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# If Pre-Storage Heating Improve the Hatchability and Decreased Embryonic Mortality of Broiler Breeder Eggs Stored for Long Period

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## ABSTRACT

The experiment was conducted on 1080 fertile eggs (average 62 grams weight) collected from AL-SHROUK breeder farms of 34 weeks old breeding flock. This eggs were randomly divided into 3 groups of 360 eggs according to storage period (7, 14 and 21 days) and subdivide into 4 groups of 90 eggs each according to warming treatments (0, 4, 8 and 12 hours) at 37.5°C, after the warming treatments eggs placed for two hours in setter hall and back into cooler operating at 16 – 18°C and 60 – 80% relative humidity until end of all storage time. Egg storage until 7 days showed the best significantly values for fertile eggs, fertility%, hatchability%, hatchability of fertile eggs%, average chick weight. However storage until 21 days showed the highest significantly number of un-hatched eggs and showed the highest number of total embryonic morality and weight losses. Pre-hating at 4 hours showed the highest significantly values for hatchability percentage and hatchability of fertile eggs percentage but Pre-hating at 12 hours showed the highest significantly number of un-hatched eggs and showed the highest number of total embryonic morality without any significant effect. Interaction between storage periods and pre-heating treatments showed significantly effect on hatchability percentage, hatchability of fertile eggs percentage, chick weight, un-hatched egg, embryonic mortality, percentages of chick weight before and after storage, and dead chicks.

**Keywords**: (Egg storage; pre-heating; embryonic mortality)

## INTRODUCTION

Hatching eggs were stored on broiler breeder farms and hatcheries to minimize transportation costs or to provide for enough eggs available to fill large capacity incubators. But egg storage for more than a week is known to increase embryonic mortality and abnormalities due to the degradation of viscosity of egg albumen (Van de Ven, 2004). Storage egg hatching is a common practice in commercial breeder farms and their hatcheries; the period of egg storage varies between seven days and several weeks. However, the total length of storage period depends on the supply of hatching eggs, maximum hatchery capacity, and the variable market demand for 1-day old chicks in the poultry industry. Usually, hatcheries set eggs after 3 to 5 days of storage, but in some time, a hatchery needs to increase the storage period more than 7 days (Gharib, 2013).The eggs stored longer than a seven days also, reduced hatchability and increased incubation time. Post-hatch performance; chick quality and poults from eggs stored for long periods are also deteriorated (Petek and Dikmen, 2006). Stored egg more than 7 days is associated with a lag in embryo development (Christensen *et al.,* 2001), altered metabolic rate (Fasenko *et al.,* 2009), increased incubation time (Ruiz and Lunam, 2002 and Tona *et al.,* 2003), impairing embryo development and livability (Elibol *et al.,* 2002 and Van de Ven, 2004), and decline in hatchability (Petek and Dikmen, 2006 and Yassin *et al.,* 2008). A lot of methods have been investigated to improve the hatchability% of stored eggs for beyond 7 days. One of them is to warm eggs prior to storage (Fasenko, 1997; Anonymous, 2000). Compared with eggs that were not warmed, the pre-heating of poultry eggs before storage was reported to result in increased hatchability% and decreased level of embryonic mortality (Fasenko et al., 2001a,b; Petek and Dikmen, 2004, 2005).

Therefore, the specific goal of current study, if pre-storage heating (0, 4, 8 and 12 hours) would improve the hatchability and decreased the embryonic mortality of broiler breeder (34 weeks of age) egg stored for long periods (7, 14 and 21 days).

## MATARILS AND METHODS

The experiment was carried out on 1080 fertile egg (average 62 gram) collected from AL-SHROUK Cobb500 breeder farms of 34 weeks old breeding flock. The collected egg was randomly divided into 3 group of 360 egg each according to storage period (7, 14 and 21 days) and subdivide into 4 group of 90 egg each according to warming treatments (0, 4, 8 and 12 hours) at 37.5°C, after the warming treatments eggs placed for two hours in setter hall and back into cooler operating at 16–18$^0$C and 60–70% relative humidity until to the end of all storage period. The egg was set in the setter after end storage period. Temperature of the setter was maintained at 99.5°F with 60% relative humidity during the first 18$^{th}$ days. After the 18$^{th}$ days of incubation egg were transferred from setter to hatch. Hatch temperature, wet bulb temperature and other conditions are shown in tables (1, 2, 3 and 4). Chicks were taken out the hatch after egg completed hatching.

