



Effect of Force Molting by Dietary Supplementation with ZnO and Vitamin C and Postmolting Periods on Egg Production of Broiler Breeder chickens

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Abstract:

Zinc as Zinc Oxide at three levels (15000, 20000 and 25000ppm) with or without vitamin C was used as a method to induced molting of 296 Arbor Acres broiler breeder at 375 days old. Hens were randomly divided into eight treatments. Two treatments (T1 and T2) were free of Zinc included control with or without (1g/ kg) vitamin C; three treatments (T3, T5 and T7) included different levels of zinc (15000, 20000 and 25000ppm Zn as ZnO) without vitamin C; while, (T4, T6 and T8) included different levels of zinc (15000, 20000 and 25000ppm Zn as ZnO) with (1g/ kg) vitamin C addition. Postmolting periods were divided into 6 periods. All treatments and post molting periods had significant ($P<0.05$) effects on egg production traits. Hens in T4 significantly ($P<0.05$) better in most egg production traits. While hens in T8 had significantly ($P<0.05$) higher egg weight. Hens in T1 and at period 1 had significantly ($P<0.05$) lowest feed efficiency compared with others. Results also indicated that highest weight of eggs, number of eggs/ hen and cumulative egg/ hen for all treatments occurred during the Period 6 followed by Period 5 and 7 and the lowest number and cumulative egg/ hen was at Period 1 and 8.

Key words: Zinc Oxide, vitamin C, molting, Broiler Breeder hens, egg production traits.

I. Introduction

“Forced molting” or “Induced molting” is a process that simulates natural molting events, and employed commercially to stop egg production (EP) in laying and breeding hens in order to recycle them for another season of EP [1; 2]. Forced natural molting completely halted reproductive function and EP resumed and increased rapidly to a profitable rate following this artificial molt [3,4,5]. Moreover, it has a positive effect on the environment through reduction of waste and natural resources needed for growing more birds for EP [1 6; 7]. The benefits of forced molting are an increase

in EP, and egg mass (EM) [8; 9]. Van den Brand et al. [10] and Zita et al. [11] showed that the egg weight (EW) increased with hen’s age. Different levels of Zinc (Zn) had significant ($P<0.05$) effects on EP, without any effect on feed intake (FI) and feed conversion ratio (FCR) [12]. Mohammed [13] found a significant difference between molting treatments by ZnO with or without vitamin AD₃E on EW, EM; also he reported that these traits were greater in Postmolting periods in all molted hens compared with unmolted hens. Contradictory, El - Deek and Al - Harthi [14] found no significant

($P > 0.05$) differences in EW of hens treated with 2 and 3% ZnO. Many studies indicated that post molting periods (by different levels of ZnO) affected rate of EP, EW, FI and FCR [8; 14; 15; 16; 17; 18]. Bell [18] observed that laying hens reached the peak of EP in the first cycle at week (wk) 8 at about 90% and in the second cycle in wk 13 at about 80%. El-Gendi et al. [19] found that after two wks of molting, FCR increased then decreased with fluctuated rates toward the end of the experimental period. Therefore, the present study aimed to investigate the effect of forced molting by different levels of Zn with or without vitamin C addition on commercial broiler breeder (Arbor Acres) egg production traits and feed efficiency.

II. Materials and Methods:

The present study was conducted using 296 hens of Arbor Acres broiler breeder at 375 days old. The experiment was carried out at the Poultry Research, Faculty of Agriculture Science, Sulaimani University in Bakrajo. Birds were randomly divided into eight treatments of 37 hens each. Each treatment contains five replicates (R) with seven hens except R1 and R2 were having eight hens. Molting period take up 9 days and the eight treatment groups were as follow: T1 (without vitamin C) and T2 (with (1g/ kg) vitamin C): Control group fed on commercial Arbor Acres diet; T3, T5 And T7: Force molting by (15000, 20000 and 25000ppm Zn as ZnO) without vitamin C; T4, T6 and T8: Force molting by ((15000, 20000 and 25000ppm Zn as ZnO) with (1g/ kg) vitamin C. On the first day of the treatment, the light program was changed to 8 Light: 16 Dark and water were provided *ad libitum* (Table I).

Table.I: Experimental design of periods schedule for Zinc induced molting.

Stage of Molt	Periods	Date	Age days	Stage of Postmolting Periods week	Feed g/ hen	Light hour	Water
Molting Period	9 days	1-9/4/1010	375-383		155	8	
Rest Periods	7 days	10-16/4/1010 day 17*	384-390	1	155	16	<i>ad-lib</i>
				2			
				3-5			
				6-8			
Postmolting Periods	13 weeks	17/4-16/7/2010	391-481	9-11	155	16	
				12 -13			
				14			

* resuming of egg production (17/4/2010).

