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EFFECT OF DIETARY VITAMIN E ON PERFORMANCE AND EGG QUALITY OF DIFFERENT INDUCED MOLTING METHODS OF LAYING HENS

(With 5 Tables)

By

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SUMMARY

Recycled Isabrown hens, by the use of low sodium diet treatments were compared to hens with feed withdrawal forced-molt procedure and an unrecycled control. The objective of the present study is to assess the effect of vitamin E on productivity and egg quality of induced two different molting programs on layer hens. The hens were randomly divided into five groups designated as 1,unmolted controls (CON); 2, molted with feed withdrawal for 10 days (FAST); 3, with feed withdrawal for 10 days molted and vitamin E supplemented diet (200mg/kg) after 11days (FAST+VE); 4, layer ration containing % 0.08 sodium for 41 day (Lo Na); 5, layer ration containing % 0.08 sodium for 41 day and vitamin E supplemented diet (200mg/kg) (Lo Na+VE). Water was provided adlibitum consumption for all groups. The photoperiod was reduced to 7h/d for molting and it was raised to 17h of light/day after molting. Comparing with the control values in the molting period, serum calcium and phosphorus concentrations of treated groups were significantly decreased ($p<0.05$). As a comparison with the control group in the post-molt period, there was an improvement in the eggshell weight and haugh unit in the all treated groups. There were statistically significant increases in the averages of the eggs specific gravity of the Lo Na and Lo Na+VE groups. Results suggested that supplementing vitamin E to diet of molted laying hens may be has a beneficial effect on egg production and eggshell thickness and haugh unit.

Key words: *Vitamin E, forced molt, layers, egg production, egg quality.*

INDRODUCTION

Forced molting of caged layers is used as a management technique to stop egg production in breeding hens for the purpose of recycling them for another season of egg production. There are several types of induced molting methods used today in the commercial egg industry. Prolonged food withdrawal is the most commonly used method of forced molting. The most effective proposed alternative molting techniques are insufficient dietary sodium (Monsi and Enos, 1977; Ross and Herrick, 1981; Naber *et al*., 1984) and feeding high levels of zinc, (Berry and Brake, 1987; Alodan and Mashaly, 1999). Some researchers obtained results with low Na nearly as efficient as the fasting methods (Nesbeth *et al*., 1976; Monsi and Enos, 1977). But in the case of Ross and Herrick, (1981) cessation of laying was incomplete and poorer performance from hens on a lo Na diet was obtained. However, recent research have shown that induced molting significantly depressed the cellular immune response and increased the severity of a concurrent Salmonella enteritidis infections (Holt *et al*., 1994; Holt and Porter, 1995). Also, Hoshino *et al*. (1988) reported that fasting is a potent stressor imposed upon the hen. According to Hoshino *et al*. (1988) the hen might respond to it with a sharp rise in plasma corticosterone levels. Increases in plasma levels of adrenocortical hormone corticosterone, have been reported to be an indicator of acut stress in poultry (Beuving and Vonder, 1978). Tengerdy (1989) suggested that vitamin E supplementation is very effective for animals because vitamin E can reduce the negative effects of corticosterone induced by stress. Other studies have shown that dietary vitamin E tends to maintain or increase egg production in chickens (Scheideler and Fonning, 1996; Saunder and Flachowsky 2001). Heinzerling *et al*., 1974) reported that chickens fed a diet supplemented with 250 and 300 mg of vitamin E/kg increased protection against a moderate E coli infection.

A lack of published data exists concerning the use of vitamin E on production performance and eggshell quality of molted laying hens. Therefore, the objective of the present study is to compare the reproductive performance egg quality of hens during and after molting induced fasting and low sodium diet with supplemented vitamin E.

MATERIALS and METHODS

Experimental layers consisted of 120 Isabrown hens that were 72 wk of age at the beginning of the pre-molt periods. The hens were randomly divided into two rooms (control and four experimental