All experimental egg was weighed after collection and at end of storage period. Dynamic weight loss occurred during storage period was expressed as a percentage of fresh egg weight.

Fertility percentage is the ratio between number of fertile egg and number of total egg, and was calculated by the equation. The accounting of unfertilized eggs was made at the end of the incubation period.

$$\text{Fertility (\%)} = \frac{\text{Number of Fertile eggs}}{\text{Number of total eggs}} \times 100$$

End incubation period (21$^{th}$ days) the chick and all un-hatched egg were removed. Un-hatched egg broken out to determination age of embryonic mortality and pips.

**Table 1. Hatch Temperature (°F) Program.**

| Step | Temperature °F | Process Time (Day:Hours) |
|---|---|---|
| | | Days: hours |
| 1 | 99.2 | 18 : 01 |
| 2 | 99.0 | 19 : 00 |
| 3 | 98.8 | 20 : 00 |
| 4 | 98.5 | 20 : 14 |
| 5 | 98.2 | 20 : 18 |
| 6 | 98.2 | 21 : 06 |

**Temperature is an independent program and must be programmed separately.**

All data were statistically analyzed the General Linear Model (GLM) procedures using statistical software SAS (2004), to evaluate the effect of storage period; warm treatment and their interaction. The significant differences between group means were tested by the multiple range test according to Duncan (1955).

**Table 2. Hatch Humidity (°F) Program.**

| Step | Humidity (°F) Wet bulb | Process Time (Day:hours) |
|---|---|---|
| | | Days : hours |
| 1 | 85 | 18 : 01 |
| 2 | 92 | 19 : 06 |
| 3 | 88 | 20 : 18 |
| 4 | 86 | 21 : 06 |

**Humidity is an independent program and must be programmed separately.**

**Table 3. Hatch Ventilation (%) Program.**

| Step | Ventilation% | | Process Time (Day : hours) |
|---|---|---|---|
| | Minimum | Maximum | Days : hours |
| 1 | 25 | 45 | 18 : 01 |
| 2 | 50 | 70 | 19 : 12 |
| 3 | 50 | 80 | 20 : 03 |
| 4 | 60 | 90 | 20 : 13 |
| 5 | 60 | 100 | 20 : 20 |
| 6 | 70 | 100 | 21 : 06 |

**Table 4. Hatch Cooling program.**

| Step | Cooling system | Process Time |
|---|---|---|
| | | Days : hours |
| 1 | Water cooled | 18 : 00 |
| 2 | Air and Water cooled; air cooling delayed | 19 : 00 |
| 3 | Air and Water plus | 20 : 18 |

## RESULTS AND DISCUSSION

**Effect of storage period and pre-heating treatments on fertility%:**

Data of storage period, pre-heating treatment and their interaction were summarized in Table (5). storage period showed significantly effect on number of fertile eggs and fertility %, increasing of storage period led to decrease fertility percentage, which was associated significantly with the increase in the number of clear eggs due to the death of embryos at early period, treatment 1, (7 days of storage) showed the best significantly values for number of fertile eggs and fertility %, which was associated with the lowest number of clear eggs (29.17, 97.22% and 0.83 respectively) when compared with other treatments, 2 (28.83, 96.11% and 1.17 respectively ) and 3 (28.08, 93.61% and 1.92 respectively). In current study, the seven day egg storage improved the hatchability%; total and fertile egg significantly compared to the 14$^{th}$ and 21$^{th}$ days egg storage. This result was expected in accordance with previous reports on broilers and other species related to egg storage and pre-storage incubation (Uddin *et al*., 1994; Fasenko, 1997; Anonymous, 2000; Fasenko *et al*., 2001a,b).

