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Egg Quality Effect by Breeder Ages and Egg Storage

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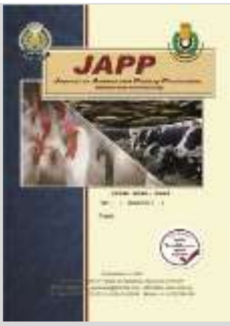

ABSTRACT

The study was conducted to investigate the effects of age of broiler breeder (30 and 45 weeks), storage period (2, 4, 6 and 8 days) and their interactions on egg quality traits of the Ross-308 broiler breeder eggs. The experiment included the measurements of the egg quality characteristics in the research laboratory. Results from this study were summarizing as: age of broiler breeder had significant effect ($p \leq 0.05$) on some quality traits of the eggs such as: egg weight, albumin weight, yolk weight, Haugh unit, yolk height, yolk index, Storage period had significant effect ($p \leq 0.05$) on egg weight, albumin weight, Haugh unit, yolk index.

Keywords: egg quality, breeder age, egg storage

INTRODUCTION

Breeder age can be considered as one of the major factors affecting variability in egg characteristics, fertility, hatchability and broiler performance (Peebles *et al.*, 2001; Elibol *et al.*, 2002; Guibert *et al.*, 2012). Egg from young breeder tend to be smaller egg with higher albumen proportion to yolk, lower albumen pH and higher shell thickness than eggs from old breeder (Peebles *et al.*, 2000). Breeder age can be also contribute factor as post- hatch performance, smaller yolk proportions of eggs from a young flock may be related with low final body weight of their generation (Ulmer *et al.*, 2010). Hulet *et al.*, (2007) revealed that broiler from old breeder had body weight higher until 35 d compared with broiler from the young breeder. 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).

A storage beyond 7 day increases duration of incubation (Tona *et al.*, 2003) and has a negative feedback on hatchability (Fasenko *et al.*, 2001; Tona *et al.*, 2004; Yassin *et al.*, 2008) and chick quality (Tona *et al.*, 2003, 2004). Negative results of prolonged egg storage may be caused by quality of embryo, changes in egg characteristics or by both (Reijrink *et al.*, 2008). Poor shell quality was related with a high percentage of moisture loss by incubation (Peebles *et al.*, 2001) and low hatchability (Narushin and Romanov, 2002).

The objective of this study was to demonstrate the effects of age of broiler breeder and egg storage period on egg quality characteristics.

MATERIALS AND METHODS

1200 eggs of broiler breeder (Ross-308) were used in this experiment, at 30 and 45 weeks of breeder's age.

The experiment was divided in to two stages, the first stage included storing the eggs for 2, 4, 6 and 8 days in cooling storage conditions including, followed by the second stage which started to measure the egg quality characteristics in the laboratory.

The experimental studied factors were as the following:

First factor: included two levels of broiler breeder age (30 and 45) weeks.

Second factor: included four levels of storage periods | (2,4,6 and 8 days).

Egg test.

Sixty (600) eggs were taken from each different breeder ages and 150 eggs were stored for each 2, 4, 6 and 8 days in cooling storage condition(50 eggs/ 3 replicates), after storage periods all eggs from each group were taken to measure the quality characteristic of the eggs.

Studied traits.

Egg weight (g).

After storing periods the eggs from each group were weighed individually using sensitive balance type Mettler toledo (max=101g and e=0.1mg) by gram.

Albumin weight (g).

After yolk separation from albumin, albumin weighed by using sensitive balance.

Yolk weight (g).

After yolk separation from albumin, yolk was weighed by the same balance.

Shell weight (g).

Shell weight was calculated by the following equation:

Egg shell weight = Egg weight (g) – Yolk with albumin weight (g)

Yolk, albumin and shell percentage.

Traits were calculated by the following equations:

$$\text{Yolk \%} = \frac{\text{Yolk weight (g)}}{\text{Egg weight (g)}} \times 100$$

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$$\text{Albumin \%} = \frac{\text{Albumin weight (g)}}{\text{Egg weight (g)}} \times 100$$

$$\text{Shell \%} = \frac{\text{Shell weight (g)}}{\text{Egg weight (g)}} \times 100$$

Yolk, albumin ratio.

