EFFECT OF FORCE MOLTING ON EGG QUALITY TRAITS OF BROILER BREEDER HENS

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ABSTRACT

One hundred fifty three, sixty weeks of age of broiler breeders were used in this experiment to investigate the effects of supplementation of different levels of zinc oxide (ZnO) and AD_3E vitamins on egg quality. The experimental treatments were T1: Control diet [without adding ZnO and vit. AD_3E], T2: T1 + 2 gm/kg of vit. AD_3E, T3: T1 + 25000 ppm of ZnO, T4: T1 + 25000 ppm ZnO + 2 gm/kg vit. AD_3E, T5: T1 + 30000 ppm ZnO, T6: T1 + 30000 ppm ZnO + 2 gm/kg vit. AD_3E, T7: T1 + 35000 ppm of ZnO and T8: T1 + 35000 ppm ZnO + 2 gm/kg vit. AD_3E. The results obtained from this study were summarized as: The effects of interactions between treatments and age periods significantly ($P<0.01$) affected yolk and albumin weight, egg shell thickness, albumin height, Haugh unit score, yolk height, yolk diameter and yolk index traits.

Key words: vitamin AD3E, zinc oxide, albumin weight, yolk index.
Part of M.Sc. thesis for the first author.

تاثير القلش الاجباري على الصفات النوعية للبيض الامهات فروج اللحم

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المستخلص

اجريت هذه الدراسة على 153 الامهات فروج اللحم لسلالة Ross-308 عند عمر 60 اسبوع. تم اجراء هذه التجربة لدراسة تاثير اضافة مستويات المختلفة من أوكسيد الزنك مع فيتامين AD_3E على الصفات النوعية للبيض. المعاملات المستخدم في هذه الدراسة هي: المعاملة الاولى: عليقة السيطرة (من دون إضافة ZnO وفيتامين AD_3E) والمعاملة الثانية: المعاملة الاولى + 2 غم/كغم من فيتامين AD_3E والمعاملة الثالثة: المعاملة الاولى + ZnO 25000 ppm والمعاملة الرابعة: المعاملة الاولى + ZnO 25000 ppm + 2 غم/كغم من فيتامين AD_3E والمعاملة الخامسة: المعاملة الاولى + ZnO 30000 ppm والمعاملة السادسة: المعاملة الاولى + ZnO 30000 ppm + 2 غم/كغم من فيتامين AD_3E والمعاملة السابعة: المعاملة الاولى +ZnO 35000 ppm والمعاملة الثامنة: المعاملة الاولى + ZnO 35000 ppm + 2 غم/كغم من فيتامين AD_3E. تتلخص النتائج هذه الدراسة بما يأتي: تاثير المعاملات والفترات العمرية كان معنويا عاليا ($P<0.01$) في وزن الصفار ووزن البياض وسمك القشرة وارتفاع الصفار وارتفاع البياض ووحدة الهاو وقطر الصفار ومعامل الصفار.

الكلمات المفتاحية: فيتامين AD3E، أوكسيد الزنك، وزن الصفار، معامل الصفار.

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INTRUDUCTION

The avian egg production is a complex system whose main purpose is reproduction. However, understanding the properties of the egg enable it to be used as a versatile and functional food source (16). Chicken egg is an excellent source of enriched food for developing embryo and for human food as a complete food source, and easily digestible; especially for children, working men and pregnant women, sick and old people or rather for all categories of human (13). In nature, birds replace some of their feathers in the season of a year to maintain good plumage at all times. A natural molting often happens before the next winter season, and needs long time especially in the chickens (layer and breeder), In such cases we can depend on artificial methods (process) called (force molting) (19). Force molting is an economic practice of laying hens to extend their productive life (2). Induced molting not only improved performance and egg shell quality, but also increased profits by optimizing the use of replacement flocks (6). Feeding molted hens is a challenge to sustain their production performance and retain essential body nutrients at the same time (11). Objectives of forced molting in chickens (layers and breeders) are to extend their productive lives by benefited of second production year and third production year (Ahmad and Roland, 2003), to improve the productive performance and egg quality traits like (egg weight, egg shell, hatchability and egg component traits),(25), decreases the costs to replacement flocks (6), to give rest duration to the chicken to rejuvenate the reproductive system when decreases efficiency flocks from egg production (10) and minimize the effect of chicken age on egg production and egg quality (4, 5). The main objectives of the present study were:

