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Alternative induced molting methods for feed withdrawal and their effect on post molt egg quality parameters of White Leghorn hens

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ABSTRACT

Forced molting were practiced using the flock of hens by promoting a second laying cycle. In the present study, the effectiveness of induced molting method was studied in comparison to conventional feed withdrawal in terms of egg quality parameters. Layer chicken (160), 72–week-old were divided into 4 groups and were subjected to induce molting for a period of 14 days. The first group that received *ad lib.* water with complete feed withdrawal served as a control. The birds of the second group received *ad lib.* layer ration without calcium fortified with organic zinc (20,000 ppm) along with organic copper (600 ppm/kg of feed). The third group was provided with organic zinc (20,000 ppm) along with organic cobalt (150 ppm/kg of feed). The fourth group was provided with organic zinc (20,000 ppm) with organic chromium (500 ppm/kg of feed). Egg and shell weight were significantly different among different treatments; whereas, in shell thickness, egg production and body weight reduction, no significant difference was observed. The feed withdrawal treatment resulted in lower egg weight than other treatments. In conclusion, mineral supplemented methods could be substituted for conventional feed withdrawal method of induced molting.

Key words: Egg quality, Feed withdrawal, Induced molting, Organic zinc, White Leghorn

Molting in avian species is a naturally occurring process generally defined as the periodic shedding and replacement of feathers which improves the rate of egg production, albumen quality and eggshell quality during the post molt period (Berry 2003). It is to be practiced either naturally or artificially. Different methods of molting include feed and water withdrawal, feeding high dietary zinc, photoperiod reduction (Sandhu *et al*. 2006), feeding low calcium diet (Breeding *et al*. 1992), high-fiber and low-energy diets (Woodward *et al*. 2005),various ratios of *alfalfa* or layer ration (Donalson *et al*. 2005), a whole-grain barley diet (Onbasilar and Erol 2007), a combination of soy-hulls based diet and corn (Mazzuco *et al*. 2011) or feeding broken rice, rice bran or cassava meal for a short period (Gongruttananun *et al*. 2013) etc. However, due to increasing animal welfare concerns regarding the use of feed restriction, other approaches that use some sort of dietary manipulation for inducing a molt have become attractive alternatives to the egg production industry (Berry 2003, Park *et al*. 2004). Due to this, innovative methods are adopted such as alternatively supplementing high doses of dietary minerals such as zinc, chromium, copper, cobalt, aluminum, calcium etc. for better economic benefits. Considering that the stress during molting has been shown to increase mineral excretion (Smith and Teeter 1987) and lipid peroxidation products in serum (Sahin *et al*. 2002), chromium and zinc are used in the poultry diet as anti-stress elements, in addition to the fact that their requirement is increased during stress (Anderson 1994). Among these, zinc is one of the trace element that is required for various physiological and metabolic functions such as physical growth, immunocompetence, reproductive function and behavioural development (Brown *et al*. 2004). Traditionally, the major sources of Zn in the mineral supplements formulated for animal feeding have been its inorganic salts like Zn sulphate ($ZnSO_4$), Zn oxide (ZnO), Zn chloride ($ZnCl_2$), etc. However, the use of 1% zinc oxide (ZnO) inclusion per kg diet, is an effective method to achieve induced molting in the laying Hens (Machebe *et al*. 2013). Several reports are available on the effect of Cr and Zn but very few studies are available on Co and Cu. Therefore, the present study was an attempt to investigate the effectiveness of organic zinc with different formulation of chromium, cobalt, copper and in comparison to feeding withdrawal in terms of egg quality parameters in White Leghorn hens.

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MATERIALS AND METHODS

The protocols involving the care and use of animals for these experiments were in accordance with the rules of the institute "Animal Ethics Monitoring Committee". The experiment was conducted at the layer farm of Central Avian Research Institute, Izatnagar, India.