Results are agreement with finding by Petek and Dikmen (2006) showed that, fertility% of egg stored for 5$^{th}$ days were significantly better than egg stored for 15$^{th}$ days. Petek *et al*. (2003), Petek and Dikmen (2004) reported that, storage egg long period prior to incubation decreased apparent fertility significantly. Factly, collection of egg for the 5- and 15-day storage groups was separated by 10 days might have accounted for the differences in fertility. But, Elibol *et al*. (2002) and Gharib (2013) didn't find any significant effects on the apparent fertility percentage among treatments eggs stored for 4, 7, 10 and 14 days at 18°C and 75% RH of broiler breeder. Pre-hating treatment didn't show any significant effect on number of fertile eggs and fertility %. The same results were found by Reijrink *et al.* (2010) and Gharib (2013) didn't find any significant effects on the apparent fertility percentage among pre-storage heating durations (0, 6, and 9 hours at 37.5° C and 56% RH) of broiler breeder eggs. On the other hand, Petek and Dikmen (2006) found that heated broiler breeder eggs for 4 and 8 h in 38.0°C significantly decreased fertility compared to non-heated eggs.

**Table 5. Effect of different treatments and their interaction on incubation characteristics.**

| Treatment | Fertile egg/rep. | Clear egg/rep. | Fertility % |
|---|---|---|---|
| Storage (A): | | | |
| 1 (7 days) | 29.17$^{a}$ | 0.83$^{b}$ | 97.22$^{a}$ |
| 2 (14 days) | 28.83$^{ab}$ | 1.17$^{ab}$ | 96.11$^{ab}$ |
| 3 (21 days) | 28.08$^{b}$ | 1.92$^{a}$ | 93.61$^{b}$ |
| SEM | 0.32 | 0.32 | 1.08 |
| Sig | * | * | * |
| Pre-heating (B): | | | |
| 1 (0 hours) | 28.89 | 1.11 | 96.30 |
| 2 (4 hours) | 29.00 | 1.00 | 96.97 |
| 3 (8 hours) | 29.00 | 1.00 | 96.97 |
| 4 (12 hours) | 29.00 | 1.00 | 96.97 |
| SEM | 0.37 | 0.37 | 1.24 |
| Sig | N.S | N.S | N.S |
| Interaction (A*B) | N.S | * | * |

**$^{a-b}$: Means having different superscripts within the same row are significantly different at P<0.05.**

In this study, it was found that interaction between storage periods and pre-heating treatments was not significant effect on number of fertile eggs. However, significant (P<0.05) effect for interaction were observed for fertility % and clear eggs. A few embryos of prolonged storage egg couldn't start developing immediately in normal incubation condition. Another point of view is that the development of embryo from stored egg for a long time proceeds at a slower rate in the first period of incubation.

**Effect of storage period and pre-heating treatments on number of chicks, hatchability %, hatchability for fertile eggs % and chick weight:**

Data of number chicks, hatchability percent, hatchability for fertile egg percent and chick weight were summarized in Table (6). The results revealed that treatment 1, (7 days of storage) showed the best significant values for hatchability and hatchability for fertile eggs percentage and chick weight at hatch (87.78%, 90.24% and 43.62 g, respectively) when compared with other storage periods, T2 (37.33%, 76.23% and 43.38 g) and T3, (54.72%, 58.81% and 43.08 g). These results agreement with (Yassin *et al*. 2008) who reported that attributed to the quality of the egg deprecates, where by the metabolic activity of the chick embryo is affected, which in turn influences the embryonic development of the chick. Fertility refers to the percentage of incubated egg that are fertile, while hatchability is the percentage of fertile eggs

that hatch. Fertility and hatchability are interrelated heritable traits that vary among breed, variety and individuals in a breed or variety. A number of other factors including age of egg (Tarongoy *et al*., 1990), storage factor (Brah and Sandhu, 1989), flock age (Rogue and Soares, 1994), husbandry and rearing (Weis, 1991), mating (Gebhardt-Henrich and Mark, 1991), incubation RH and turning angle egg.

