AgroLife Scientific Journal - Volume 11, Number 2, 2022
ISSN 2285-5718; ISSN CD-ROM 2285-5726; ISSN ONLINE 2286-0126; ISSN-L 2285-5718

THE USE OF MARBLE POWDER IN MOLTING PROGRAMS IN LAYING HENS

Fatih YILDIRIM

University of Atatürk, Veterinary Medicine, Yakutiye, Erzurum, Turkey

Corresponding author email: fatihyildirim@atauni.edu.tr

Abstract

Molting is a common practice used by the commercial egg industry to rejuvenate flocks. The aim of this study was to evaluate the effect of marble powder on egg production performance of laying hens during premolt and postmolt periods. For this purpose, 69126 Hy-Line White 36 (W-36) laying hens (80 weeks old) were obtained from a commercial egg production farm. All of the chickens who lived to 90 weeks of age were subjected to the forced molting program. The time of the molting program was determined according to the body weight loss of the chickens. On the tenth day of the molting program, when hens in the group had lost an average of 23.10% of their body weight, feeding was resumed. Egg production performance was tracked for hens who lived to 100 weeks of age. It was observed that egg production (% hen-day) ranged from 42.69 to 69.51%, 0 to 51.59% and 0 to 74.68% in the premolt, molt and postmolt periods, respectively. The results of this study suggest that the addition of marble powder to forced molting programs of laying hens has a beneficial effect on egg production, particularly during the postmolt period.

Key words: *feed supplements, layer, molt.*

INTRODUCTION

Induced molting of laying hens can provide significant economic benefits for egg production farms by extending the productive life of hens (Gongruttananun et al., 2017). Forced molting in adult hens causes the loss and renewal of feathers, stops egg production, and slows reproductive processes (Park et al., 2004). The subsequent year's egg production is increased. Also, to avoid the cost of replacing pullets, producers may use different molting programs with older flocks (Sariözkan et al., 2016). Critical evaluation of molting programs can help producers decide whether to buy new hens or apply molting programs to older chickens.

Conventional molting programs cause rapid loss of the hen's body weight (Bland et al., 2014) by reducing the hours of exposure to light (Hambree et al., 1980) and withdrawing feed (Christmas et al., 1985) and water (Brake & Thaxton, 1982). Different molting methods can be applied, including the complete withdrawal of food, essentially starving the hens periodically; feeding with cereals such as barley, wheat, and crushed corn; adding zinc oxide and hormones to the diet without limiting feed; and limiting the length of the lighting period (Mccormick & Cunningham, 1987; Alodan & Mashaly, 1999).

For a forced molting program to be successful, the starvation period and the subsequent mortality rate should be low. Egg production should resume in a short time after molting and then increase rapidly. It has been reported that the withdrawal method can be applied successfully in the poultry industry, and that this method leads to satisfactory results in terms of yield criteria in the second year of production (Küçükyılmaz et al., 2003). Many producers no longer use starvation periods during molting programs because of concerns for animal welfare. However, there are still some producers who continue to practice this method. Egg production performance in the postmolt period is important for commercial egg producers. Egg production drops during the molting period; however, once production resumes after molting is completed, production rates may be higher than 1st cycle. Some researchers have found that the rate of egg production (hen-day) after molting increased 86.46 to 87.82% (Single Comb White Leghorn hens, 85 to 106 weeks of age) (Bozkurt et al., 2016), while others have found that production rates improved 80.68 to 88.41% (Brown laying hens, 81 to 95 weeks of age) (Gongruttananun et al., 2017). Also, postmolt hen-day egg production (5-41 weeks) in the experiment conducted using Hy-Line W-36 hens (68 weeks of age) increased 70 to 73% (Bland et al., 2014). Brown layers produced 61.2% more at the beginning of molting (80-82 weeks), 6.3% more during molting (82-86 weeks) and 60.4% more during postmolting (86-90 weeks), in terms of hen-day production (Zhao et al., 2016).

Some researchers have stated that *S. enteritidis* invasion and colonization may be directly related to the rapid kinetics of feed withdrawal and its effects on microbial ecology and crop microenvironments during molting (Ricke, 2003). The use of diets that are either low in calcium and low in zinc, or high in zinc, have been shown to reduce the occurrence of this condition in hens (Kubena et al., 2001; Ricke et al., 2001).