Experimental birds: White Leghorn layer hens (160), 72-week-old were used for the experiment, which has completed their first laying cycle. The birds were housed in individual cages and were maintained under uniform standard management conditions with 14 h light: 10 h dark. Prior to starting of molting, all hens were weighed for the determination of body weight changes.

Molt induction: Hens were divided into 4 groups of 40 birds each and subjected to induce molting for a period of 14 days. The birds in the first group that received *ad lib.* water with complete feed withdrawal (FW) served as a control. The birds of the second, third and fourth group received *ad lib.* layer ration without calcium fortified with organic zinc (Avila Zn) (20,000 ppm) along with the different concentration of copper (600 ppm), cobalt (150 ppm) and organic chromium (500 ppm)/kg of feed respectively. After 14 days, birds of all the groups were returned to normal layer ration. Body weight change, egg production, egg quality parameters were measured for further analysis.

Statistical analysis: Data presented in Table 1 were analyzed using a one-way ANOVA, rest other data were analyzed by using two-way ANOVA. Means were compared using Duncan's multiple range tests. The level of significance used in all results was P<0.05.

RESULTS AND DISCUSSION

In the present study, the body weight reduction was around 24 to 29%, with a significant difference between group 2 and 3 (Table 1). The similar findings on the body weight loss were reported in laying hens (Aygun and Olgun 2010, Petek and Alapy 2008). Ruszler (1998) stated that for optimum post-molt production, the body weight loss should be between 15–40% during the molt period. Our finding was also supported by Khan *et al*. (2011). They reported that more body weight reduction during molting gave better post-molt egg quality. In the current study, the egg weight was observed significantly (P<0.05) higher during 21–30 wks with increasing age of the birds provided mineral diet for molting in comparison to feed withdrawal (Table 2). The higher egg weight may be due to the continuous feeding of these birds. In contrast to our findings, Hassanabadi and Kermanshahi (2007) observed that there were no differences between feed removal treatment and non-feed removal treatment for post-molt egg weight.

In this study, we observed that no significant effect of mineral induced diets on shell thickness (Table 4), whereas shell weight was significantly high in groups (T2 and T4) that were fortified with mineral diets (Table 3). Shell weight was higher in the Cr-supplemented group among all mineral supplemented groups. We assume that excessive supplementation of zinc regressed the reproductive tract faster, but because of added minerals like Cu, Co and Cr in diet, rejuvenation process was better in group 2nd, 3rd and 4th for the next laying cycle as compared to the birds kept without feed in group 1st. Paik (2001) evaluated organic Zn, Cu and Mn sources in layer diets, and observed higher egg shell percentage in the eggs of layers fed organic trace minerals. These findings were in agreement with our results. In addition to this, dietary zinc-induced molting was proved to be better in improving the immune status (Sandhu *et al*. 2008) as well as the production performance (Sandhu *et al*. 2006) and the favourable alternate to the conventional fast molting procedures (Koch *et al*. 2007, Koelkebeck and Anderson 2007). Shell weight was also increased after the 10th week of molting, which has already been reported by Khajali *et al*. (2008). They observed a positive effect on the egg shell quality during the first 3–6 months of laying after molting. Those results could be due to the involution of the uterus, which appears to reduce the fat accumulation in the glandular epithelium of the uterus, which will eventually lead to an increase in the calcium binding efficiency of glandular epithelium. The similar findings were also reported by Brake (1992) and Heryanto *et al*. (1997). The present results were also consistent with those

Table 1. Mean body weights (g) (±SE) of single comb White Leghorn layers before and after induced molting

