Egyptian J. Anim. Prod. 35, Suppl. Issue, Dec. (1998):641-652.

EFFECT OF BROILER BREEDER AGE, TEMPERATURE AND LENGTH OF EGG STORAGE TIME ON SOME EGG CHARACTERISTICS DURING INCUBATION

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SUMMARY

The objective of this study was to determine the effect of broiler breeder age, storage temperature and the egg storage time on embryonic development, embryonic mortality at different ages during incubation , loss of egg weight during incubation and hatchability. Eggs from 45 and 56 wk- old broiler breeder hens (Arbor Acres) were incubated at 37.5°C after storage for zero (fresh), 5, 10 and 15 days at room temperature (24 - 30°C) or cooled storage room (18 - 20°C) .

The fresh eggs had significantly greater hatchability than the stored eggs. Hatchability declined sharply after storing eggs for ten days at room temperature for both age groups. Hatchability was not affected when eggs from the younger hens were stored in cold room up to 10 days. There was no difference between hatchability for eggs stored for 5 days at either room temperature or the cold room for both age groups .

In general, the 6-day embryonic mortality rate increased with the storage time. The mortality rate reached 66.7% and 56.2% after 15 - days of storing the eggs at room temperature for breeder flock aged 45 and 56- wk, respectively .

Eggs from the 45-wk old flock had higher hatchability than the eggs from the 56-wk old flock , for the different storage times except for the eggs stored at room temperature for 15 days . In general, the growth rate of the embryos that hatched from older flock (56-wk) was lower than those hatched from younger one (45-wk) .

During storage period and until the sixth day of incubation egg weight loss was positively correlated with the increase of storage period .

Keywords : Broiler breeder,egg storage, hatchability, embryonic mortality, egg weight loss

INTRODUCTION

Hatching eggs are often stored for extended periods in commercial breeding operation to increase , in a given hatch, the chick numbers . The tropical and subtropical zones are characterized by certain seasonal climatological changes , namely the big fluctuation in atmospheric temperature and small variation in day length when compared with the temperate zone . These factors are vitally linked with the fertility , hatchability and embryonic mortality .

Hatchability gradually decline with increased length of the storage time, temperature at which eggs are held and the flock age . Long storage of eggs prior to incubation causes a decline in hatchability (Becker,1964) .On the contrary , eggs stored for a few days have been reported to hatch better than those set in an incubator soon after oviposition (Asmundson and MacIlriath, 1948). Albumen quality decreases by storage (Walsh, 1993) and flock age (Romanoff and Romanoff, 1949). Hurnik *et al* . (1978) found that the lower the albumen quality at oviposition, the more rapid its decline during storage . This decline in albumen quality during storage is due to evaporate. (Romanoff and Romanoff ,1949). These changes that occur within the albumen probably have profound effects upon the developing embryo and may also influence embryonic development (North, 1984).Wilson (1973) indicated that storage temperatures of 12.8 to 21°C were satisfactory and that 22.8°C was adequate for 1 week storage .

The purpose of this study was to assess the effect of storage time, storage temperature and flock age on some egg characteristics during incubation.

MATERIALS AND METHODS

This experiment was carried out at the Poultry Research Center, Agriculture College, Cairo University from 1 June until 1 August 1996 .

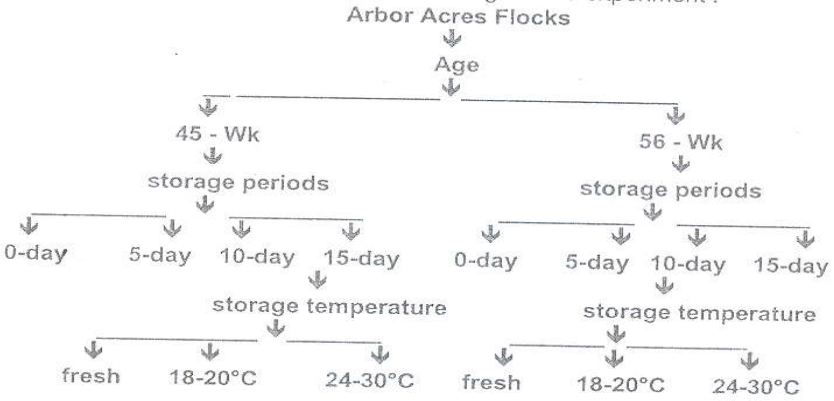
The number of eggs used in this study was 1540 collected from broiler breeder flocks (Arbor Acres). 770 eggs were collected from a 45- wk old flock and the same number (770 eggs) from a 56-wk old flock .To avoid the influence of egg weight on hatchability and embryonic development only eggs that weight between 60 & 63 gm were selected from both flocks.