On the other hand, Petek *et al*. (2005) showed that hatchability of fertile and total egg not affected by length of storage for quail's eggs at 1, 3, 5, or 7 d. Pre-hating 4 hours showed the highest significantly values for hatchability and hatchability for fertile eggs percentage (77.04% and 82.22%) when compared with other treatments, non-pre-heating, pre-heating 8 hours and pre-heating 12 hours but control treatment (0 hours) showed the highest significantly values for chick weight at hatch (44.49 g) when compared with other pre-heating treatments 4, 8 and 12 hours (42.88, 43.19 and 42.88g, respectively).

**Table 6. Effect of different treatments and their interaction on number of chicks, hatchability%, hatchability for fertile egg and chick weight.**

| Treatment | NO. of chick/rep. | Hatchability% | Hatchability for fertile egg% | Chick weight(g) |
|---|---|---|---|---|
| Storage (A): | | | | |
| 1 (7 days) | 26.33$^{a}$ | 87.78$^{a}$ | 90.24$^{a}$ | 43.62$^{a}$ |
| 2 (14 days) | 22.00$^{b}$ | 73.33$^{b}$ | 76.23$^{b}$ | 43.38$^{ab}$ |
| 3 (21 days) | 16.42$^{c}$ | 54.72$^{c}$ | 58.81$^{c}$ | 43.08$^{b}$ |
| SEM | 0.68 | 2.28 | 2.08 | 0.15 |
| Sig | * | * | * | * |
| Pre-heating (B): | | | | |
| 1 (0 hours) | 22.67$^{a}$ | 75.56$^{a}$ | 78.08$^{ab}$ | 44.49$^{a}$ |
| 2 (4 hours) | 23.11$^{a}$ | 77.04$^{a}$ | 82.22$^{b}$ | 42.88$^{b}$ |
| 3 (8 hours) | 20.89$^{ab}$ | 69.63$^{ab}$ | 72.03$^{bc}$ | 43.19$^{b}$ |
| 4 (12 hours) | 19.67$^{b}$ | 65.56$^{b}$ | 68.03$^{c}$ | 42.88$^{b}$ |
| SEM | 0.79 | 2.63 | 2.40 | 0.17 |
| Sig | * | * | * | * |
| Interaction (A*B) | * | * | * | * |

**$^{a-c}$: Means having different superscripts within the same row are significantly different at P<0.05.**

Egg storage more than 7th days decreased embryonic mortality, embryo weight, hatchability% and chick quality grade (Fasenko, 2007; Hamidu *et al*., 2011). Negative effects of storage egg long period on hatchability and chick quality may be caused by changes in the embryo or in the egg characteristics, or by both (Reijrink *et al*., 2010). Marandure *et al*. (2012) found that hatchability percentage for broiler breeder egg exposed to pre-heating for 4h significantly higher than for egg exposed to pre-heating for 8h or 12 h after collection against the control which was not subjected pre-heating treatment. But, Gucbilmez *et al*. (2013) didn't find any benefit effect due to heating broiler breeder's eggs for 1 d of a 6-d storage period on hatchability percentage. Interaction between storage periods and pre-heating treatments showed significant effect on hatchability and hatchability for fertile eggs percentage and chick weight at hatch.

**Effect of storage period and pre-heating treatments on un-hatched egg, embryonic mortality, pips and abnormal chicks:**

The effects of storage period and pre-heating treatments and their interactions on Un-hatched egg, embryonic mortality, pips and abnormal chicks are presented in Table 7. Results declared that storage at 21 days showed the highest significantly number of un-hatched eggs (10.08) when compared with other storage periods (2.67 and 5.05 for 7 and 14 days of storage, respectively), also the same treatment showed the highest significant number of total embryonic morality (7.59) when compared with other treatments (1.58 and 3.66 for 7 and 14 days of storage, respectively). However, the storage period and pre-heating treatments and their interactions didn't show any significant differences on pips (live or dead) and abnormal chicks.