The following equation was used to measure this trait:

$$\text{Yolk, albumin ratio} = \frac{\text{Yolk weight (g)}}{\text{Albumin weight (g)}}$$

Albumin height (mm).

Albumin height was recorded after pouring albumin on the phial-layer by spherometer.

Haugh unit (HU).

Haugh unit was calculated by depend on albumin height (mm) and egg weight (g) by the following equation:

$$HU = 100 [\log (H+7.57 - 1.7 W^{0.37})]$$

H= height of albumin (mm)
W= weight of egg (g)

Yolk height (mm).

Yolk height was recorded by the spherometer.

Yolk diameter (mm).

Yolk diameter was measured by the same Vernier.

Yolk index.

Yolk index was calculated depending on the following equation:

$$\text{Yolk index} = \frac{\text{Yolk height}}{\text{Yolk diameter}}$$

Egg specific gravity.

Egg specific gravity was measured after egg storing . Egg was weighted individually on electric balance after that put the same egg in the water solution and egg specific gravity were calculated according to the following equation:

$$\text{egg specific gravity} = \frac{\text{Egg weight}}{\text{Egg weight} - \text{Egg weight in the water solution}}$$

Statistical analysis.

The present experiment was conducted using Completely Randomized Design (C.R.D) with two factors namely broiler breeder ages and storage periods to study the effect of these factors on the egg quality traits. Statistical analysis was accomplished using (Xlstat-2017 Program for Windows version 19.6). Duncan's multiple range tests (Duncan, 1955) were used to determinate the significant difference among treatment means. Significant level to analyze was ($P \leq 0.05$).

RESULTS AND DISCUSSIONS

Results

Egg weight (g) and Albumin weight (g).

The effects of interactions between broiler breeder ages and storage periods had significant ($p \leq 0.05$) effect on egg weight (g) (Table 1), the highest weight (67.979g) was resulted in broiler breeder 45 weeks of age with 2 day of storage period and the lowest weight (56.731g) was resulted in broiler breeder 30 weeks of age with 8 day of storage period.

The effects of interactions between broiler breeder age, storage period had significantly affected ($p \leq 0.05$) albumin weight (g) as shown in (Table 1), the highest weight of albumin (43.421 g) was resulted in broiler breeder 45 weeks of age with 2 day of storage period and the lowest (33.48 g) was resulted in broiler breeder 30 weeks of age with 8 day of storage period.

Table 1. Effect of interactions between breeder age and storage period on egg weight (g) and albumin weight (g) (Mean ± SEM).

Factors		Traits					
Breeder age (weeks)	Storage periods (days)	Egg weight (g)			Albumin weight (g)		
30	2	65.812	ab	± 0.34	40.512	b	± 0.32
	4	65.636	ab	± 0.75	40.579	b	± 0.71
	6	62.603	bc	± 1.02	40.079	b	± 0.59
	8	56.731	c	± 0.53	33.48	d	± 1.32
45	2	67.979	a	± 1.09	43.421	a	± 0.25
	4	66.883	a	± 0.41	41.603	ab	± 0.66
	6	64.52	ab	± 0.74	39.61	bc	± 1.11
	8	60.732	b	± 0.13	35.86	c	± 0.99

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

Yolk weight (g) and shell weight (g).

The effects of interactions between broiler breeder ages, storage periods had significantly affected ($p \leq 0.05$) yolk weight (g), (Table 2), the highest value (18.78 g) of yolk weight was resulted in broiler breeder 45 weeks of age with 4 day of storage period and the lowest (15.36 g) was resulted in broiler breeder 30 weeks of age with 6 day of storage period. Also, there were no significant effects ($p \leq 0.05$) of interactions between broiler breeder ages, storage periods on egg shell weight (g), (Table 2).

Table 2. Effect of interactions between breeder age and storage period on yolk weight (g) and shell weight (g) (Mean ± SEM).