1. Determine the best concentration of zinc oxide (ZnO) to force molting method.
2. Effect of ZnO molting method for maximize profits in (**Ross-308**) broiler breeder hens.
3. Study the role of vitamin AD_3E mixture with ZnO on molted hens during post-molt periods.

MATERIALS AND METHODS

Study Design

A total of 153 hens of broiler breeder Ross-308 were used in this experiment, at age 60 weeks from 8/11/2009 to 21/2/2010. The experiment was divided in to five periods, each period included 3 weeks, and birds were randomly allotted in to 8 different treatments, each treatment had 3 replicates and T1, T2, T4, T6 and T8 constitute from 18 broiler breeder and T3, T5 and T7 constitute from 21 broiler breeder. The experimental treatments were as the following:

T1: Control diet.
T2: T1 + 2 g/kg of vit. (AD_3E).
T3: T1 + 25000 ppm of ZnO.
T4: T1 + 25000 ppm (ZnO) + 2 g/kg vit. (AD_3E).
T5: T1 + 30000 ppm ZnO.
T6: T1 + 30000 ppm (ZnO) + 2 g/kg vit. (AD_3E).
T7: T1 + 35000 ppm of ZnO.
T8: T1 + 35000 ppm (ZnO) + 2 g/kg vit. (AD_3E).

Housing Environment

Before treating the birds, photoperiod was 16 hours/day and during treatment period for (9 days) photoperiod was reduced to 8 hours/day; at day 10 hens fed on control diet and received 16 hours of light/day. Temperatures were recorded three times a day at 8:00 am, 1:00 pm and 6:00 pm. Their average values are shown in table 1 and the ventilation was controlled by fans type (Damandeh) to get good air ventilation.

Table 1. Average temperature during the study periods.

Study period	Bird age (week)	Average of temperature (°C)
1	61-63	17
2	64-66	19
3	67-69	20
4	70-72	20
5	73-75	19

Feeding

The control diet which used in this experiment is shown in table 2. The data were analyzed statistically by using tow-way of ANOVA with (SPSS-17 Package Program for

Windows). Least Significant Difference tests (L.S.D) were used to determine the significance of difference among treatments means. Level of significance used in all results was ($P<0.01$) and all percentage data were converted Arcsines prior to analysis.

Table 2. Ingredient composition and calculated chemical analysis of control diet provided to the broiler breeder hens

Feed stuff	%
Wheat	45
Barley	10
Yellow corn	16
Soybean meal (44%)	12
Meat and bone meal	5
Corn oil	2
Limestone	7.6
Di-calcium phosphate	1.4
Salt (Nacl)	0.2
Methionine	0.1
Lysine	0.2
Choline	0.2
premix	0.3
Calculated chemical component	
Crude protein %	15.5
Metabolized energy kcal/kg	2750
Calcium %	3.6
Available phosphorus%	0.7

The nutritional requirement determined according to (NRC1994)

RESULTS AND DISCUSSION

Effect Of Force Molting Using Zno And Addition Vitamin Ad_3e On:

Egg Yolk, Albumin And Shell Weight.