Eggs were collected one day every 5 days for a period of 15 days and randomly assigned in factorial arrangement of treatments consisting of flock age, stored temperature and storage periods. One hundred and ten eggs from each flock were used as fresh (0 d of storage), 660 eggs from each flock were assigned to three groups stored for three period (5,10 and 15 days) . Every 220 eggs were subdivided to those stored in cold room (18 - 20°C) and those stored at room temperature (24 - 30°C).

Eggs were weighed after collection and then weighed again before incubation for every storage period (5 ,10 ,15 days) and storage temperature. Ten eggs from each storage period and storage temperature were broken to determine the egg component (albumen and yolk percentage) and shell thickness. The eggs were weighed every 6 days during incubation to determine the egg weight loss and also to cull the infertile eggs. After candling, the eggs were broken to separate the infertile eggs from the early dead embryos.

At 18 days of incubation, a total of 70 eggs (5 eggs from each storage period, storage temperature and each age) were weighed and then broken to weighed the embryo and residual yolk to determine the embryo to egg weight ratio .

The following diagram describes the design of the experiment .



Statistical Analysis

Data were analyzed using multiway ANOVA using the general linear models (GLM) procedure of SAS(SAS 1989).The main effects were flock age, length storage periods and storage temperature. The significance level was chosen to be 5% .

RESULTS AND DISCUTION

Egg weight and componants

Average initial weight of hatched eggs were 61 g and 62 g for younger and older hens respectively (Table1) . The similarity of egg weights for both flocks was due to choosing 60 to 63 g eggs for both ages. The eggs from the older

hens had significantly (P≤ 0.01) thicker shell than the eggs from the younger hens, (Table 1).There were no significant differences in the yolk or albumin percentages between the two ages (Table 1). These results are not in agreement with the previous results reported by Fletcher *et al.* (1981) & (1983); Reinhart and Hurnik (1984), Anthony *et al.* (1989); O' Sullivan *et al.* (1991) and Hussin *et al.* (1993) .They reported that broiler breeder age affects egg weight and consequently egg component and its ratio . This may be due to that the initial weight of the eggs used were similar for both age groups in this study .

Table 1 . Effect of flock age on egg characteristics during incubation

Traits	Age	
	45-wk	56-wk
Set weight (g)	61.34 ± 1.79[a]*	61.50 ± 1.82[a]
Transfer (18 days) weight (g)	52.56 ± 2.50[b]	54.63 ± 2.54[a]
Albumen %	54.34± 2.10[a]	54.13 ± 1.90[a]
Yolk %	32.04 ± 1.40[a]	32.36 ±1.56[a]
Shell thickness (micron)	29.26 ± 3.03[b]	33.33 ± 4.25[a]

* Means (±SE) with the same letter in every row are not significantly different (P≤.05).

Transfer Weight (after 18 days of incubation)

Transfer Weight was significantly (P≤ 0.01) affected by age. The eggs from the younger hens had lower transfer weight than the eggs from the older hens. This may be due to the increased weight loss during incubation from the younger hens had lower shell thickness than the older hens (Table 1) .

Egg Weight Loss

Egg weight loss up to 18 days of incubation as percentage of initial egg weight were affected by age, storage temperature and storage periods (Table 2). Eggs from the younger hens lost significantgy (P≤ .05) more weight when compared to eggs from older hens. These results disagree with those of Kirk *et al.* (1980), North and Bell (1990), Roque and Soares (1994) and Reis *et al.* (1997). The present results show that the mean weight loss of the eggs up to 18 days of incubation , expressed as percentage of the initial egg weight were 13.3% and 11.7% for the eggs from the 45-wk old flock and the 56-wk old flock respectively. This egg weight loss may be due to different embryonic grower in those eggs up to 18 days of incubation. This may increase egg temperature slightly and consequently water vapor pressure, inside the egg (Ar, 1991) therefore evaporating more moisture from the eggs of the younger hens this may be due to the different in shell thickness between the two flocks.