Pre-hating at 8 and 12 hours showed the highest significant number of un-hatched eggs (7.00 and 8.00) when compared with other pre-heating treatments (4.11 and 5.22 for control and pre-hating at 4 hours, respectively), also the same treatment showed the highest number of total embryonic morality (5.44 and 6.45) for group (3 and 4, pre-heating 8 and 12 h, respectively) when compared with other pre-heating group ((2.67 and 2.56) for control and pre-hating at 4 hours, respectively). All treatments didn't show any significant effect on pips (live or dead) and abnormal chicks. Interaction between storage periods and pre-heating treatments showed significant effect on un-hatched egg and embryonic mortality without any significant effect on pips and abnormality chicks due to interaction.

Similar results were observed by Reijrink *et al*. (2010) and Gharib (2013) who found that significantly higher late embryonic mortality rate was observed in egg stored for 10$^{th}$ and 14$^{th}$ days at 18°C and 75% RH of broiler breeder eggs as compared to the other storage period groups ( 4 and 7 days at the same treatment) . Recently (Hamidu *et al*., 2010, 2011) showed the harmful impact of prolonged storage on broiler and layer blastodermal cell viability, cell death and mechanism of survival. Although, it isn't clear the extent of embryonic metabolic imbalance created by prolonged egg storage and what implications embryonic metabolism might have in reduction of embryonic cell viability, embryo development and early chick quality grade. Our Results are agreement with finding by Petek and Dikmen (2006) found that heated broiler breeder

eggs for 4 and 8 h in 38.0°C significantly increased embryonic mortality compared to non-heated eggs. But, Gucbilmez *et al*. (2013) when heating broiler breeder's eggs for 1 d of a 6-d storage period, they didn't find any benefit effect on early and late dead.

**Table 7. Effect of different treatments and their interaction on un-hatched egg, embryonic mortality, pips and abnormal chicks.**

| Treatment | Un-hatched egg/rep. | Embryonic mortality/rep. | | | | Piped eggs/rep. | | Abnormal chicks/rep. |
|---|---|---|---|---|---|---|---|---|
| | | Early dead | Mid dead | Late dead | Total | Live | Dead | |
| Storage (A): | | | | | | | | |
| 1 (7 days) | 2.67$^{c}$ | 1.08$^{c}$ | 0.25$^{ab}$ | 0.25 | 1.58$^{c}$ | 0.08 | 0.00 | 0.00 |
| 2 (14 days) | 5.50$^{b}$ | 2.33$^{b}$ | 0.58$^{a}$ | 0.75 | 3.66$^{b}$ | 0.25 | 0.00 | 0.08 |
| 3 (21 days) | 10.08$^{a}$ | 7.17$^{a}$ | 0.00$^{b}$ | 0.42 | 7.59$^{a}$ | 0.17 | 0.00 | 0.00 |
| SEM | 0.56 | 0.33 | 0.12 | 0.22 | 0.18 | 0.11 | 0.00 | 0.05 |
| Sig | * | * | * | NS | * | NS | NS | NS |
| Pre-heating (B): | | | | | | | | |
| 1 (0 hours) | 4.11$^{c}$ | 1.67$^{b}$ | 0.22$^{ab}$ | 0.78 | 2.67$^{b}$ | 0.11 | 0.00 | 0.00 |
| 2 (4 hours) | 5.22$^{bc}$ | 2.00$^{b}$ | 0.56$^{a}$ | 0.00 | 2.56$^{b}$ | 0.11 | 0.00 | 0.00 |
| 3 (8 hours) | 7.00$^{ab}$ | 4.78$^{a}$ | 0.22$^{ab}$ | 0.44 | 5.44$^{a}$ | 0.11 | 0.00 | 0.00 |
| 4 (12 hours) | 8.00$^{a}$ | 5.67$^{a}$ | 0.11$^{b}$ | 0.67 | 6.45$^{a}$ | 0.33 | 0.00 | 0.11 |
| SEM | 0.65 | 0.38 | 0.14 | 0.25 | 0.28 | 0.12 | 0.00 | 0.06 |
| Sig | * | * | * | N.S | * | N.S | N.S | N.S |
| Interaction (A*B) | * | * | * | * | * | N.S | N.S | N.S |

