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Effects of layer's age and egg storage period on egg quality characteristics

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***Abstract*---**The study was carryout to show the effects of layer age at (30, 34 and 38 weeks), egg storage period (2, 4, and 6 days) and their interactions on egg quality traits of the hy-line layer eggs. The experiment included the measurements of the egg quality characteristics in laboratory. Results from this study were summarizing as: age of layers had significant effect ($p \leq 0.05$) on some quality traits of the eggs such as: egg weight, albumin weight, yolk weight, Haugh unit and yolk height; Also, storage period had significant effect ($p \leq 0.05$) on egg weight, albumin weight, Haugh unit, yolk height.

***Keywords*---**hy-line layer, egg quality, layer, egg storage.

Introduction

The avian egg is a complex system whose primary purpose is reproduction; however, understanding the properties of the egg enables it to be used as a versatile and functional food source (Kevin and Wilson, 2000). Chicken egg is an excellent source of enriched food for developing embryo in it (Jadhave and Siddiqui, 2007). Most studies associated with the effect of egg storage period on internal egg quality characteristics; Some negative changes in egg quality of all poultry species have been reported due to prolonged storage time. For example, water loss from the eggs (Ahmed and Al-Sardary, 2014). On the other hand, Tilki and Saatçi (2004) reported that storage time influences egg white quality (index,

Haugh unit). Raji *et al.* (2009) reported that lower egg quality in the Bovans brown strain was recorded with increased storage time; also, the eggs stored at a high temperature were already spoilt and not fit for human consumption after 2 weeks of storage.

The main factors directly associated to egg deterioration are temperature and relative humidity conditions, besides manipulation and storage period, however, during egg storage, some components of albumen and yolk may alter and tend to deteriorate egg quality (Vivian *et al.,* 2017). Some other factors, such as age of the breeder and egg storage before incubation, may also affect embryonic life of the chick and thereafter the quality of the hatched chick and the growth potential post hatch (Tona *et al.,* 2004).

Layer's age could be considered as one of the major factors affecting variability in egg characteristics, fertility, hatchability and broiler performance (Elibol *et al.,* 2002; Guibert *et al.,* 2012; Peebles *et al.,* 2001). It is known that eggs from young breeders tend to have smaller eggs with higher proportion of albumen to yolk, lower albumen pH and higher shell thickness than eggs from old breeders (Peebles *et al.,* 2000). The aim of this study was to investigate the effects of layer ages and egg storage periods on egg quality characteristics.

Material and Methods

A total of (900 eggs) from hy-line layer at 30, 34 and 38 weeks of layer's age were used in this experiment. The experiment was divided in to two stages, the first stage was including storing the eggs for 2, 4 and 6 days in cooling storage conditions, followed by the second stage which start to measure the egg quality characteristics in the laboratory. The experimental factors were the following; Factor one: including three levels of layer ages (30, 34 and 38) weeks. Factor two: including three levels of storage periods (2,4 and 6) days. 50 eggs randomly were selected for quality tests from each group.

Statistical analysis.

This investigation was conducted by using two factorial Completely Randomized Design (C.R.D) which were layer ages and egg storage periods to study the effects of interactions of these factors on egg quality characteristics. All data were analyzed by using (Xlstat-2016 Program). Duncan's multiple range tests (Duncan, 1955) were used to determinate the significant difference among factors data means. Significant level to analyze was ($P \leq 0.05$).

Results and Discussions

Egg weight (g) and Albumin weight (g)

The effects of interactions between layer ages and egg storage periods had significant ($p \leq 0.05$) effect on egg weight (g) (Table 1), the highest weight (53.906 g) was recorded by 38 weeks of age with 2 day of storage period and the lowest weight (47.078 g) was recorded by 30 weeks of age with 4 day of storage period. The effects of interactions between layer ages and egg storage periods had

significantly ($p \leq 0.05$) affected albumin weight (g) (Table 1), the highest weight of albumin (32.489 g) was recorded by 38 weeks of age with 2 day of storage period and the lowest (28.011 g) was recorded by 30 weeks of age with 4 day of storage period.

