutrients in moult period, particularly Ca (Berry, 2003). The rate in the alfalfa meal group was greater than in the other groups during the moulting and post-moulting period. In this study, cracked egg percentage in all groups, including the non-moult controls was found to be greater than standard values (North & Bell, 1990).

Although there were no significant differences for daily hen-housed post-moult feed intake among the groups, feed intake per hen in the alfalfa group was found to be numerically lower than the other groups. Since the feed intake in moulting groups was very low, feed intake values regarding the moult period were not evaluated. As expected, post-moult mean egg weight in the groups was much higher than in non-moult control hens (Petek, 2001; Aksoy *et al.*, 1987). There were similar moult average egg weights when birds were fed the grain barley and alfalfa diets in the experiment. In this study, only 2 birds died during the moulting period in the treatment groups. Total mortality at the end of experiment was 5.55% for both experimental groups. The rate of mortality during a moult varies due to factors such as the health and vigour of the flock, season of the year, age of the flock, and the flock's previous mortality rate. A properly culled flock should only have a very moderate rise in mortality (Ruszler, 1997).

In general, compared to unmoulted birds, moulted ones exhibited increased productivity and better feed efficiency (Alodan & Mashaly, 1999). Although early post-moult performance of hens in non-feed removal groups was not at accepted level the technique may provide satisfactory results in a long term period if there is no other more performant technique. This is consistent with the finding of Landers *et al.* (2005) who reported that early post-moult production (0–7 weeks) of moulted hens was lower than that of unmoulted hens. It is probable that prolongement of post-moult laying period results in higher egg production level in the moulting group.

Due to increasing public awareness regarding animal welfare issues with feed withdrawal moult induction, alternative non-feed removal moulting techniques are becoming much more important for the commercial egg laying industry in the future. The egg quality, bone and reproductive traits examined by us (Petek *et al.*, 2008; Yildiz & Alpay, 2008) indicated that satisfactory performance could be achieved from non-feed removal methods, particularly by a grain barley moulting programme. Further studies would be useful to investigate the effects of grain barley and alfalfa meal on long-term post-moult egg production traits.

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