groups). In each room, six replicate groups of 24 hens were assigned. Hens were housed two per cages (24x41x45) and received 17h of light and 7h of darkness/d. Feed and water were provided for adlibitum consumption prior to the beginning of the experiment. The four molting programs were used to compare their effects on egg quality and production. The hens were randomly divided into five treated groups of 24 hens. The hens in the first treatment group (FAST) were fed withdrawn for 10 days and water was provided adlibitum. The photoperiod was reduced to 7h/d. At day 11, hen fed pullet grower ration adlibitum until day 41 and at day 42 hens were returned to a full feed layer ration and received 17h of light/day. In the second group (FAST+VE), the hens were fed withdrawn for 10 days and water was provided for adlibitum consumption. The photoperiod was reduced to 7h/d. At day 11, hens were fed pullet grower ration adlibitum until day 42 and the ration was supplemented with 200mg/kg vitamin E. At day 42 hens were returned to a full feed layer ration and supplemented with 200mg/kg vitamin E. and received 17h of light/day. In the third group (Lo Na) were fed layer ration containing % 0.08 sodium for 41 days and water was provided adlibitum. The photoperiod was reduced to 7h/d. At day 42 hens were returned to a full feed layer ration and received 17h of light/day. In the fourth group (Lo Na+VE) the hens were fed layer ration containing % 0.08 sodium for 41 days and supplemented with 200mg/kg vitamin E. Water was provided adlibitum consumption. At day 42 hens were returned to a full feed layer ration + vitamin E (200mg/kg) and received 17h of light/day. The last group served as a control (CON).

Egg production and mortality were recorded daily while body weight was recorded weekly. Egg weight, shell weight, shell thickness, specific gravity, and haugh unit analysis were also determined. Egg quality measurements made on the same days when the blood samples were taken.

Blood samples were taken during pre-molt, at days 5 and 10 during the molting period, and at days 20 and 60 during the post-molting period in FAST and FAST+VE groups. Other groups' (Lo Na and Lo Na+VE) samples were taken during pre-molt, at days 21 and 42 during the molting period, and at days 20 and 60 prior of the post-molting period. Blood samples were obtained from the brachial vein for determinations levels of vitamin E calcium and ingoranic phophorus concentrations in plasma. Blood plasma calcium and phosphorus concentrations were determined spectrophotometrically by plasma reagent kits (Sigma Chemical Co.).

Vitamin E Analysis:

The level of vitamin E in blood plasma was determined by a method of Rizzo *et al.* (2000). A mixture of 1 ml plasma, 3 ml absolute ethanol, and 1 ml hexane (HPLC grade) was vortexed and centrifuged to obtain the hexane layer containing the extracted sample. The sample extracted in the hexane layer was injected into the HPLC to determine vitamin E concentrations.

Statistical Analysis:

All statistical analyses were carried out using the SPSS statistical analysis software. To determine the effect of Vitamin E on calcium and inorganic phosphor concentrations in plasma and egg quality parameters, one-way ANOVA were conducted for each group. The average values obtained of the groups were analysed by using Duncan's test. The results were considered significant if $p<0.05$. All data were expressed as the mean ± SEM.

RESULTS

The results presented in Tables (1&2) indicated that supplementation the diet of the feed restricted group (FAST) with vit. E decreased its plasma level in the molting period while the level was significantly increased in the postmolt.

Supplementation the low sodium diet with vit.E significantly increased its level in both molt and postmolt periods.

The results of Tables (1&2) also indicated that plasma calcium and inorganic phosphorus exhibited a similar significant decrease in all the treated groups compared with the control one during the forced molt.

In forced molting period, body weight loss occurred. The results of body weight loss at day 10 was 23.35 and 24.66 % respectively in FAST and FAST+VE, and at day 41 was 11.69 and 12.63% respectively in Lo Na and Lo Na+VE. The highest body weight loss was recorded in groups FAST+VE. After re-feeding hens on layer diet body weights were increased and became normal.

The mortality rate of fast group was 29 %, at the end of day 10 after the feed withdrawal. It was 12.5 % in FAST+VE at the end of 10 day ; 40 % in Lo Na and 8.3 % in Lo Na +VE.

Table 3 shows the results of egg production. Complete egg cessation was materialized at day 8 in FAST and at day 7 in FAST+VE. Although complete egg cessation was not materialized in low sodium diet treatment, egg production seriously decreased.

Table 4 shows the effect of feed withdrawal on egg weight, egg specific gravity, shell thickness, shell weight and haugh unit. Table 5 shows the effect of LoNa and LoNa+VE diet on egg weight, egg specific gravity, shell thickness, shell weight and haugh unit.

DISCUSSION

The experiment reported here was conducted to compare between the effect of low sodium diet and feed restriction procedure for forcing molt in hens. The effect of dietary vitamin E supplementation on performance and egg quality of different induced molting methods of laying hens were also examined. Molt and postmolt performance data for hens in the five treated groups (CON, FAST, FAST+VE, Lo Na and Lo Na+VE) were reported.