The effects of treatments and age periods was a significant ($P<0.01$) effect on yolk and albumin weight but there was no significant effect on egg shell weight traits (table 3). The highest values of yolk and albumin weights were resulted in all treated hens at P3, P4 and P5 (post-molt periods) and the lowest value were resulted in P2. Results of the present study showed that yolk, albumin weight significantly decrease through molting periods in all treated hens if compared with non-treated hens. However, there was no significant difference in egg shell weight traits between treated and non-treated hens (table 3). This decrease may be due to the effect of zinc oxide on reproductive system by reducing and slower growth of follicles in ovary and inactive oviducts in this works specially Magnum to produce albumin. On the other hand, decrease liver in weight which has role in producing yolk. After molting and during P3, P4 and P5 these traits increased in all treated hens when compared with non-treated hens (table 3), this may be due to renewing reproductive system in his works. These results were in agreement with the suggestions of (7, 18, 1) whom found that hens induced molted by zinc oxide had significant effects on egg yolk and albumin weight. While the results were in contrast with findings of (11, 3) whom found that induced molting by zinc oxide had no significant effect on egg yolk, albumin and shell weight traits.

Egg Yolk, Albumin And Shell Percentage And Yolk, Albumin Ratio

There was no significant effect of treatments and age periods on egg yolk, albumin and shell percentage and yolk, albumin ratio traits (table 4). However, these traits were lower numerically in control group compared with treated groups in all age periods. This may be due to change egg weight with increase and decrease of eggs components and found these traits percentage by dividing part weight on total egg weight. These results were confirmed with the results reported by (11, 3) whom found that induced molted by zinc oxide had no significant effect on egg yolk, albumin and shell percentage and yolk, albumin ratio traits.

Egg Shell Thickness