The increase of egg weight with advancing age of broiler breeders (older breeders) refers to increase the parts of egg components like yolk and albumin giving more growth and activation of the reproductive system of layers compared to younger layers (Hemin and Khasraw, 2019). Similar results were recorded by some investigators with respect to egg weight increase with advancing layers age (Javid *et al.,* 2016; Akyurek and Okur, 2009). the results of the present study indicated that egg weight of fresh egg decreased and egg weight loss increased with prolonged eggs storage period and storage condition. It is agreement with (Hemin and Khasraw, 2019) who reported that the storage period is extended the egg weight decline may be due to loss of moisture from the egg. The main factors directly associated with egg deterioration are temperature and relative humidity, besides manipulation and storage period, however, during egg storage, some components of albumen and yolk may alter and tend to deteriorate egg quality (Feddern et al., 2017). The increase in the albumin egg weight in older layers may be due to more growth and activation of the reproductive system of females compared to younger layers (Javid *et al.,* 2016). And albumin weight was decreased with a longer storage period of egg and storage condition, this is caused by water loss or migration from the albumin. These results were in agreement with the suggestions of (Yeasmin *et al.,* 2014; Jin *et al.* 2011) whom reported that the albumin weight was greatly influenced by the storage temperature condition and storage period of the eggs.

Table 1. Effect of interactions between layer ages and egg storage periods on egg weight (g) and albumin weight (g) (Mean ± SEM)

Factors		Traits	
Layer age (weeks)	Egg storage periods (days)	Egg weight (g)	Albumin weight (g)
30	2	48.446 de ± 0.14	29.053 cd ± 0.46
	4	47.078 e ± 0.38	28.011 d ± 0.23
	6	48.864 cde ± 0.67	29.128 cd ± 0.17
34	2	50.654 bc ± 0.77	30.407 bc ± 1.21
	4	49.729 bcd ± 1.09	29.659 bcd ± 0.26
	6	49.918 bcd ± 0.12	30.270 bc ± 1.07
38	2	53.906 a ± 0.22	32.489 a ± 0.05
	4	51.006 b ± 0.19	31.522 ab ± 0.46
	6	50.906 b ± 0.26	31.093 ab ± 0.26

Means values in the same column having different superscripts are significantly different at P≤0.05.

Yolk weight (g) and shell weight (g)

The effects of interactions between layer ages and egg storage periods had significantly ($p \leq 0.05$) affected egg yolk weight (g), (Table 2), the highest value of

yolk weight (16.156 g) was recorded by 38 weeks of age with 2 day of storage period and the lowest (14.406 g) was recorded by 30 weeks of age with 4 day of storage period. Also, there were no significant ($p \leq 0.05$) effects of interactions between layer ages, storage periods on egg shell weight (g), (Table 2). The main factors directly associated with egg deterioration are temperature and relative humidity, besides manipulation and storage period, however, during egg storage, some components of albumen and yolk may alter and tend to deteriorate egg quality (Feddern et al., 2017). Yolk weight increasing by progressing the age may be due to more activation of reproductive system of females and liver activity compared to younger breeders; these results were similar to the finding by (Javid *et al.,* 2016) who recorded the increase in egg components by old breeders compared with young breeders. In addition, yolk weight increased with a longer storage period of egg and storage condition this was caused by some of water migration from the albumin to the yolk, these finding of the present study were in agreement with results reported by several authors (Muhammad *et al.,* 2014; Muhammad *et al.,* 2013) whose reported that positive correlation between increased yolk weight with increased storage periods and condition.

Table 2. Effect of interactions between layer ages and egg storage periods on Yolk weight (g) and Shell weight (g) (Mean ± SEM)

Factors		Traits	
Layer age (weeks)	Egg storage periods (days)	Yolk weight (g)	Shell weight (g)
30	2	14.602 b ± 0.45	4.791 a ± 0.43
	4	14.406 b ± 0.36	4.661 a ± 0.37
	6	15.001 ab ± 0.23	4.735 a ± 0.33
34	2	14.882 ab ± 1.68	5.364 a ± 0.28
	4	15.242 ab ± 1.14	4.829 a ± 0.2
	6	14.606 b ± 0.47	5.042 a ± 0.34
38	2	16.156 a ± 0.42	5.261 a ± 0.12
	4	15.037 ab ± 0.67	4.448 a ± 0.1
	6	14.778 ab ± 0.05	5.035 a ± 4.89

Means values in the same column having different superscripts are significantly different at P≤0.05.