The calcium needs of poultry are tried to be met by calcium carbonate, which is also known as limestone or marble powder (Guinotte et al., 1991). Also, the calcium appears to play a pivotal role in molt induction as calcium carbonate feeding prolongs ovulation during the initial stages of an induced molt (Brake, 1993).

Different materials (barley, wheat, etc) have been used to induce molting programs. The aim of this study was to investigate the impact on egg production performance when marble powder is used during forced molting process in Hy-Line W-36 laying hens.

MATERIALS AND METHODS

Throughout the experiment, ethical practices were followed to assure that the welfare of the birds was monitored and maintained. Experimental procedures were approved by the Ethics Committee for Experiments on Animals in Faculty of Veterinary of Atatürk University (Approval no. 28).

In this experiment, the data of 69126 Hy-Line W-36 laying hens (80 weeks old) were obtained from a commercial egg production farm (BAY-TAV TAVUKCULUK, Turkey).

From week 80 until week 90, all chickens were provided with a lighting program of 17 hours of light and 7 hours of darkness per day and given *ad libitum* access to feed and water. Environmental temperature and relative air humidity were maintained at 20-24ºC and 60-70%, respectively. The nutrient composition of the hens' diets is presented in Table 1.

Table 1. Ingredients and nutrient composition of commercial laying diet in the premolt period

Items	%
Corn	61.90
Full fat soybeans	5.70
Soy bean meal	17.00
Sunflower meal	2.50
Salt	0.36
Dicalcium phosphate	1.50
Marble powder	9.69
Fish meal	1.00
Vitamin premix	0.25
Mineral premix	0.10
ME (kcal/kg)	2710
Crude protein, %	17

Before the molting program started, all chickens were introduced to 48 hours of light exposure. The time of the molting program beginning at the 90th week was determined according to the body weight loss of the chickens (Table 2). To determine the body weight loss of the entire flock, before the molting program began, 98 chickens were randomly selected, and they placed in wire cages (40 cm W x 80 cm L x 40 cm H, seven hens per cage) as a group, for a total of fourteen groups (7 hens/group).

Table 2. Molting programs used in the study

Days	Marble Powder	Light time (h/day)	Body Weight lost (%)
1	25 g/hen	2	-
2	25 g/hen	2	-
3	-	10	-
4	-	10	10.40
5	25 g/hen	10	-
6	-	10	15.60
7	30 g/hen	10	-
8	-	10	18.70
9	-	10	20.05
10	-	10	23.10

- : No implementation

Then, the body weight of those (98 hens) were recorded from the first day to tenth day of the molting program. At the 10th day of the molting program, the 98 hens lost an average of 23.10% of their body weight. All other hens were subjected to molting program according

to the body weight results from the group. All of hens feed was withdrawn on the first day of the molting program, at the 11th day began to be given again. On the 11th day after the molting period was completed, the daily photoperiod was increased to 12 hours per day. On the 18th day, it was increased to 14 hours per day. The photoperiod was increased 30 minutes per week thereafter until a 17-hour photoperiod was established.
In this study, in addition, daily mortality, calculated using hen-day mortality, was recorded from the week 80 to week 100 for all hens.
Egg production performance started to be measured at the 80th week, before the onset of forced molting at the 90th week. These measurements continued until 100th week. Egg production was recorded daily during the 21-week trial period. The number of standard, i.e. medium and large eggs (53-73 g), jumbo, i.e. extra-large eggs (greater than 73 g), cracked eggs and dirty eggs (calculated using hen-day egg production) were counted throughout the experiment.

Statistical analysis
The data related to the effect of egg productions were analysed by ANOVA using the GLM procedure of SPSS Statistics 20. When the influence of egg productions was stated by ANOVA test, Tukey's post-hoc test was applied to compare the means of each group. Statistical differences were considered significant when the p-value is less than 0.05.

RESULTS AND DISCUSSIONS

Figure 1 shows percentage changes in weekly egg production. Egg production (% hen-day) through the experimental period ranged from 42.69 to 69.51%, 0 to 51.59% and 0 to 74.68% in the premolt, molt and postmolt periods, respectively. This effect of the marble powder in postmolt period of the egg production is remarkable. The complete cessation of egg production occurred after eight days of the molting period. Birds were returned to lay eggs 23 days after the onset of the molt period.
The experimental period included premolt, molt and postmolt periods. The premolt period was during 80 to 90 week of age, molt period was 90 to 92 week of age, whereas that for postmolt period was during 92 to 100 week of age. x : for premolt period, y : for molt period, and z : for postmolt was highest hen-day egg production percentage in their own period (Figure 1).