The effects of treatments and age periods significantly ($P<0.01$) affected on egg shell thickness at equatorial and pointed parts. Its decrease in treated groups during P2 and increase immediately after molting (table 5). This decrease during molting period may be due to effectiveness of zinc oxide on shell glands in the Uterus in the oviduct. The improvement in egg shell thickness after molting associated with increased calcium binding protein in the shell gland (12, 14). On the other hand, Abdullah (1) suggested that the improved egg shell quality could be correlated with better calcium metabolism. These results were in confirmation with the results reported by (18, 6, 5, 26, 1). While the results were in contrast with finding of (21, 17, 15).

Table 3. Effects of interactions between treatments and age periods on yolk, albumin and shell weight traits (Mean±SEM)

Interactions		Traits								
Age period	Treatments	Yolk weight (g)			Albumin weight (g)			Shell weight (g)		
1	T1	19.00	±	0.28	38.62	±	0.25	9.47	±	0.19
	T2	21.19	±	0.06	40.25	±	0.15	9.29	±	0.20
	T3	20.18	±	0.55	38.74	±	0.42	9.57	±	0.35
	T4	20.64	±	0.44	40.40	±	0.24	9.33	±	0.32
	T5	19.59	±	0.18	40.04	±	0.22	9.41	±	0.46
	T6	20.32	±	0.20	40.97	±	0.46	9.88	±	0.32
	T7	19.73	±	0.06	40.25	±	0.16	8.97	±	0.16
	T8	20.59	±	0.14	41.97	±	0.50	9.44	±	0.20
2	T1	19.41	±	0.45	40.27	±	0.31	9.38	±	0.23
	T2	21.80	±	0.34	41.95	±	0.91	9.25	±	0.04
	T3	19.82	±	1.59	38.18	±	1.20	8.04	±	0.26
	T4	20.23	±	1.63	38.96	±	0.37	9.31	±	0.73
	T5	22.68	±	0.89	40.60	±	2.27	9.92	±	0.32
	T6	19.69	±	1.02	42.03	±	1.16	9.18	±	1.40
	T7	19.81	±	1.00	39.78	±	1.92	9.33	±	0.82
	T8	21.41	±	1.17	38.24	±	2.94	8.98	±	0.63
3	T1	20.00	±	0.18	40.42	±	0.51	9.54	±	0.26
	T2	21.99	±	0.71	42.23	±	0.59	10.0	±	0.03
	T3	21.39	±	0.06	41.01	±	0.86	9.08	±	0.31
	T4	21.60	±	0.32	42.88	±	0.72	9.66	±	0.30
	T5	22.10	±	0.24	43.30	±	1.15	9.43	±	0.26
	T6	21.44	±	0.08	40.87	±	1.38	10.3	±	0.76
	T7	21.59	±	0.18	41.87	±	0.37	9.43	±	0.43
	T8	22.45	±	0.34	46.14	±	2.41	9.90	±	0.60
4	T1	20.08	±	0.16	40.22	±	0.37	9.81	±	0.18
	T2	20.70	±	0.14	41.05	±	0.21	9.60	±	0.20
	T3	20.99	±	0.21	41.50	±	0.30	9.81	±	0.12
	T4	21.06	±	0.34	41.41	±	0.48	9.62	±	0.33
	T5	21.05	±	0.20	40.78	±	0.92	10.1	±	0.11
	T6	21.87	±	0.43	42.21	±	1.36	10.3	±	0.21
	T7	20.99	±	0.37	42.42	±	0.69	9.83	±	0.37
	T8	21.33	±	0.33	42.28	±	0.55	10.0	±	0.30
5	T1	21.15	±	0.28	39.90	±	0.45	9.16	±	0.29
	T2	21.43	±	0.20	42.06	±	0.76	9.77	±	0.21
	T3	21.21	±	0.45	41.14	±	0.38	9.38	±	0.33
	T4	21.03	±	0.07	41.20	±	0.52	8.90	±	0.15
	T5	21.12	±	0.38	41.04	±	0.12	8.81	±	0.56
	T6	20.70	±	0.34	41.93	±	0.46	9.10	±	0.03
	T7	20.43	±	0.12	40.49	±	0.06	9.67	±	0.23
	T8	20.94	±	0.10	41.28	±	0.63	9.75	±	0.36
LSD (p<0.01)		2.09			3.68			ns		