At day10 post molt, hens from all molting treatment were returned to a regular broiler breeder diet and 16 hours/ day (h/ d) of photoperiod. The basal diet was formulated

using a linear program, to contain 2858 Kcal Metabolism Energy/ Kg diet and 16% Crude Protein to meet, at least the nutrient requirements, and hen received 155g/ day

(g/ d) according to Arbor Acres broiler breeder nutrition manual [20] (Table II). All eggs were weighted individually from the initiation until to the end of study. Egg weight (EW) and egg number (Egg No.) were recorded daily to calculate Cumulative Egg (cumu. eggs/ hen/ week), Egg Mass (EM) (g/hen/wk), Feed Efficiency values (feed g/eggs g) and Egg

Production was calculate by Hen House Production (HHP %). Statistical analysis was accomplished using SPSS-17 Package Program for Windows. Least Significant Difference tests (L.S.D) was used to determine the significant of difference among treatments means [21]. Level of significant used in all results was ($P<0.05$).

Table.II: Composition of Ingredient and calculated of analytical content of diets.

Ingredient	%
Yalow Corn	54.8
Wheat	14.2
Soybean meal (44% CP)	21.5
Breedmix-2.5 W*	2.5
Dicalcium Phosphate	0.3
limestone	6.5
salt	0.2
Total	100
Calculated	
ME, kcal/kg	2858
CP (%)	16
Calcium (%)	3.2
Methionine + cyst. (%)	0.69
Lysine (%)	0.85
Fiber (%)	3.1
Zinc** (ppm)	80%

* added Vitamin and Minerals per kg:

Vitamin. A 700.000 IU; Vitamin. D₃ 140.000IU; Vitamin. E 960 mg; Vitamin. K 80 mg; Vitamin. B1 10 mg; Vitamin. B2 200 mg; Pantothenic acid 320 mg; Vitamin. B6 80 mg; Vitamin. B12 800 mg; Nicotinic acid 800 mg; Folic acid 20 mg; Biotin 3.680 mcg; Choline Chloride 12.000mg; Antioxidant 1.800 mg; Iron 2.000 mg; Copper 400 mg; Manganese 3.200 mg; Zinc 2.400 mg; Iodine 40 mg; Selenium 8 mg; Calcium 23.00%; Phosphorus (available) 8.60%; Methionine 5.40%; Methionine + Cystine 5.40%; Sodium 5.30%; Lysine 2.50%. ** Zinc calculated by chemically analytical.

III. Results and Discussion:

A. Effect of Treatments

Table (III) showed that EW, Egg No. and cumu. egg/ hen significantly ($P<0.05$) affected by all treatments. The highest values of EW were resulted in T8 followed by T4, and the lowest was resulted in T7 followed by T5. Furthermore, values of EW in T2, T4, T6 and T8 were higher compared with values of EW in corresponded treatments T1, T3, T5 and T7. Such results indicated that, using vitamin C as a tool of reduce stress of molt induction had effect on the rate of EW when compared with other molting treatments. Such results in contrariwise with [22] whom found no differences were observed for EW, for the different levels of vitamin C in the molting diet. The treatments T1 and T2 had significantly ($P<0.05$) the lower numbers of eggs and

cumu. egg/ hen compared with forced molting treatments. Such significant difference between T1 and T2 may be due to treatments with vitamin C, whereas, Zapata and Gernat [22] suggest that supplementing vitamin C to molt laying hens can be beneficial to egg production. But Mohammed [13] found that diet supplemented of vitamin AD₃E had the lower Egg No. compared with control once. Among molting treatments, the highest number of eggs and cumu. egg/ hen were attained by hens in the T4. Such results could be attributed to the fact that birds in T4 remained out of EP for a shorter time and return to production earlier than other molting treatments, following treatments were T5 and T3 which also took a shorter time to out and return to produce egg [23].

Table.III: Effect of treatments on egg weight, egg number and cumulative egg/hen values (Mean \pm SEM) during post molting periods.