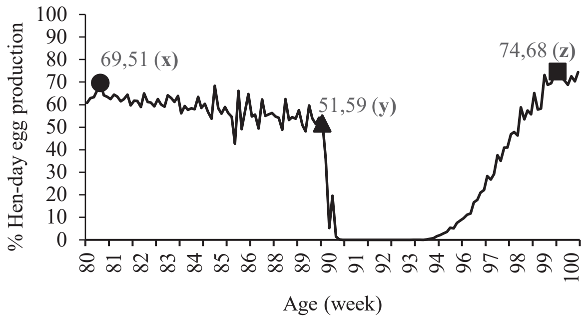

Figure 1. Average weekly percentage hen-day egg production of the experimental hens through the experimental period

Table 3 shows the percentage increase in weekly production of standard, cracked, jumbo, dirty and total eggs during the premolt and postmolt periods. During the premolt period, production of standard and total eggs in week 80, jumbo eggs in week 82 and cracked eggs in week 83 were all significantly higher than in other weeks. However, there were no significant differences in dirty egg production in the premolt period.

Table 3. Egg production parameters during the premolt and postmolt period

Items		Eggs % Hen-day egg production				
		Standard	Cracked	Jumbo	Dirty	Total
Premolt period (week)	80	61.57^{a}	1.14^{abc}	1.00^{bc}	0.00	64.43^{a}
	81	59.71^{ab}	1.14^{abc}	1.57^{ab}	0.00	62.57^{ab}
	82	57.71^{abc}	1.43^{ab}	1.86^{a}	0.00	61.29^{abcd}
	83	58.43^{abc}	1.57^{a}	1.57^{ab}	0.00	61.86^{abc}
	84	55.71^{abc}	0.86^{bc}	1.57^{ab}	0.14	58.86^{abcde}
	85	56.86^{abc}	1.14^{abc}	0.86^{bc}	0.00	58.86^{abcde}
	86	54.86^{abc}	1.00^{abc}	0.00^{d}	0.00	55.86^{bcde}
	87	54.57^{abc}	0.57^{c}	0.00^{d}	0.00	55.57^{cde}
	88	53.00^{bc}	0.86^{bc}	0.29^{cd}	0.00	54.43^{de}
	89	52.00^{c}	1.00^{abc}	0.71^{cd}	0.00	53.71^{e}
Average		56.44	1.07	0.94	0.01	58.74
SEM		0.569	0.055	0.095	0.014	0.615
P-value		0.001	0.001	0.000	0.450	0.000
Postmolt period (wk)	95	4.71^{e}	0.00^{b}	0.00^{b}	0.00^{b}	5.14^{e}
	96	15.00^{d}	0.14^{b}	0.00^{b}	0.00^{b}	15.86^{d}
	97	32.00^{c}	1.14^{a}	1.00^{a}	0.00^{b}	34.14^{c}
	98	49.57^{b}	1.14^{a}	1.00^{a}	0.00^{b}	52.29^{b}
	99	63.71^{a}	1.00^{a}	0.86^{a}	0.86^{a}	66.43^{a}
	100	69.43^{a}	1.00^{a}	1.00^{a}	0.43^{ab}	72.00^{a}
Average		39.07	0.74	0.64	0.21	40.98
SEM		3.804	0.084	0.075	0.073	3.941
P-value		0.000	0.000	0.000	0.000	0.000

$^{a-e}$: Values within the same column with different superscript differ significantly ($P < 0.05$)

During the postmolt period, there were significant differences in the production of standard, jumbo, cracked, dirty and total eggs. Weekly egg production rates during 99 and 100 weeks of age were significantly higher than in other postmolt periods.

The mortality rate of birds in premolt and postmolt periods was low, ranging from 0.01 to 0.04%. However, during the molt period this rate increased to 0.57%.

Marble powder is typically used as a calcium source in the composition of basal diets fed to laying hens (Lukic et al., 2009). Therefore, the marble powder was deemed safe and its use may also prevent illnesses such as such as *S. enteritidis* invasion and colonization during molting (Ricke, 2003), while allowing a diet that is low in calcium and allowing the preservation of eggshell quality (Lukic et al., 2009).