Factors		Traits					
Breeder age (weeks)	Storage periods (days)	Yolk weight (g)			Shell weight (g)		
30	2	18	a	± 0.17	7.3	a	± 0.44
	4	17.131	b	± 0.04	7.926	a	± 0.12
	6	15.36	c	± 1.05	7.164	a	± 1.37
	8	16	c	± 0.93	7.251	a	± 0.33
45	2	18.09	a	± 0.15	6.468	a	± 0.36
	4	18.78	a	± 0.04	6.5	a	± 0.25
	6	18.18	a	± 0.09	6.73	a	± 0.46
	8	17.92	ab	± 0.37	6.952	a	± 0.78

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

Albumin and Yolk percentage.

The effects of interactions between broiler breeder ages, storage periods had a significant effect ($p \leq 0.05$) on albumin percentage (Table 3), the highest value (64.02 %) of albumin percentage was resulted in broiler breeder 30 weeks of age with 6 day of storage and the lowest (59.04 %) was resulted in broiler breeder 45 weeks of age with 8 day of storage period.

The effects of interactions between broiler breeder ages, storage periods had a significant effect ($p \leq 0.05$) on yolk percentage (Table 3), the highest value (29.50 %) of yolk percentage was resulted in broiler breeder 45 weeks of age with 8 day of storage period and the lowest (24.53 %) was resulted in broiler breeder 30 weeks of age with 6 day of storage period.

Table 3. Effect of interactions between breeder age and storage period on albumin and yolk percentage (Mean ± SEM)

Factors		Traits					
Breeder age (weeks)	Storage periods (days)	Albumin (%)			Yolk (%)		
30	2	61.55716	ab	± 0.15	27.35064	ab	± 0.55
	4	61.8243	ab	± 0.88	26.10001	ab	± 0.02
	6	64.02089	a	± 0.32	24.53557	b	± 0.07
	8	59.05535	b	± 0.52	28.20328	a	± 0.11
45	2	63.87414	a	± 0.61	26.61116	ab	± 0.35
	4	62.20265	ab	± 0.44	28.07888	a	± 0.31
	6	61.39182	ab	± 0.35	28.17731	a	± 0.44
	8	59.0463	b	± 0.46	29.50669	a	± 0.27

Means values in same column having different superscripts are different significantly at $P \leq 0.05$.

Shell percentage and yolk albumin ratio.

The effects of interactions between broiler breeder ages, storage periods had a significant ($p \leq 0.05$) effect on shell percentage (Table 4), the highest value of shell percentage (12.78 %) was resulted in broiler breeder 30 weeks of age with 8 day of storage period and the lowest (9.71 %) was resulted in broiler breeder 45 weeks of age with 4 day of storage period. Also, there were no significant ($p \leq 0.05$) effects of interactions between broiler breeder ages, storage periods on yolk albumin ratio, (Table 4).

Table 4. Effect of interactions between breeder age and storage period on shell percentage and yolk albumin ratio (Mean ± SEM).

Factors		Traits					
Breeder age (weeks)	Storage periods (days)	Shell (%)			Yolk albumin ratio		
30	2	11.0922	ab	± 0.44	0.444313	a	± 0.01
	4	12.07569	ab	± 0.27	0.422164	a	± 0.03
	6	11.44354	ab	± 0.56	0.383243	a	± 0.07
	8	12.78137	a	± 0.26	0.477897	a	± 0.06
45	2	9.814703	ab	± 0.13	0.416619	a	± 0.25
	4	9.718464	b	± 0.17	0.45141	a	± 0.18
	6	10.43087	ab	± 0.15	0.458975	a	± 0.25
	8	11.44701	ab	± 0.25	0.499721	a	± 0.11

Means values in same column having different superscripts are significantly different at $P \leq 0.05$.

Albumin height (mm) and haugh unit.