ns: not significant

Table 4. Effects of interactions between treatments and age periods on yolk, albumin, shell percentage and yolk, albumin ratio traits (Mean±SEM)

Interactions		Traits											
Age period	Treatments	Yolk (%)			Albumin (%)			Yolk,Albumin ratio			Shell (%)		
1	T1	27.56	±	0.24	55.97	±	0.33	0.49	±	0.01	13.77	±	0.15
	T2	29.97	±	0.22	56.98	±	0.36	0.53	±	0.00	13.15	±	0.22
	T3	29.34	±	0.55	56.28	±	0.45	0.53	±	0.02	13.87	±	0.53
	T4	29.49	±	0.58	57.75	±	0.48	0.51	±	0.01	13.24	±	0.46
	T5	28.24	±	0.10	57.78	±	0.45	0.50	±	0.01	13.48	±	0.62
	T6	28.55	±	0.11	57.64	±	0.43	0.50	±	0.00	13.81	±	0.37
	T7	28.61	±	0.11	58.37	±	0.18	0.49	±	0.00	12.87	±	0.22
	T8	28.53	±	0.12	58.20	±	0.12	0.49	±	0.00	13.03	±	0.20
2	T1	27.94	±	0.41	57.97	±	0.25	0.48	±	0.01	13.50	±	0.38
	T2	29.88	±	0.52	57.42	±	0.59	0.52	±	0.01	12.70	±	0.12
	T3	29.95	±	1.78	57.87	±	1.99	0.52	±	0.05	12.18	±	0.39
	T4	29.46	±	1.52	56.99	±	1.98	0.52	±	0.05	13.55	±	0.69
	T5	31.07	±	1.91	55.38	±	1.81	0.56	±	0.05	13.55	±	0.23
	T6	27.70	±	0.57	59.27	±	1.44	0.47	±	0.01	12.87	±	1.68
	T7	28.72	±	0.61	57.73	±	1.72	0.50	±	0.03	13.55	±	1.14
	T8	31.11	±	0.37	55.43	±	1.07	0.56	±	0.01	13.10	±	0.95
3	T1	28.38	±	0.18	57.33	±	0.27	0.49	±	0.00	13.53	±	0.36
	T2	29.31	±	0.70	56.30	±	0.65	0.52	±	0.02	13.35	±	0.17
	T3	30.01	±	0.32	57.23	±	0.63	0.53	±	0.01	12.70	±	0.47
	T4	29.15	±	0.44	57.81	±	0.84	0.51	±	0.01	13.06	±	0.42
	T5	29.59	±	0.30	57.80	±	0.25	0.51	±	0.01	12.61	±	0.08
	T6	29.55	±	0.81	56.21	±	0.59	0.53	±	0.02	14.24	±	0.68
	T7	29.65	±	0.17	57.44	±	0.67	0.52	±	0.01	12.93	±	0.56
	T8	28.81	±	0.76	58.82	±	0.75	0.49	±	0.02	12.63	±	0.53
4	T1	28.65	±	0.21	57.34	±	0.05	0.50	±	0.00	14.02	±	0.23
	T2	29.00	±	0.20	57.49	±	0.10	0.51	±	0.00	13.48	±	0.30
	T3	29.04	±	0.16	57.37	±	0.28	0.51	±	0.01	13.61	±	0.13
	T4	29.24	±	0.31	57.48	±	0.71	0.51	±	0.01	13.35	±	0.29
	T5	28.93	±	0.21	56.06	±	0.76	0.53	±	0.02	13.92	±	0.04
	T6	30.90	±	1.38	59.80	±	3.68	0.52	±	0.01	14.32	±	0.72
	T7	28.61	±	0.12	57.84	±	0.40	0.50	±	0.00	13.37	±	0.55
	T8	29.03	±	0.29	57.52	±	0.39	0.51	±	0.00	13.63	±	0.49
5	T1	30.11	±	0.07	56.82	±	0.31	0.53	±	0.00	13.06	±	0.35
	T2	29.36	±	0.07	57.45	±	0.43	0.51	±	0.00	13.37	±	0.39
	T3	29.56	±	0.46	57.43	±	0.78	0.52	±	0.02	13.04	±	0.39
	T4	29.60	±	0.22	57.92	±	0.28	0.51	±	0.01	12.54	±	0.31
	T5	29.81	±	0.10	57.96	±	0.87	0.52	±	0.01	12.40	±	0.62
	T6	28.90	±	0.23	58.45	±	0.10	0.50	±	0.00	12.69	±	0.12
	T7	28.65	±	0.20	56.78	±	0.49	0.51	±	0.01	13.53	±	0.24
	T8	29.33	±	0.11	57.80	±	0.93	0.51	±	0.01	13.62	±	0.48
LSD (p<0.01)		ns			ns			ns			ns		

ns = not significant.

Table 5. Effect of interactions between treatments and age periods on egg shell thickness traits (Mean±SEM)