Parameter	Group 1 (FW)	Group 2 (AZF+Cu)	Group 3 (AZF+Co)	Group 4 (AZF+Cr)
Initial body weight (g) (before molting)	1.69±0.04	1.63±0.04	1.62±0.04	1.56±0.04
Body weight on 14 day of molting (g)	1.24±0.04	1.24±0.04	1.16±0.03	1.14±0.03
Body weight reduction (%)	26.86^{ab}±0. 94	24.73^{a}±0.72	28.82^{b}±1.01	27.31^{ab}±0.92
Body wt. (g) on 5% egg production (after molting)	1.56±0.03	1.53±0.04	1.46±0.03	1.47±0.04
Body wt. (g) on maximum egg production (after molting)	1.67±0.06	1.67±0.04	1.55±0.03	1.58±0.055
Egg production (%)	51.28±1.44	54.33±1.18	3.41±1.20	53.72±1.37

^{a,b,c}Means bearing different superscript differs significantly (P<0.05) between groups.

Table 2. Mean egg weight (g) (±SE) of single comb White Leghorn layers after induced molting

Week	Group 1 (FW)	Group 2 (AZF+Cu)	Group 3 (AZF+Co)	Group 4 (AZF+Cr)
1–10 wks	$49.04^{a1}\pm0.36$	$52.12^{b1}\pm0.40$	$51.35^{b1}\pm0.34$	$51.46^{b1}\pm0.37$
11–20 wks	$50.81^{a2}\pm0.46$	$54.69^{b2}\pm0.42$	$53.37^{b2}\pm0.46$	$53.48^{b2}\pm0.49$
21–30 wks	$53.99^{a3}\pm0.46$	$56.18^{b3}\pm0.48$	$55.53^{b3}\pm0.57$	$56.20^{b3}\pm0.53$

[a,b,c]Means bearing different superscript differs significantly (P<0.05) between groups. [1,2,3]Means bearing different superscript differs significantly (P<0.05) within group.

Table 3. Mean shell weight (g) (±SE) of single comb White Leghorn layers after induced molting

Week	Group 1 (FW)	Group 2 (AZF+Cu)	Group 3 (AZF+Co)	Group 4 (AZF+Cr)
1–10 wks	$4.34^{a1}\pm.04$	$4.75^{c}\pm.04$	$4.45^{a1}\pm.05$	$4.59^{b1}\pm.03$
11–20 wks	$4.50^{a12}\pm.08$	$4.73^{ab}\pm.09$	$4.61^{ab12}\pm.06$	$4.77^{b2}\pm.06$
21–30 wks	$4.61^{a2}\pm.04$	$4.72^{a}\pm.05$	$4.66^{a2}\pm.04$	$4.91^{b2}\pm.06$

[a,b,c]Means bearing different superscript differ significantly (P<0.05) between groups. [1,2,3]Means bearing different superscript differs significantly (P<0.05) within group.

Table 4. Mean shell thickness (g) (±SE) of single comb White Leghorn layers after induced molting

Week	Group 1 (FW)	Group 2 (AZF+Cu)	Group 3 (AZF+Co)	Group 4 (AZF+Cr)
1–10 wks	0.31±0.003	0.31±0.003	0.31±0.002	0.31±0.002
11–20 wks	0.31±0.004	0.32±0.004	0.31±0.004	0.32±0.005
21–30 wks	0.32±0.003	0.32±0.003	0.32±0.003	0.32±0.002

of Rutz *et al*. (2006), who observed higher egg shell weight of Isa Brown layers supplemented with organic trace minerals (Se, Zn and Mn). In particular, it is also reliable to conclude that regression and removal of old tissues of the uterus and the recovery of the tissues with new cells may enhance the calcium binding protein (Calbindin) which would improve the shell quality. Khan *et al*. (2011) also reported that mineral feeding appears to be the best alternative to conventional molting methods and yield comparable results to feed withdrawal method. In present study, we observed that mineral based methods of induced molting produce better post molt eggs in terms of some of the egg quality parameters as compared to conventional feed withdrawal method. However, extensive research need to be performed using different combinations and with different ratio of minerals. Perhaps this study would be an important observation for further studies to go ahead about the effect of minerals on the post-molt egg quality parameters.

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