Treatments	Egg Weight (g)	Egg Number/ T/ wk	Cumulative Egg/hen/wk
T1	64.171 ^{cd} \pm 0.25	20.861 ^g \pm 1.58	2.826 ^f \pm 0.22
T2	64.447 ^{bcd} \pm 0.58	23.272 ^f \pm 1.47	3.149 ^e \pm 0.20
T3	65.832 ^{ab} \pm 0.57	29.428 ^{bc} \pm 1.97	3.992 ^{bc} \pm 0.27
T4	66.251 ^a \pm 0.92	30.861 ^a \pm 2.06	4.190 ^a \pm 0.29
T5	64.123 ^{cd} \pm 0.57	29.989 ^{ab} \pm 2.10	4.065 ^{ab} \pm 0.29
T6	65.692 ^{abc} \pm 0.85	28.656 ^{cd} \pm 1.93	3.993 ^{bc} \pm 0.27
T7	63.856 ^d \pm 1.20	26.844 ^e \pm 1.94	3.739 ^d \pm 0.27
T8	66.449 ^a \pm 0.61	27.828 ^{de} \pm 2.05	3.876 ^{cd} \pm 0.29

Different superscript alphabets in a column differ significantly ($P<0.05$).

The lowest number of eggs was attained by hens in the T7 followed by T8 and T6. Furthermore, results indicated that as the lower level of Zn (15000ppm Zn), number of eggs and cumu. egg/ hen were higher compared with the other higher levels of

Zn. Such results in contrariwise with Mohammed [13] who found hens fed with diet containing 35000ppm Zn + vitamin AD₃E had the highest value of egg number compared with diet containing 20000 or 25000ppm Zn.

Table.IV: Effect of treatments on hen house production, egg mass and feed efficiency values (Mean \pm SEM) during post molting periods.

Treatments	Hen House Production (%)	Egg Mass (g)	Feed Efficiency
T1	40.366 ^f \pm 3.08	25.976 ^e \pm 2.01	8.522 ^a \pm 1.38
T2	44.990 ^e \pm 2.79	29.101 ^d \pm 1.89	6.400 ^{bc} \pm 0.62
T3	57.032 ^{bc} \pm 3.88	37.580 ^b \pm 2.59	5.230 ^d \pm 0.61
T4	59.850 ^a \pm 4.07	40.501 ^a \pm 3.06	5.287 ^d \pm 0.75
T5	58.067 ^{ab} \pm 4.12	37.618 ^b \pm 2.76	5.579 ^{cd} \pm 0.76
T6	57.032 ^{bc} \pm 3.87	38.142 ^b \pm 2.75	5.565 ^{cd} \pm 0.82
T7	53.416 ^d \pm 3.88	34.411 ^c \pm 2.64	6.431 ^b \pm 1.03
T8	55.373 ^{cd} \pm 4.11	37.262 ^b \pm 2.89	6.060 ^{bcd} \pm 0.95

Different superscript alphabets in a column differ significantly ($P < 0.05$).

Moreover, Sarica *et al.* [24] reported that treatment group fed 15000ppm of Zn for 9 days produced 113.0 eggs compared with 108.63 eggs for group fed 10000ppm Zn during a second laying period of 161 days. Such differences might attribute to differences in Zn levels and differences in other nutrient supplementation, or to differences in breed. Effects of all treatments on HHP%, EM and FE were significant ($P < 0.05$) (Table IV). The HHP%, EM and FE of all molting treatments ($P < 0.05$) increased compared with unmolting treatments. These results may attribute to the reduction in BW [23]. Whereas, forced molting conduces to rejuvenate the reproductive organs, as well as, to reduction of BW. The loss in body weight is an important factor contributing to the success of forced molting because of its effect on reproductive and on fat deposits [23; 25]. Furthermore, the percentage of BW loss is also highly correlated with hen performance during the second cycle [26]. As well as Zn level having the higher role in increasing EP [27], they also reported that the Zn levels in plasma showed a positive correlation with an increase in EP, the highest plasma concentration of Zn was at the peak of the 2nd production cycle, which started

increasing with the increase in EP, but declined at the end of production. Or maybe by effect of Zn in the concentration of serum copper and manganese whereas, Yousaf *et al.* [28] found that serum Zn decreased at the peak of the second production cycle, while serum copper and manganese increased at the 5% and peak of the second production cycle in Zn molted group. On the other hand, the significant ($P < 0.05$) differences of HHP% and EM between T1 and T2 attributed to the treatment with vitamin C. Such results in agreement with results reported by Hung *et al.* [29] whom observed that vitamin C supplementation increased significantly EP. While, contrary with El-Gendi *et al.* [19] whom showed that pullets treated with vitamin C had lower ($P < 0.001$) EP rate but higher EW and EM compared with control. The differences found between results may be partially attributable to differences of ages of birds. However, hens in T4 significantly ($P < 0.05$) had higher value of HHP% and EM than T3. Such results may be attributed to effect of vitamin C in T4, moreover hens in T4 initiated to produce eggs and reach to 50-60% production earlier than hens in T3, although hens in T4 took a longer time to out of EP and shorter time to produce first egg [23].