The data of Table (1) cleared that fasting of hens for forcing molt caused an increase in the level of vit.E in blood plasma during molt and post-molt periods compared with the control group, while supplementing the diet with vit.E slightly decreased its level during the molt period and increased significantly ($p<0.05$) the level in the postmolt.

The results presented in Table (2) showed that feeding the low sodium diet for hens caused an increase in the plasma vit.E level during molt and post-molt periods, while supplementing the dliet with vit.E increased significantly ($p<0.05$) its level in plasma during both periods of molt and post-molt..

Plasma total calcium and plasma inorganic phosphate exhibited a similar significant decrease in the all treatment (FAST, FAST+VE, Lo Na and Lo Na+VE) groups during the forced molt (Tables 1 & 2). The levels of plasma Ca and Pi were in the normal levels during both pre- and post-molt egg production. These findings are in agreement with those of Brake and Thaxton, 1979; Garlich *et al.* 1984; Turkmen and Mengi, 1994).

In the present study body weight loss shows great differences among the treated groups. The percent of body weight loss was 23.33 in FAST and 24.66 in FAST+VE. In low sodium diet group, the percentage was even less, it was 11.69 % in Lo Na and 12.63 in Lo Na +VE. The loss of body weight was depending on the feed withdrawal. Baker *et al.* (1983) suggested there are close relationship between post-molt performance and body weight reduction during the molting period. But Rolon (1993) claims there are no relationships between these two. Since there is a relationship between body weight loss and involution of the reproductive tract, post-molt performance might improve (Decuypere

and Verheyen, 1986; Brake 1992; Zimmermann *et al.*, 1987). But in the present study, the rate of egg production was not significantly improved by molting treatments when compared with the control group (Table 3) Since the post-molting period was limited to 6 weeks in this study, this was the reason of not being able to determine the egg peak. The highest hen-day egg production was 55.91 % in the FAST+VE group. Another possible reason for improved egg production is the length of egg production cessation period. Some researchers suggested that the longer the cessation period, the better the post-molt production (Buhr and Cunningham,1994).

In the present study fast treatment effectively induced a complete cessation of lay during the molting phase. Although egg production decreased in the Lo Na group, there was no complete cessation. The extent of cessation of lay during the molt phase and improvement in post-molt production was greatly due to the quantity of sodium in dietary (Naber *et al.*, 1984; Said *et al.*, 1984; Berry and Brake, 1987).

Shell weight and thickness increased in FAST and FAST+VE in post-molting compared to pre-molting. Post-molting haugh units and shell weight were also higher in FAST and FAST+VE when compared with the control. These findings are in agreement with those of Garlich *et al.* (1984), Christmas *et al.* (1985), Berry and Brake (1987) and Koelkebeck *et al.* (1992). Post-molting gravity and haugh unit were higher in Lo Na and Lo Na+VE when compared with the control. These values are statistically significant ($p<0.05$) and are in agreement with the finding of some researchers (Naber *et al.*, 1984; Berry and Brake, 1987).

In conclusion, feed withdrawal provided complete egg cessation and higher body weight loss but the rate of mortality was higher than low sodium diet treatment. When these two methods were compared in respect to production and egg quality, no significant differences were found. That is why low sodium dietary treatment can be preferred in order to improve the welfare of hens. However, supplemented vitamin E contributed to the quality of egg and production in both methods. The dietary supplementation of vitamin E for layer hens may be beneficial in reducing the negative effect of stress induced by molting.

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Table 1. Effect of dietary vitamin E on plasma vitamin E, calcium and inorganic phosphorus during pre-molt, molt, post-molt in CON, FAST and FAST+VE groups.