Interactions		Traits								
Age period	Treatments	Blunt (mm)			Equatorial (mm)			Pointed (mm)		
1	T1	0.29	±	0.0002	0.30	±	0.0005	0.31	±	0.0012
	T2	0.29	±	0.0040	0.30	±	0.0028	0.31	±	0.0034
	T3	0.29	±	0.0031	0.29	±	0.0046	0.31	±	0.0049
	T4	0.30	±	0.0014	0.30	±	0.0044	0.32	±	0.0037
	T5	0.30	±	0.0051	0.30	±	0.0053	0.32	±	0.0032
	T6	0.30	±	0.0009	0.30	±	0.0021	0.31	±	0.0029
	T7	0.30	±	0.0033	0.30	±	0.0044	0.31	±	0.0062
	T8	0.30	±	0.0061	0.30	±	0.0091	0.32	±	0.0078
2	T1	0.29	±	0.0015	0.30	±	0.0053	0.31	±	0.0048
	T2	0.31	±	0.0088	0.31	±	0.0081	0.33	±	0.0076
	T3	0.28	±	0.0176	0.29	±	0.0145	0.29	±	0.0273
	T4	0.30	±	0.0088	0.31	±	0.0219	0.32	±	0.0186
	T5	0.31	±	0.0153	0.32	±	0.0167	0.35	±	0.0067
	T6	0.29	±	0.0100	0.29	±	0.0088	0.29	±	0.0252
	T7	0.31	±	0.0153	0.32	±	0.0273	0.31	±	0.0260
	T8	0.30	±	0.0186	0.31	±	0.0173	0.32	±	0.0219
3	T1	0.28	±	0.0031	0.30	±	0.0033	0.31	±	0.0030
	T2	0.30	±	0.0110	0.30	±	0.0066	0.32	±	0.0078
	T3	0.31	±	0.0131	0.32	±	0.0087	0.34	±	0.0099
	T4	0.30	±	0.0054	0.30	±	0.0041	0.31	±	0.0059
	T5	0.30	±	0.0091	0.32	±	0.0116	0.31	±	0.0101
	T6	0.29	±	0.0127	0.31	±	0.0075	0.31	±	0.0079
	T7	0.29	±	0.0076	0.30	±	0.0034	0.31	±	0.0024
	T8	0.29	±	0.0052	0.29	±	0.0040	0.31	±	0.0045
4	T1	0.29	±	0.0029	0.30	±	0.0011	0.31	±	0.0037
	T2	0.29	±	0.0031	0.30	±	0.0035	0.31	±	0.0020
	T3	0.30	±	0.0015	0.31	±	0.0021	0.32	±	0.0040
	T4	0.31	±	0.0037	0.37	±	0.0514	0.33	±	0.0025
	T5	0.30	±	0.0009	0.31	±	0.0030	0.32	±	0.0054
	T6	0.30	±	0.0029	0.31	±	0.0053	0.32	±	0.0025
	T7	0.30	±	0.0097	0.31	±	0.0068	0.32	±	0.0036
	T8	0.31	±	0.0071	0.32	±	0.0055	0.33	±	0.0076
5	T1	0.30	±	0.0019	0.30	±	0.0056	0.31	±	0.0053
	T2	0.30	±	0.0042	0.30	±	0.0034	0.34	±	0.0078
	T3	0.30	±	0.0053	0.31	±	0.0041	0.32	±	0.0040
	T4	0.30	±	0.0038	0.30	±	0.0045	0.31	±	0.0041
	T5	0.30	±	0.0037	0.30	±	0.0037	0.31	±	0.0044
	T6	0.30	±	0.0028	0.31	±	0.0012	0.32	±	0.0050
	T7	0.30	±	0.0049	0.31	±	0.0003	0.32	±	0.0029
	T8	0.30	±	0.0050	0.30	±	0.0024	0.30	±	0.0038
LSD (p<0.01)		ns			0.044			0.036		

Egg Specific Gravity, Albumin Height And Haugh Unit

There was no significant effect of treatments and age periods on egg specific gravity (Table 6). These results were in agreement with the suggestions of (8, 9, 22, 17) whom found that induced molting had no significant effect on egg specific gravity trait. The effects of interactions between treatments and age periods significantly (P<0.01) affected albumin height and Haugh unit score. The highest value of these traits was resulted in P3, P4 and P5 in all treated hens when compared with non-treated hens. Molting to cause higher Haugh unit score of eggs such effect could explained by the formation of more intense thick while clearly indicates that the magnum of such hens became highly active and secretes more protein for consolidation of thick white (23). On the other hand, increasing feed consumption after feeding on the control diet produce more albumins on the oviduct (Magnum) and eventually increase egg weight. Afterall Haugh unit is calculated numerically depending on egg weight and albumin height. These results were confirmed with the results reported by (10, 1, 23) whom suggested that induced molting had significant effect on albumin height and Haugh unit score. While the results were in contrast with findings of Ocak et al., (21), Khodadadi et al., (17) and Ahmed (3) whom found that induced molting had no significant effect on albumin height and Haugh unit traits.

Yolk Height, Yolk Diameter And Yolk Index

Treatments and age periods had significant (P<0.01) effect on egg yolk height, yolk diameter and yolk index traits (table 7). This is may be due to produce more yolk and increase of yolk weight after molting in treated hens compared with non-treated hens. These results were in agreement with the finding of (24, 10, 1) whom found that induced molting had a significant effect on egg yolk height, yolk diameter and yolk index traits.