In order to achieve success in molting programs, it is necessary to achieve a certain reduction (20 to 30%) in the body weight of laying hens while minimizing mortality rates. In the current study, the mortality rate of hens throughout the experimental period was low, ranging from 0.01 to 0.57%. This mortality rate was lower than in previous studies; for example, Brown laying hens (72 weeks of age) had mortality rates ranging from 2.22 to 3.33% (Gongruttananun et al., 2017), and White Leghorn hens (82 weeks of age) had mortality rates ranging from 2.80 to 3.55% (Bozkurt et al., 2016). In addition, in successful molting programs, certain goals for reduction in body weight must be achieved to reach increased productivity in the second laying cycle (Sariözkan et al., 2016. During the first ten days of molting, desired levels of body weight losses ranged from 20 to 30%, as previously reported (Baker et al., 1983; Hüssein, 1996; Webster, 2003; Kara & Güçlü, 2012; Sariözkan et al., 2016). In this study, average body weight loss was 18.70% on the eighth day the molt period; on the tenth day molt period, it was 23.10%.

During the molting period, egg production stopped after eight days of fasting. This finding is similar to findings from Cunningham & McCormick (1985), who reported that fasted breeders took five to eight days to stop producing eggs, and El-Deek & Al-Harthi (2004), who found that egg production ceased after eight days of fasting. Moustafa et al. (2010) found that complete cessation occurred after nine days of fasting.

Postmolt egg productivity is typically correlated with body weight loss; moreover, egg production decreased during the 28th day of molt period (Bland et al., 2014). In this study, egg production performance increased 50% on the day 25th day of the postmolt period.

The weekly egg production results in the current study are in agreement with reports from researchers (Gongruttananun et al., 2017) who have noted that molted hens returned to egg production at slow rates after receiving the diet, and then rapidly increased production during the postmolt period. In this experiment, the rate of hen-day egg production was higher than in the premolt period in terms of total eggs, especially during weeks 99 and 100.

In this study, hen-day egg production (%) in the postmolt period was lower than egg production observed by other researchers (Bozkurt et al., 2016; Gongruttananun et al., 2017) and was similar to week 100 of the postmolt period (Bland et al., 2014). However, egg production during weeks 99 and 100 in the postmolt period was higher than results reported by other researchers (Zhao et al., 2016). These differences are likely to be related to factors such as the laying hens' genetic strains, laying ages, and the composition of experimental diets.

CONCLUSIONS

The results of this study suggest that the addition of marble powder to the diet of laying hens in forced molting programs have a beneficial effect on egg production, particularly during the postmolt period. In the research, after molting with marble powder at the 90th week, results above the egg yield values in the premolt period were obtained in the postmolt period. However, nowadays, molting programs are gradually turning practice with more roughage. For this reason, it can be recommended to carry out research involving the use of marble powder, which is used as a feed additive, with roughage.

ACKNOWLEDGEMENTS

The authors thank the commercial egg production farm (BAY-TAV) and Betül Apaydin for their support of this study.

REFERENCES

Alodan, M. A. & Mashaly, M. M. (1999). Effect of induced molting in laying hens on production and immune paramaters. *Poultry Science,* 78, 171-177.

Baker, M., Brake, J., Mcdaniel, G. R. (1983). The relationship between body weight loss during an induced molt and postmolt egg production, egg weight and shell quality in caged layers. *Poultry Science,* 62, 409-413.

Brake, J. (1993). Recent advances in induced molting. *Poultry Science*, 72, 929-931.

Bland, K., Utterback, P., Koelkebeck, K., Parsons, C. (2014). Evaluation of feeding various sources of distillers dried grains with solubles in non-feed-withdrawal molt programs for laying hens. *Poultry Science*, 93, 1421-1427.

Bozkurt, M., Bintaş, E., Kırhan, S., Akşit, H., Küçükyılmaz, K., Erbaş, G., Çabuk, M., Akşit, D., Parın, U., Ege, G., Koçer, B., Seyrek, K., Tüzün, A. E. (2016). Comparative evaluation of dietary supplementation with mannan oligosaccharide and oregano essential oil in forced molted and fully fed laying hens between 82 and 106 weeks of age. *Poultry Science,* 95, 2576-2591.

Brake, J. & Thaxton, P. (1982). Comparative effect of photoperiod modification and / or fasting with a short period without water on physiological and performance parameters associated with molt in SCWL hens. *Poultry Science,* 61, 1423-1424.

Christmas, R. B., Harms, R. H., Junqueria, O. M. (1985). Performance of single comb white Leghorn hens subjected to 4 or 10-day feed withdrawal force rest procedures. *Poultry Science,* 64, 2321–2324.