The effects of interactions between broiler breeder ages, storage periods had a significant ($p \leq 0.05$) effect on Albumin height (mm) (Table 5), the highest value of albumin height (8.3 mm) was resulted in broiler breeder 45 weeks of age with 2 day of storage period and the lowest value (4.2 mm) was resulted in 30 weeks broiler breeder of age with 8 day of storage. The effects of interactions between broiler breeder ages, storage periods had a significant ($p \leq 0.05$) effect on Haugh unit (Table 5), the highest value of Haugh unit (89.04) was resulted in broiler breeder 45 weeks of age with 2 day of storage and the (62.27) lowest was resulted in 30 weeks of age of broiler breeder with 8 day of storage.

Table 5. Effect of interactions between breeder age and storage period on albumin height (mm) and haugh unit (Mean ± SEM).

Factors		Traits					
Breeder age (weeks)	Storage periods (days)	Albumin height (mm)			HU		
30	2	7.79	ab	± 0.33	86.67345	a	± 1.53
	4	7.1	ab	± 0.27	82.44836	b	± 0.94
	6	5.81	ab	± 0.04	74.22712	ab	± 0.77
	8	4.2	b	± 0.07	62.27684	c	± 0.12
45	2	8.3	a	± 0.12	89.04809	a	± 0.55
	4	8.1	a	± 0.17	88.1934	a	± 0.57
	6	6.81	ab	± 0.21	80.86202	b	± 0.67
	8	4.56	ab	± 0.15	63.96782	c	± 1.23

Means values in same column having different superscripts are different significantly at $P \leq 0.05$.

Egg specific gravity and yolk height.

Also, The effects of interactions between broiler breeder ages, storage periods had significant ($p \leq 0.05$) effect on egg specific gravity, (Table 6), the highest value (1.090) was resulted in both broiler breeder 30 and 45 weeks of age with 2 day of storage period and the lowest

(1.070) was resulted in broiler breeder 30 weeks of age with 8 day of storage period, also, the value (1.070) obtained from breeders 45 weeks of age with 8 days of storage period.

The interactions between broiler breeder ages, storage periods had significant ($p \leq 0.05$) effect on yolk height (mm) (Table 6), the highest value of yolk height (19.790 mm) was resulted in broiler breeder 45 weeks of age with 2 day of storage period and the lowest (16.08 mm) was resulted in 30 weeks of age broiler breeder with 8 day storage.

Table 6. Effect of interactions between breeder age and storage period on egg specific gravity and yolk height (mm) (Mean ± SEM).

Factors		Traits					
Breeder age (weeks)	Storage periods (days)	Egg specific gravity			Yolk height (mm)		
30	2	1.09	a	± 0.01	19.14	a	± 0.13
	4	1.08	ab	± 0.21	18.9	a	± 0.57
	6	1.08	ab	± 0.15	17.56	ab	± 0.74
	8	1.07	b	± 0.01	16.8	b	± 0.52
45	2	1.09	a	± 0.01	19.79	a	± 0.55
	4	1.08	ab	± 0.03	19.76	a	± 0.12
	6	1.075	b	± 0.21	18.89	a	± 0.11
	8	1.07	b	± 0.003	18.01	ab	± 0.27

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

Yolk diameter (mm) and yolk index.

The interactions between broiler breeder ages, storage periods had a significant ($p \leq 0.05$) effect on yolk diameter (mm) (Table 7), the highest value of yolk diameter (40.61 mm) was resulted in broiler breeder 45 weeks of age with 8 day of storage period and the lowest value (35.78 mm) was resulted in 30 weeks of age of broiler breeder with 2 day of storage.

Broiler breeder ages and storage periods interactions had significant effects ($p \leq 0.05$) on yolk index (Table 7), the highest value of yolk index (0.5511) was resulted in 45 weeks of age broiler breeder with 2 day of storage and the lowest value (0.4159) was resulted in 30 weeks of age broiler breeder with 8 day of storage.

Table 7. Effect of interactions between breeder age and storage period on yolk diameter (mm) and yolk index (Mean ± SEM).