Parameters	Groups	Pre-molt	Molting (1)	Molting (2)	Post-molt (1)	Post-molt (2)
Vitamin E (µg/ml)	CON	13.10±3.21	11.35±2.61	8.98±1.94^{b}	10.58±3.99^{b}	7.08±3.18^{c}
	FAST	9.14±4.03	13.51±8.84	17.59±8.42^{a}	14.20±6.92^{b}	20.94±5.93^{b}
	FAST+VE	9.42±4.03	7.29±1.65	16.21±7.17^{a}	52.08±22.97^{a}	71.76±11.10^{a}
Calcium (mg/dl)	CON	25.94±3.15^{a}	27±2.54^{a}	25.56±2.16^{a}	26.07±2.08^{a}	24.45±2.97^{a}
	FAST	24.1±3.10^{a}	11.2±1.5^{c}	9.19±1.58^{b}	15.62±1.36^{c}	23.72±3^{a}
	FAST+VE	26.93±3.15^{a}	9.74±1.27^{b}	8.46±0.98^{b}	15.15±1.1^{b}	24.79±2.16^{a}
Inorganic phosphorus (mg/dl)	CON	5.8±0.77^{a}	5.99±0.59^{a}	5.52±0.61^{a}	5.74±0.45^{ab}	5.46±0.54^{a}
	FAST	5.35±0.64^{a}	5.24±0.71^{b}	3.73±0.8^{b}	4.99±0.98^{c}	5.89±1.24^{a}
	FAST+VE	5.74±0.6^{a}	4.67±0.78^{b}	3.63±0.58^{b}	5.08±1.06^{bc}	6.6±2.06^{a}

^{a,b,c} In each column within each group, the differences between any two means with different letters are significantly different (P<0.05).

Table 2: Effect of dietary vitamin E on plasma vitamin E, calcium and inorganic phosphorus during pre-molt, molt, Post-molt in CON, Lo Na and Lo Na+VE groups.

Parameters	Group	Pre-molt	Molting (1)	Molting (2)	Post-molt (1)	Post-molt (2)
Vitamin E (µg/ml)	CON	11.57±7.27	7.74±2.98^{b}	8.41±3.34	8.52±3.56^{c}	8.50±4.31^{c}
	Lo Na	9.14±4.03	8.39±1.94^{b}	11.28±5.18	17.08±5.18^{b}	16.58±8.64^{b}
	Lo Na+VE	10.34±4.93	29.53±16.47^{a}	13.30±4.80	23.99±16.44^{a}	33.44±23.16^{a}
Calcium (mg/dl)	CON	25.94±3.15^{a}	27.09±1.4^{a}	26.36±1.4^{a}	24.98±1.46^{a}	25.93±1.91^{a}
	Lo Na	24.1±3.1^{a}	14.5±0.69^{b}	12.25±4.5^{b}	20.1±3.19^{b}	24.02±2^{a}
	Lo Na+VE	26.93±3.15^{a}	14.07±1.15^{b}	10.89±2.53^{b}	19.02±3.1^{b}	25.78±1^{a}
Inorganic phosphorus (mg/dl)	CON	5.8±0.77^{a}	5.86±0.52^{a}	5.67±0.76^{a}	5.37±0.94^{a}	5.37±0.59^{a}
	Lo Na	5.35±0.64^{a}	4.54±0.69^{b}	4.87±0.75^{b}	4.77±0.85^{a}	4.77±0.53^{a}
	Lo Na+VE	5.74±0.6^{a}	4.12±1.06^{b}	2.97±0.51c	4.58±1.09^{a}	4.58±1^{a}

^{a,b,c} In each column within each group, differences between any two means with different letters are significantly different (P<0.05).

Table 3: Effect of four force molting procedures on hen-day egg production during premolt molt Postmolt.

Periods	CON	FAST Group	FAST+VE Group	Lo Na Group	Lo Na+VE Group
Pre-molt (21 days)	% 47.2	% 50.7	% 48	% 50.47	% 47.91
Molting (1-42 days)	% 56.30	% 12.31	% 12.78	% 34.80	% 39.82
Post-molt (42 days)	% 54.86	% 53.83	% 55.91	% 40.53	% 43.56

Table 4:Effect of dietary vitamin E on egg weight, egg specific gravity, shell thickness, shell weight and haugh unith during pre-molt, molt, Post-molt in CON, FAST and FAST+VE groups.