Albumin and Yolk percentage

The effects of interactions between layer ages and egg storage periods had a significant ($p \leq 0.05$) effect on albumin percentage (Table 3), the highest value of albumin percentage (61.800 %) was recorded by 38 weeks of age with 4 day of storage and the lowest (59.500 %) was recorded by 30 weeks of age with 4 day of storage period.

The effects of interactions between layer ages and egg storage periods had a significant ($p \leq 0.05$) effect on yolk percentage (Table 3), the highest value of yolk percentage (30.700 %) was recorded by 30 weeks of age with 6 day of storage period and the lowest (29.030 %) was recorded by 38 weeks of age with 6 day of storage period. Albumin and yolk percentage of eggs were affected significantly (p

≤ 0.05) by storage conditions and the interaction between layers ages and storage periods. When decreased albumin ratio already increased yolk ratio, this was because albumin loses more water than yolk, which caused a proportional increase in yolk ratio. The results were similar to the finding of (Demirel and Kirikci, 2009; Kırıkçı *et al.,* 2005) whom found the effect of storage period on albumin and yolk percentage.

Table 3. Effect of interactions between layer ages and egg storage periods on Albumin percentage and Yolk percentage (Mean ± SEM)

Factors		Traits	
Layer age (weeks)	Egg storage periods (days)	Albumin percentage	Yolk percentage
30	2	59.970 ab ± 1.36	30.140 a ± 0.21
	4	59.500 b ± 0.69	30.600 a ± 0.37
	6	59.610 b ± 0.55	30.700 a ± 0.3
34	2	60.030 ab ± 0.45	29.380 ab ± 0.29
	4	59.640 b ± 0.76	30.650 a ± 0.21
	6	60.640 ab ± 0.46	29.260 b ± 0.03
38	2	60.270 ab ± 0.06	29.970 a ± 0.23
	4	61.800 a ± 0.63	29.480 ab ± 0.36
	6	61.080 ab ± 2.56	29.030 b ± 2.93

Means values in the same column having different superscripts are significantly different at P≤0.05.

Shell percentage and yolk albumin ratio

There were no significant (p ≤ 0.05) effects of interactions between layer ages, storage periods on shell percentage (Table 4). Also, there were no significant (p ≤ 0.05) effects of interactions between layer ages, storage periods on yolk albumin ratio, (Table 4). According to the results there were no effects of main factors and their interactions on yolk albumin ratio, this is may be due to the variety and the proportion of the yolk and albumin of eggs during the storage periods (Hemin, 2020). These results were in agreement with those suggested by Suk and Park, (2001).

Table 4. Effect of interactions between layer ages and egg storage periods on Shell percentage and Yolk albumin ratio (Mean ± SEM)

Factors		Traits	
Layer age (weeks)	Egg storage periods (days)	Shell percentage	Yolk albumin ratio
30	2	9.890 a ± 0.72	0.503 a ± 0.05
	4	9.900 a ± 0.55	0.514 a ± 0.02
	6	9.690 a ± 0.49	0.515 a ± 0.01
34	2	10.590 a ± 0.35	0.489 a ± 0
	4	9.710 a ± 0.39	0.514 a ± 0.02
	6	10.100 a ± 0.12	0.483 a ± 0.01
38	2	9.760 a ± 0.24	0.497 a ± 0.01

	4	8.720 a ± 0.48	0.477 a ± 0
	6	9.890 a ± 0.33	0.475 a ± 0.01

Means values in the same column having different superscripts are significantly different at P≤0.05.

Albumin height (mm) and haugh unit

There were no significant (p ≤ 0.05) effects of interactions between layer ages, storage periods on Albumin height (mm) (Table 5). The effects of interactions between layer ages and egg storage periods had a significant (p ≤ 0.05) effect on Haugh unit (Table 5), the highest value of Haugh unit (82.257) was recorded by 38 weeks of age with 4 day of storage period and the lowest (77.882) was recorded by 38 weeks of age with 6 day of storage period. The results in the present study showed that Haugh unit values decreased by increased egg storage periods, water loss from the egg, or migration of water from the albumen to the yolk or evaporation from the eggs components is the most likely reason of it. These results were consistent with the findings of (Hemin, 2020).