**$^{a-c}$: Means having different superscripts within the same row are significantly different at P<0.05.**

Total embryonic mortality during incubation in current study was affected by the main factor (storage time; pre-heating) and interactive effects significantly. Embryonic mortality of egg in the 4 and 8h pre-heating treatment were significantly increased compared to the non-warmed group. Most embryonic mortality was in egg stored for 21$^{th}$ days. The embryos of egg stored for 21$^{th}$ days showed noticeably lower hatchability and higher embryonic mortality (Tables 5 and 6). Significant in interaction (pre-heating × egg storage) for hatchability and embryonic mortality revealed that pre-heating treatment decreased hatchability% and increased embryonic mortality in egg stored for 21 days.

## CONCLUSION

Results of the current study provide evidence that prolong egg storage to 21 days had a negative effect on fertile egg, clear egg, fertility %, chicks number, hatchability%, hatchability of fertile egg %, average weight of chicks, un-hatched egg and embryonic mortality. It is recommended that should be taken to store egg below the minimum recommended storage period 7 days.

In addition, pre-heating treatments especially, 4 hour that may increase the viability of stored egg and therefore should be applicated to minimize the harmful impact of prolonged egg storage.

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## هل تقوم عملية التسخين الحرارى- قبل تخزين بيض التفريخ- بتحسين نسبة الفقس وتقليل النفوق الجنينى لبيض الدجاج المخزن مدة طويلة

**زياد محمد قلبة , السمرة حسن أبو عجله و محمد عبد المنعم طمان**

**قسم إنتاج الدواجن- كلية الزراعة- جامعة المنصورة- المنصورة- مصر**

أجريت التجربة على ١٠٨٠ بيضة مخصبة (متوس ط وزن ٦٢ جراما) ش تم جمعها من قطيع التربية بمزرعة الشروق للأمهات عمر ٣٤ أسبوعا. تم تقسيم البيض عشوائيا إلى ٣ مجموعات كل مجموعة بها ٣٦٠ بيضة كل حسب فترة التخزين (٧ و ١٤ و ٢١ يوما) وتم تقسيم كل مجموعة تخزينية إلى ٤ مجموعات مكونة من ٩٠ بيضة كل علي حسب معاملات التدفئة (٠و ٤ و ٨ و ١٢ ساعة) علي درجة حرارة ٣٧.٥°م، بعد المعاملات الحرارية للبيض تم وضع البيض لمدة ساعتين في صالة المفرخات وتم إعادته بعد ذلك إلي حجرة التبريد وحفظه علي درجة حرارة ١٦-١٨° م ورطوبة نسبية ٦٠-٨٠٪ حتى نهاية كل فترة تخزينية. أظهرت النتائج أن البيض المخزن حتى ٧ ايام أظهر أفضل قيم معنوية لعدد البيض المخصب والخصوبة ونسبة الفقس للبيض المخصب ومتوسط وزن الكتاكيت عند الفقس. بالرغم من ذلك فإن التخزين علي ٢١ يوم أظهر أعلى عدد من البيض الكابس، وأظهر أعلى عدد من الأجنة الميتة، ومتوسط الفقد في وزن البيض وعدد الكتاكيت الملتصقة. تدفئة البيض المخزن ٤ ساعات أظهرت أعلى قيم معنوية لنسبة الفقس ونسبة الفقس من نسبة البيض المخصب ولكن تدفئة البيض ١٢ ساعة أظهرت أعلى قيم لعدد البيض الكابس وأظهرت أعلى عدد من الأجنة الميتة. أظهر الداخل بين فترات التخزين ومعاملات الدفئة تأثيرا معنويا على نسب الفقس الكلية، فقس البيض المخصب، وزن الكتاكيت، البيض الكابس، النفوق الجنيني.