Parameters	Groups	Premolt	Molting (1)	Molting (2).	Postmolt (1)	Postmolt (2)
Egg Weight (g)	CON	69.49±6.15	68.63±6.04	68.59±4.31	66.82±4.88	68.64±8.72
	FAST	70.33±8.75	66.32±7.50	66.46±6.92	65.69±5.12	65.97±9.43
	FAST+VE	68.08±6.15	67.35±7.32	70.00±7.03	69.30±7.93	66.80±8.74
Egg specific gravity	CON	1.0629±0.001	1.0660±0.002	1.0621±0.003	1.0630±0.002	1.0642±0.001
	FAST	1.0600±0.002	1.0641±0.003	1.0632±0.001	1.0631±0.002	1.0635±0.003
	FAST+VE	1.0720±0.001	1.0645±0.003	1.0665±0.001	1.0664±0.001	1.0637±0.003
Shell Weight (g)	CON	6.00±1.80	5.68±1.33 [a]	6.05±0.85 [a]	5.79±1.21 [b]	5.81±1.08 [b]
	FAST	5.88±1.31	4.61±0.88 [b]	5.50±0.07 [b]	6.01±1.21 [a]	6.11±1.13 [a]
	FAST+VE	5.79±0.44	5.47±1.08 [a]	5.58±1.06 [b]	6.25±1.33 [a]	6.66±0.54 [a]
Shell thickness (mm)	CON	0.363±0.0006	0.363±0.0052	0.370±0.0038	0.371±0.0028 [a]	0.373±46
	FAST	0.375±0.0037	0.340±0.0042	0.355±0.0016	0.338±0.0012 [b]	0.370±0.0022
	FAST+VE	0.358±0.0032	0.345±0.0020	0.346±0.0015	0.371±0.00 32 [a]	0.380±0.0029
Haugh unit	CON	71.2±0.12	70.2±0.12	70.6±0.10 [a]	68.5±0.10	64.5±0.04 [c]
	FAST	71.4±0.08	71.3±0.14	62.4±0.14 [b]	68.2±0.08	68.2±0.09 [a]
	FAST+VE	69.1±0.12	72.4±0.12	71.1±0.10 [a]	70.3±0.11	70.1±0.03 [a]

[a,b,c] In each column within each group, the differences between the means with different letters are significantly different (P<0.05).

Table 5: Effect of dietary vitamin E on egg weight, egg specific gravity, shell weight, shell thickness, and haugh unit, during pre-molt, molt, Post-molt in CON, Lo Na and Lo Na+VE groups.

Parameters	Groups	Premolt	Molting (1)	Molting (2).	Postmolt (1)	Postmolt (2)
Egg weight (g)	CON	69.44±6.03	69.50±7.26 [ab]	69.60±7.90 [ab]	68.64±9.72	68.77±2.17 [b]
	Lo Na	71.61±8.07	74.37±4.07 [a]	71.85±6.87 [a]	68.64±9.72	72.76±1.07 [a]
	Lo Na+VE	70.49±7.56	64.51±4.69 [b]	65.48±5.25 [b]	69.00±3.01	71.90±1.90 [a]
Egg specific. gravity	CON	1.0637±0.001	1.0644±0.002[ab]	1.0626±0.002 [b]	1.0620±0.003[b]	1.0632±0.001[b]
	Lo Na	1.0639±0.001	1.0695±0.003[a]	1.0686±0.001[a]	1.0060±0.001[a]	1.0710±0.002 [a]
	Lo Na+VE	1.0637±0.003	1.0623±0.002 [b]	1.0630±0.003[b]	1.0662±0.003[b]	1.094±0.002 [a]
Shell weight (g)	CON	5.98±1.24	5.73±0.72	6.01±0.85	5.84±0.60 [b]	5.97±1.32 [b]
	Lo Na	5.90±1.31	5.89±1.04	6.02±0.87	6.36±0.71 [a]	6.41±1.08 [a]
	Lo Na+VE	5.81±1.33	5.94±1.22	5.80±0.86	6.16±0.98 [a]	6.43±0.81 [a]
Shell thickness (mm)	CON	0.377±0.0043	0.381±0.0023 [a]	0.366±0.0034	0.369±0.0059	0.395±0.0099 [b]
	Lo Na	0.381±0.0033	0.357±0.0017 [b]	0.387±0.0028	0.388±0.0018	0.424±0.0018 [a]
	Lo Na+VE	0.371±0.0049	0.361±0.0024 [a]	0.398±0.0052	0.379±0.0017	0.386±0.0012 [b]
Haugh unit	CON	68.2±0.12	67.4±0.07	65.8±0.14[b]	66.4±0.04	67.1±0.10 [b]
	Lo Na	69.3±0.12	67.3±0.09	62.8±0.11[b]	68.3±0.03	68.7±0.12 [b]
	Lo Na+VE	69.7±0.13	68.5±0.06	69.3±0.11[a]	69.7±0.01	70.2±0.08 [a]

[a,b,c] In each column within each group, differences between any two means with different letters are significantly different (P<0.05).