Table 6. Effect of interactions between treatments and age periods on egg specific gravity, albumin height and Haugh unit traits (Mean±SEM)

Interactions		Traits								
Age period	Treatments	Egg specific gravity			Albumin height (mm)			Haugh unit		
1	T1	1.085	±	0.001	5.81	±	0.12	71.90	±	1.11
	T2	1.083	±	0.001	5.76	±	0.04	70.89	±	0.21
	T3	1.085	±	0.000	5.69	±	0.04	70.89	±	0.59
	T4	1.082	±	0.002	5.63	±	0.11	69.94	±	0.94
	T5	1.085	±	0.001	5.97	±	0.18	73.04	±	1.59
	T6	1.083	±	0.000	6.03	±	0.18	73.23	±	1.03
	T7	1.086	±	0.001	5.79	±	0.11	71.71	±	0.84
	T8	1.084	±	0.002	5.94	±	0.14	71.83	±	0.97
2	T1	1.085	±	0.000	5.75	±	0.13	71.01	±	0.99
	T2	1.078	±	0.004	5.31	±	0.28	65.79	±	2.56
	T3	1.088	±	0.004	6.93	±	0.19	81.13	±	1.72
	T4	1.087	±	0.002	5.21	±	0.36	66.65	±	2.87
	T5	1.085	±	0.003	6.53	±	0.33	76.02	±	2.60
	T6	1.082	±	0.006	6.40	±	0.47	75.47	±	4.33
	T7	1.088	±	0.002	5.98	±	0.50	73.10	±	3.22
	T8	1.093	±	0.003	6.33	±	0.41	75.80	±	3.86
3	T1	1.085	±	0.001	5.82	±	0.17	71.03	±	1.61
	T2	1.084	±	0.001	5.91	±	0.08	70.56	±	0.45
	T3	1.085	±	0.001	5.99	±	0.07	72.49	±	0.84
	T4	1.086	±	0.001	6.12	±	0.12	72.60	±	1.02
	T5	1.085	±	0.001	5.97	±	0.19	71.10	±	1.45
	T6	1.087	±	0.001	6.11	±	0.19	72.99	±	2.09
	T7	1.087	±	0.001	5.75	±	0.19	69.94	±	1.67
	T8	1.084	±	0.003	6.27	±	0.22	72.59	±	0.86

Table 6.

Interactions		Traits								
Age period	Treatments	Egg specific gravity			Albumin height (mm)			Haugh unit		
4	T1	1.082	±	0.002	5.63	±	0.12	69.93	±	1.20
	T2	1.082	±	0.002	5.34	±	0.12	66.81	±	1.02
	T3	1.085	±	0.001	5.83	±	0.13	70.82	±	0.96
	T4	1.086	±	0.002	5.67	±	0.09	69.56	±	0.49
	T5	1.087	±	0.001	5.93	±	0.02	71.57	±	0.35
	T6	1.086	±	0.000	5.84	±	0.03	70.48	±	0.49
	T7	1.085	±	0.000	5.65	±	0.03	68.90	±	0.67
	T8	1.087	±	0.001	5.96	±	0.04	71.28	±	0.22
5	T1	1.083	±	0.001	5.62	±	0.07	69.81	±	0.60
	T2	1.084	±	0.000	5.99	±	0.05	71.89	±	0.24
	T3	1.085	±	0.001	5.90	±	0.04	71.63	±	0.45
	T4	1.083	±	0.000	5.88	±	0.03	71.75	±	0.36
	T5	1.086	±	0.001	6.20	±	0.05	74.37	±	0.01
	T6	1.085	±	0.000	5.92	±	0.19	71.83	±	1.37
	T7	1.084	±	0.001	6.11	±	0.17	73.49	±	1.27
	T8	1.086	±	0.002	5.83	±	0.03	71.22	±	0.23
LSD (p<0.01)		ns			0.71			5.91		