This lead to a conclusion that, applying ZnO with vitamin C as a method of molt induction had better effect on the rate of EP, when compared with other molting treatments. While, Zapata and Gernat [22] found no interactions were observed between the levels of vitamin C and calcium in molting treatments. HHP% resulted by hens in T5 and T7, did not significantly ($P<0.05$) differ with corresponding value for hens in T6 and T8. Moreover, EM significantly ($P<0.05$) differed between T7 and T8, due to lower EW and HHP% in T7. The non-significant differences between molting treatments with vitamin C T6 and T8 compared with other molting treatments without vitamin C T5 and T7 could be attributed to the interfere of high levels of Zn with vitamin C [31]. However, Zapata and Gernat [22] found that EP for Single Comb White Leghorn hens increased ($P<0.06$) an average of 5% for the levels of 250 and 500ppm vitamin C. Differences between results could be attributed to type of molting, kind and amount of additives and breed of hens used. Statistical analysis indicated a significant ($P<0.05$) effect of treatments upon FE during post molting periods (Table IV). The differences between treatments T3, T5 and T7 with corresponded treatments T4, T6 and T8 were not significant. Moreover, presence of vitamin C in T2 significantly improved FE of hens. El-Gendi *et al.* [31], Essa [32], Essa *et al.* [33] and Sinkalu and Ayo [34] whom reported that dietary addition with vitamin C improved the productive performance. The benefit effect of vitamin C supplementation may be attributed to its role in activating thyroid gland which influenced the FI [35]. Also, vitamin C scavenges free oxygen radicals which are important, however, to prevent stress caused by oxidation of cell membrane in the digestive system and restore efficient

feed utilization [36]. It was also noted that hens in T3 or T4 utilized feed more efficiently ($P<0.05$) as compared to those of the T7 hens. This may be due to hens in T3 and T4 produced eggs earlier than hens in T7, which make significant differences in Egg No. subsequently, significant differences in converting feeds to eggs. Goodman [38] found no significant differences were observed among treatments for egg (g)/ hen-day, feed (g)/ egg (g) when Leghorn hens, 15 months old fed diets to which ZnO was added at 10000, 5000, or 2500ppm for 7, 14, or 21 days during the 22 wk experimental period. Also, Zamani *et al.* [12] reported that different levels of Zn significantly ($P<0.05$) did not have any effect on FI and FCR. However, Mohammed [13] found that different levels of Zn did not effect on FCR.

B. Effect of Postmolting Periods

Effect of different periods of postmolting on EW, egg number, and cumu. egg/ hen was significant ($P<0.05$) (Table V). The highest weight of eggs was attained by hens at P6. These results were in contrast with Hassanabadi and Kermanshahi [16] who reported that the effect of Zn on EW at 4 periods of postmolt production 3wks each was not significant, although at the peak of post molting production was 63.7g. While Mohammed [13] found the highest value of EW was resulted at P3 and the lowest value of EW was recorded at P1. Results also indicated that highest number of EP and cumu. egg/ hen for all treatments occurred during the P6 followed by P5 and P7, and the lowest egg No. and cumu. egg/ hen was at P1. Birds in molting treatments at once initiate to produce EP after molting period, subsequently affected the total number of eggs in this periods. The second lowest period was at P8. It is natural

phenomena the EP decreased with increasing bird's age. While, Mohammed [13] found significant difference between age's periods on egg No., the number of eggs gradually increased from P2 until P5; also he found that the number of eggs at P1 was greater than once in P2. Stevenson and Jackson [39] found that egg No. and mean EW during periods 3 to 7 inclusive were similar in all groups. The statistical

analysis for post molting periods effect on HHP% and EM showed significant differences at ($P<0.05$) (Table VI). Highest HHP% and EM were attained by hens at P6, may be due to that all molting treatments reached peak production at this period. Bell [18] reported that laying hens peaked in the first cycle at wk 8 at about 90% and in the second cycle in wk 13 at about 80%.

Table.V: Effect of post molting periods on egg weight, egg number and cumulative egg/ hen values (Mean \pm SEM).