Factors		Traits					
Breeder age (weeks)	Storage periods (days)	Yolk diameter (mm)			Yolk index		
30	2	35.78	c	± 0.25	0.534936	a	± 0.42
	4	36.64	b	± 0.55	0.51583	ab	± 0.33
	6	36.94	ab	± 0.13	0.475365	ab	± 0.25
	8	40.39	a	± 0.32	0.415945	b	± 0.24
45	2	35.91	bc	± 0.17	0.5511	a	± 0.56
	4	36.33	b	± 0.42	0.543903	a	± 0.67
	6	36.51	b	± 0.23	0.517392	ab	± 0.34
	8	40.61	a	± 0.27	0.443487	b	± 0.59

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

Discussions

The increase of egg weight with advancing age of broiler breeders (older breeders) may be due to increase the parts of egg components (especially yolk and albumin weight) giving more growth and activation of the reproductive system of broiler breeders compared to younger breeders. This can be explained by the associated increase in egg weight with age. Similar results were reported by (Yildirim, 2005; Vieira *et al.,* 2005; Akyurek and Okur, 2009; Javid *et al.,* 2016).

Also, 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. When the storage period is extended the egg weight declines due to loss of moisture from the egg. These results with respect to the effect of storage period on egg weight loss agreed with those of (Reijrink *et al.,* 2010; Gonzalez, 2010).

The increase in the albumin egg weight in older breeders may be due to more growth and activation of the reproductive system of females compared to younger breeders (Javid *et al.,* 2016). Albumin weight was decreasing with a longer storage of egg and storage condition, this is resulted by water loss or migration from the albumin. These results were in agreement with the suggestions of (JIN *et al.* 2011; Yeasmin *et al.,* 2014) whom revealed that the albumin weight affected by storage temperature condition and storage period of eggs.

Generally, the present study showed that the interaction between the main factors after storage showed clearly the decreased the egg weight and albumin weight for eggs that stored 6 and 8 days, this was may be due to the storage periods and storage condition that caused the loss of moisture from the egg. The present results very similar to those results reported by (Reijrink *et al.,* 2010; Gonzalez-Redondo, 2010; JIN *et al.,* 2011).

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) that recorded the increase in egg components by old breeders compared with young breeders. And 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 chose by several authors (Demirel and kirikci, 2009; Muhammad *et al*,. 2013; Muhammad *et al.,* 2014) who reported positive correlation between increased yolk weight with increased storage periods and condition. The interaction between the main factors showed clearly the increase of yolk weight for old broiler breeders was caused by activity of reproductive system of females and liver, and for storage periods, this was may be due to the and migration of moisture from the albumin to the yolk. The results were very similar to the results reported by (Demirel and kirikci, 2009; muhammad *et al*,. 2013; muhammad *et al.*, 2014; javid *et al.*, 2016).

According to the present results there were no effects of the interactions between the main factors on shell weight, however, numerically shell weight increased with advancing of age in broiler breeders. These findings were in line with (Silversides and Scott, 2001; Akyurek and Okur, 2009; Yeasmin *et al.,* 2014) whom reported no effects of storage temperature and storage period on shell weight.

Albumin and yolk percentage of eggs were affected significantly by storage conditions and the interaction between broiler breeder 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 (Kırıkçı *et al.,* 2005; Demirel and kirikci, 2009) whom found the effect of storage period on albumin and yolk percentage.

The cause of affecting of interaction between broiler breeder ages and storage periods on increasing of shell percentage may be due to decrease of other eggs component ratio during storage period. Shell ratio determined in the present study was similar to the finding of Demirel and kirikci, (2009).

According to the results there were no effects of main factors and their interactions on yolk albumin ratio. However, numerically there was a little difference between the interactions of main factors; this is may be due to the variety and the proportion of the yolk and albumin of eggs during the storage periods. These results were in agreement with those suggested by Suk and Park, (2001).

In the present study there was not effect of age of broiler breeder on albumin height, but had significant effect of interactions between age of broiler breeder with storage temperature condition on albumin height. These results were consistent with the findings of (Silversides and Scott, 2001; Yeasmin *et al.,* 2014) who reported the reduction of albumin height was due to the decrease in thick albumen height, because of breakdown of the ovomucin-lysozyme complex during storage periods.