Table 7. Effects of interactions between treatments and age periods on yolk height, yolk diameter and yolk index traits (Mean±SEM)

Interactions		Traits								
Age period	Treatments	Yolk height(mm)			Yolk diameter(mm)			Yolk index		
1	T1	18.47	±	0.09	39.08	±	0.41	0.51	±	0.039
	T2	18.14	±	0.06	41.73	±	0.25	0.44	±	0.003
	T3	18.24	±	0.04	41.41	±	0.16	0.44	±	0.002
	T4	18.10	±	0.07	56.68	±	15.04	0.42	±	0.013
	T5	18.55	±	0.22	41.30	±	0.07	0.44	±	0.005
	T6	18.64	±	0.28	41.66	±	0.14	0.45	±	0.006
	T7	18.32	±	0.18	40.95	±	0.16	0.45	±	0.003
	T8	18.44	±	0.05	41.90	±	0.22	0.44	±	0.004
2	T1	18.07	±	0.15	39.33	±	1.28	0.57	±	0.120
	T2	18.40	±	0.03	40.95	±	0.18	0.44	±	0.001
	T3	18.17	±	0.13	42.99	±	0.33	0.42	±	0.000
	T4	18.23	±	0.07	40.64	±	0.63	0.45	±	0.007
	T5	18.94	±	0.64	42.22	±	0.55	0.45	±	0.010
	T6	18.39	±	0.09	40.95	±	0.29	0.45	±	0.004
	T7	18.69	±	0.26	41.26	±	0.54	0.45	±	0.004
	T8	20.41	±	1.43	43.16	±	1.15	0.47	±	0.023
3	T1	18.75	±	0.27	40.83	±	0.15	0.46	±	0.008
	T2	18.47	±	0.29	41.69	±	0.24	0.44	±	0.006
	T3	19.34	±	0.24	41.78	±	0.28	0.46	±	0.008
	T4	19.60	±	0.21	41.45	±	0.20	0.47	±	0.003
	T5	19.69	±	0.60	42.01	±	0.71	0.47	±	0.013
	T6	19.31	±	0.43	42.70	±	0.46	0.45	±	0.006
	T7	19.19	±	0.58	42.18	±	0.46	0.46	±	0.009
	T8	19.41	±	0.51	42.18	±	0.78	0.46	±	0.004
4	T1	17.87	±	0.13	40.97	±	0.20	0.44	±	0.001
	T2	18.00	±	0.08	40.33	±	0.12	0.45	±	0.002
	T3	18.61	±	0.24	41.73	±	0.15	0.45	±	0.005
	T4	18.72	±	0.12	41.75	±	0.24	0.45	±	0.004
	T5	18.82	±	0.22	41.59	±	0.15	0.45	±	0.006
	T6	19.06	±	0.18	41.31	±	0.36	0.46	±	0.005
	T7	18.20	±	0.13	41.15	±	0.17	0.44	±	0.004
	T8	18.71	±	0.05	41.46	±	0.16	0.45	±	0.002

Table 7.

Interactions		Traits								
Age period	Treatments	Yolk height(mm)			Yolk diameter(mm)			Yolk index		
5	T1	18.38	±	0.11	41.48	±	0.08	0.44	±	0.002
	T2	19.04	±	0.13	41.01	±	0.31	0.47	±	0.011
	T3	18.85	±	0.23	42.06	±	0.35	0.45	±	0.009
	T4	19.79	±	0.68	41.22	±	0.28	0.48	±	0.021
	T5	19.43	±	0.14	41.89	±	0.07	0.46	±	0.003
	T6	18.99	±	0.35	40.21	±	0.85	0.53	±	0.043
	T7	19.21	±	0.18	41.68	±	0.33	0.46	±	0.001
	T8	18.91	±	0.08	41.19	±	0.03	0.46	±	0.002
LSD (p<0.01)		1.334			9.03			0.096		

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