Cunningham, D. L., McCormick, C. C. (1985). A multicycle comparison of dietary zinc and feed removal, molting procedures, production and income performance. *Poultry Science,* 64, 253-260.

El-Deek, A. A. & Al-Harthi, M. A. (2004). Post molt performance parameters of Broiler breeder hens associated with molt induced by feed restriction, high dietary zinc and fasting. *International Journal of Poultry Science,* 3, 456-462.

Gongruttananun, N., Kochagate P., Poonpan, K., Yu-Nun, N., Aungsakul J., Sopa, N. (2017). Effects of an induced molt using cassava meal on body weight loss, blood physiology, ovarian regression, and postmolt egg production in late-phase laying hens. *Poultry Science*, 96, 1925-1933.

Guinotte, F., Nys, Y., De Monredon, F. (1991). The effects of particle size and origin of calcium carbonate on performance and ossification characteristics in broiler chicks. *Poultry Science*, 70, 1908-1920.

Hambree, D. J., Adams A. W., Craig J. V. (1980). Effects of force-molting by conventional and experimental light restriction methods on performance and agonistic behavior of hens. *Poultry Science*, 59, 215–223.

Hüssein, A. S. (1996). Induced molting procedures in laying fowl. *World's Poultry Science Journal,* 52, 175-187.

Kara, K. & Güçlü, B. K. (2012). The effects of different molting methods and supplementation of grape pomace to the diet of molted hens on postmolt performance, egg quality and peroxidation of egg lipids. *Journal of Faculty of Veterinary Medicine, Erciyes University*, 9, 183-196.

Kubena, L. F., Kwon, Y. M., Byrd, J. A., Woodward, C. L., Moore, R. W., Ziprin, R. L., Anderson, R. C., Nisbet, D. J., Ricke, S. C. (2001). Drinking water treatment and dietary treatment effects on *Salmonella enteritidis* in Leghorn hens during forced molt. *Poultry Science,* 80, 88.

Küçükyılmaz, K., Erensayın, C., Orhan, H. (2003). Effect of duration of fasting on post-molt laying hen performance and some ınternal and egg shell quality characteristics. *Mediterranean Agricultural Sciences*, 16, 199-210.

Lukic, M., Pavlovski, Z., Skrbic, Z., Jokic, Z., Vitorovic, D., Petricevic, V. (2009). Possibility of preventing short term calcium deficit by using large size marble particles in nutrition of young laying hens. *Archiva Zootechnica*, 12, 22-36.

Mccormick, C. C. & Cunnıngham, D. L. (1987). Performance and phsiological profiles high dietary zinc and fasting as methods of ınducing a forced rest: A diract comparison. *Poultry Science*, 66, 1007-1013.

Moustafa, G. Z., Anwer, W., Badawy, E. M. (2010). Effect of induced molting on performance of Cobb broiler breeders under field condition. *European Poultry Science*, 74, 87- 93.

Park, S. Y., Birhold, S. G., Kubena, L. F., Nisbet, D. J., Ricke, S. C. (2004). Effects of high zinc diets using zinc propionate on molt induction, organs and postmolt egg production and quality in laying hens. *Poultry Science,* 83, 24-33.

Ricke, S. C., Kwon, Y. M., Woodward C. L., Byrd, J. A., Nisbet D. J., Kubena L. F. (2001). Limitation of *Salmonella enteritidis* colonization by diets containing low calcium and low zinc concentrations. *Poultry Science*, 80, 262.

Ricke, S. C. (2003). The gastrointestinal tract ecology of *Salmonella enteritidis* colonization in molting hens. *Poultry Science*, 82, 1003-1007.

Sariözkan, S., Kara, K., Güçlü, B. K. (2016). Applicability of non-feed removal programs to induce molting instead of the conventional feed withdrawal method in brown laying hens, *Brazilian Journal of Poultry Science,* 18, 535-542.

Webster, A. B. (2003). Physiology and behavior of the hen during induced molt. *Poultry Science*, 82, 992-1002.

Zhao, J. P., Zhang, Q., Jiao, H. C., Wang, X. J., Jiang, M. J., Luo, H., Lin, H. (2016). Ovalbumin expression in the oviduct magnum of hens is related to the rate of egg laying and shows distinct stress-type-specific responses. *The Journal of Animal Physiology and Animal Nutrition*, 100, 876-883.