In the present study the storage of eggs clearly reducing of (HU) between young and older breeders. Also, these effects caused by the effects of interaction of storage with age (Tona *et al*,. 2004), these results may be due to increase of egg weight and albumin height of eggs from old broiler breeders compared to young broiler breeders. This reduce HU was returrn to age of broiler breeders or storage periods which were similar with the reports of (Akyurek and Okur, 2009; Tona *et al*,. 2004; Silversides and Scott, 2001).

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 Monira *et al.* (2003), who reported that values decreased with storage period. The results related to the effect of storage on HU were similar with (Tilki and Saatçi, 2004; Demirel and Kirikçi, 2009; Nowaczewski *et al.*, 2010; Alsobayel and Albadry, 2011; Michael *et al*,. 2016), who reported that the Haugh unit significantly decreased with increasing days of storage, due to loss of water from the eggs.

There was no significant effect of broiler breeder ages on egg specific gravity, these results were in agreement with (Gualhanone *et al*,. 2011; Akyurek and Okur, 2009) who reported that no effect of breeder age on (ESG). On the other hand, eggs specific gravity decline gradually with the advancing of storage period as a resulting in decreases at prolonged of storage periods, and with increasing days of storage the specific gravity of eggs declined more rapidly than that eggs for 2 days of storage, this might be due to the size of the air cell with increase of storage period and temperature the size of the air cell increased. These results were in agreement with (Yeasmin *et al*,. 2014; Alsobayel and Albadry, 2011; Akyurek and Okur, 2009) who observed the size of the air cell increased with different storage temperatures.

In the present study the yolk height values were increased by advancing the age of broiler breeders, this was may be due to the size of yolk in heavy egg compared to light egg, but 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 index value. These results were confirmed with (Abdel-Azim and Farahat, 2009; Günlü *et al.,* 2007) who found the change of yolk index value under the effect of changing yolk height value.

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. The results were similar with (Kirunda and McKee, 2000) who founded that strength of vitelline membrane decreases by storage and makes yolk more susceptiblity 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. The yolk diameter values were higher in eggs stored for 2 days, because at the eggs stored for the long time, the amount of water migration from the albumen to the yolk is high, which caused to increase yolk diameter (Yeasmin *et al.,* 2014).

The results of (table 7) also showed that the yolk index (YI) values were significantly decrease with increased storage periods which was most likely due to water loss from the egg. On the other hands, the yolk index values equation depended on the yolk height and yolk diameter, when the yolk diameter increased with increase storage periods and conditions which resulted in an increase the YI values. These results were similar to those found by (Kuzniacka *et al.*, 2005; Günlü *et al.*, 2007; Gupta *et al*,. 2007; Abdel-Azim and Farahat 2009).

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This study was conducted at the poultry farm of College of Agricultural Sciences, University of Sulaimani. The experiment was included measurements of the egg quality characteristics in the research laboratory by investigate the effect of broiler breeder ages, storage periods and their interactions on egg quality traits of the Ross-308 broiler breeder eggs.

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تأثير عمر الامهات وفترات خزن البيض على صفات النوعية للبيض

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اجري هذا البحث لدراسة تاثير عمر امهات دجاج اللاحم (30 و 45 اسابيع) وفترات الخزن (2 ، 4 ، 6 و 8 ايام) والتداخل بيناهما على صفات النوعية للبيض الناتج من امهات الدجاج اللاحم من نوع روز-308. اثناء التجربة يتم قياس الصفات النوعية للبيض داخل المختبر. ويتلخص النتائج من هذه الدراسة كالتالى: تاثير عمر امهات دجاج اللاحم لهاتاثيرات معنوية على مستوى ($P\leq0.05$) في تحسين الصفات النوعية للبيض منها وزن البيض، وزن البياض، وزن الصفار، وحدة الهيو، ارتفاع الصفار ودليل الصفار. و هناك تاثير معنوي على مستوى ($P\leq0.05$) لفترات الخزن البيض على الصفات وزن البيض، وزن البياض، وحدة الهيو وكذلك دليل الصفار.