Post Molting Period (wk)	Egg Weight (g)	Egg Number/ T/ wk	Cumulative egg/hen/wk
P3 2	61.566 ^d \pm 0.81	13.375 ^f \pm 1.27	1.820 ^f \pm 0.17
P4 3-5	65.294 ^{bc} \pm 0.30	26.463 ^d \pm 0.59	3.621 ^d \pm 0.08
P5 6-8	66.129 ^{ab} \pm 0.28	34.167 ^b \pm 0.53	4.681 ^b \pm 0.08
P6 9-11	67.257 ^a \pm 0.59	37.542 ^a \pm 1.23	5.148 ^a \pm 0.18
P7 12-13	64.584 ^c \pm 0.87	30.833 ^c \pm 1.46	4.229 ^c \pm 0.21
P8 14	65.786 ^{bc} \pm 0.45	20.925 ^e \pm 1.27	2.873 ^e \pm 0.18

Different superscript alphabets in a column differ significantly ($P<0.05$).

Table.VI: Effect of post molting periods on hen house production, egg mass and feed efficiency values (Mean \pm SEM).

Post Molting Period (wk)	Hen House Production (%)	Egg Mass (g)	Feed Efficiency
P3 2	26.001 ^f \pm 2.38	16.329 ^f \pm 1.65	12.471 ^a \pm 0.86
P4 3-5	51.722 ^d \pm 1.16	33.748 ^d \pm 0.75	4.685 ^c \pm 0.11
P5 6-8	66.873 ^b \pm 1.19	44.269 ^b \pm 0.87	3.558 ^d \pm 0.08
P6 9-11	73.544 ^a \pm 2.53	49.720 ^a \pm 1.90	3.373 ^d \pm 0.18
P7 12-13	60.415 ^c \pm 2.93	39.199 ^c \pm 2.06	4.672 ^c \pm 0.36
P8 14	41.030 ^e \pm 2.52	27.178 ^e \pm 1.72	8.047 ^b \pm 1.11

Different superscript alphabets in a column differ significantly ($P<0.05$).

Such differences in the results could be attributed to differences in hen's age, or being from different breed. Reddy *et al.* [15] reported that when molted two breeds of broiler breeder above 60 wks of age with 4 experimental periods of 28 days each, the Cornish layers reached peak EP at P2 was 49.51%, while, the Rock layers reached at P3 was 50.59%. The HHP% and EM was the lowest at P3, due to the fact that hens in molting treatments at once initiate to produce eggs. El-Gendi *et al.* [19] reported that after molt EM started to increase with different magnitude and continued to increase sharply during the second two wks after molt and steadily towards the end of the experimental period with different rates within the different experimental groups 1 % Zn and injected with the 4 components. The lower HHP% and EM at P8, is natural phenomena EP decreased with increasing age. Mohammed [13] found the highest HHP% was resulted at P4 and P5, but highest EM resulted at P5. Such results were in agreement with [16; 8]. However, any differences between our results and other studies may be due to differences of method and material, breed, age, nutrition and molting period. The mean postmolt FE of the hens during the post molt periods significantly ($P < 0.05$) differed (Table VI). Hens at P3 were significantly ($P < 0.05$) utilized feed for EP less than other periods. Such results could be due to hens being in molting treatments produced at once initiated to produce egg; subsequently the number and weight of

eggs were less than at other periods. Mohammed [13] found that hens at P2 had lower FE compared with other periods. Moreover, hens at P6 followed by P5 utilized feed more efficient as compared to those at P4 and P7, while the hens at P8 had the lowest efficiency to convert feed to egg. It is natural phenomena that the reproductive efficiency decreased with age; subsequently the feed is directed to increase weight instead of EP. The present finding is agreement with Onbasilar and Erol [17] who fed hens a diet containing 10000 mg/kg of ZnO for 10 day; he found that the initial FCR /dozen eggs were 4.36 increased to 5.24 at 5–22 wks. Also Reedy *et al.* [15] reported that FCR during 1-28 day was 8.07 kg/ dozen eggs produced, and during the subsequent periods, 28 day each, the average FCR values were 3.5, 3.92 and 4.03kg/dozen eggs produced; and at the end of experimental periods was 5.08kg/ dozen eggs produced. The average values for molted Rock layers at the 2-28 day was 10.61kg/ dozen eggs produced, such values were 3.24, 3.74 and 3.33kg/ dozen egg produced during the subsequent periods, and it was 5.23 at the end of experimental periods. El-Gendi *et al.* [19] found that after two wks of molting, FCR increased then decreased with fluctuated rates toward the end of the experimental period. Hassanabadi and Kermanshahi [16] reported that FI and FE for Zn-treated hens with for 10 days were not significantly differed between different periods of post molt production.

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