Table 5. Effect of interactions between layer ages and egg storage periods on Albumin height (mm) and Haugh unit (Mean ± SEM)

Factors		Traits	
Layer age (weeks)	Egg storage periods (days)	Albumin height (mm)	Haugh unit
30	2	2.910 a ± 0.03	79.775 bc ± 0.49
	4	3.000 a ± 0.03	80.695 ab ± 0.67
	6	3.080 a ± 0.04	80.847 ab ± 0.22
34	2	3.210 a ± 0.07	81.341 ab ± 0.6
	4	3.060 a ± 0.05	80.525 ab ± 0.24
	6	3.200 a ± 0.19	81.427 ab ± 1.37
38	2	2.840 a ± 0.17	78.087 cd ± 1.27
	4	3.360 a ± 0.03	82.257 a ± 0.23
	6	2.720 a ± 0.55	77.882 d ± 0.19

Means values in the same column having different superscripts are significantly different at P≤0.05.

Egg specific gravity and yolk height

There were no significant (p ≤ 0.05) effects of interactions between layer ages, storage periods on egg specific gravity. The interactions between layer ages and egg storage periods had significant (p ≤ 0.05) effect on yolk height (mm) (Table 6), the highest value of yolk height (21.550 mm) was recorded by 38 weeks of age with 2 day of storage period and the lowest (18.900 mm) was recorded by 30 weeks of age with 6 day of storage period. yolk height decreased with increase of storage periods and storage temperature, this was may be due to the decrease of the strength of vitelline membrane that caused loss a little of water from the yolk and finally it caused the change in yolk height value (Hemin, 2020).

Table 6. Effect of interactions between layer ages and egg storage periods on Egg specific gravity and Yolk height (Mean ± SEM)

Factors		Traits	
Layer age (weeks)	Egg storage periods (days)	Egg specific gravity	Yolk height
30	2	1.090 a ± 0.003	20.170 ab ± 1.12
	4	1.085 a ± 0.001	19.890 ab ± 0.07
	6	1.085 a ± 0.001	18.900 b ± 0.58
34	2	1.095 a ± 0.001	20.220 ab ± 0.39
	4	1.090 a ± 0	19.950 ab ± 0.39
	6	1.085 a ± 0.002	19.860 ab ± 0.9
38	2	1.085 a ± 0.001	21.550 a ± 0.29
	4	1.095 a ± 0	20.440 ab ± 0.23
	6	1.090 a ± 0.001	19.570 b ± 1.51

Means values in the same column having different superscripts are significantly different at P≤0.05.

Yolk diameter (mm) and yolk index

The interactions between layer ages and egg storage periods had significant ($p \leq 0.05$) effect on yolk diameter (mm) (Table 7), the highest value of yolk diameter (41.320 mm) was recorded by 38 weeks of age with 6 day of storage period and the lowest (39.450 mm) was recorded by 30 weeks of age with 2 day of storage period. (Table 7). Also, there were no significant ($p \leq 0.05$) effects of interactions between layer ages, storage periods on yolk index (Table 7). The increase in yolk diameter observed in the present study could be due to decrease of the strength of vitelline membrane. When eggs are stored for long periods, the strength of vitelline membrane breaks which makes the yolk to spread into the albumin (Hemin, 2020). these results were in agreement with (Kirunda and McKee, 2000) who founded that strength of vitelline membrane decreases by storage and makes yolk more susceptibility to breaking, as a result, water slowly enters into the yolk from the albumen, so this creates a mottled appearance in yolk, and the yolk becomes flattened.

Table 7. Effect of interactions between layer ages and egg storage periods on Yolk diameter (mm) and Yolk index (Mean ± SEM)

Factors		Traits	
Layer age (weeks)	Egg storage periods (days)	Yolk diameter (mm)	Yolk index
30	2	39.450 b ± 0.68	0.511 a ± 0.46
	4	39.810 ab ± 0.92	0.499 a ± 0.18
	6	40.310 ab ± 1.15	0.468 a ± 0.12
34	2	40.070 a ± 1.4	0.504 a ± 0.04
	4	40.630 a ± 0.23	0.491 a ± 0.04
	6	40.800 a ± 3.87	0.486 a ± 0.18
38	2	39.590 b ± 1.94	0.544 a ± 0.11
	4	40.800 a ± 1.61	0.500 a ± 0.18

	6	41.320 a ± 1.83	0.473 a ± 0.11

Means values in the same column having different superscripts are significantly different at P≤0.05.

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