Table 2. Effect of flock breeder age on different egg traits during incubation

Traits	Age	
	45-wk	56-wk
Embryo (18 days) %	56.91 ±1.20[a]*	53.28 ±1.28[b]
Yolk sac (18 days of incubation) %	22.30 ±0.56 [a]	23.67 ±0.60[a]
Egg loss during Storage periods (%)	1.29 ± 0.07[a]	1.55 ±0.07[b]
Egg loss after 6-day of incubation (%)	6.74 ±0.10[a]	6.98 ±0.10[a]
Egg loss after 12-day of incubation(%)	11.03 ±0.20[a]	9.76 ±0.21[b]
Egg loss after 18-day of incubation (%)	13.30 ±0.13[a]	11.70 ±0.13[b]

* Means (±SE) with the same letter in every row are not significantly different (P≤.05).

The egg weight loss for different storage temperatures is shown in Table 3. There was a significant difference in egg weight loss at 6 days of incubation between the eggs stored at different temperatures . The eggs stored at room temperature had higher weight loss expressed as percentage to initial egg weight. The egg weight loss for the fresh eggs lowest at 6,12 and 18 days of incubation. Albumen quality is affected by storage temperature and storage period (Walsh, 1993) . Associated with this decline, during storage, is a loss of weight due to the evaporative loss of water (Romanoff and Romanoff, 1949) . These changes that occur within the albumen probably have profound effects upon the developing embryo (Benton and Brake , 1996) .

Table 3 . Effect of storage temperature on different egg traits during incubation

Traits	Fresh	Room temperature 20-30°C	Cold room 18-20°C
Embryo (18 days) %	58.51 ± 2.1[a]*	54.12±1.35[b]	54.92 ±1.43[b]
Yolk sac (18 days) %	21.67 ± 0.99[a]	23.49±0.63[a]	22.91 ±0.67[a]
Egg loss during storage periods %	0.00 ± 0.0[c]	1.82 ± 0.07[a]	1.53 ± 0.07[b]
Egg loss after 6-day of incubation %	5.26 ± 0.17[c]	7.37 ± 0.11[a]	6.94 ± 0.10[b]
Egg loss after 12-day of incubation %	8.75 ± 0.37[b]	11.11±0.23[a]	10.41 ±0.21[a]
Egg loss after 18-day of incubation %	10. 95 ±0.24[b]	13.09± .15[a]	12.6 ± 0.14[a]

* Means(±SE) with different superscripts within row are not significantly different (P≤.05).

When the egg weigh0t loss during storage is substracted from the whole egg weight loss, for eggs stored at room temperature and cold room, the weight loss of the eggs up to 18 days of incubation was almost the same . These values were 10.95, 11.27 and 11.07% for unstored eggs, room temperature and cold room respectively. These values correspond approximately to the optimal water loss needed to obtain the highest hatchability (Tullett , 1981; Peebles , 1986 ; Davis *et al*., 1988) .

Eggs stored for 15 days before incubation lost significantly (P≤ .01) more weight than those stored for 5 or less days (Table 4). Reis *et al*. (1997) found

that eggs stored for 1-day had higher weight loss up to 18-d of incubation than eggs not stored or stored for 2-d .

Table 4.Effect of storage periods on different egg traits during incubation

Traits	Period (day)			
	0 - day	5 - day	10 - day	15 - day
Embryo (18 days)%	58.51± 1.9^{a}	58.19 ±1.4^{a}	54.50 ±1.48^{b}	49.49 ±1.68^{c}
Yolk sac (18 days) %	21.67± 0.95^{b}	23.09±0.72^{ab}	24.5± 0.74^{a}	21.75 ±0.84^{b}
Egg loss during storage periods (%)	00.00± 0.00^{d}	0.82± 0.07^{c}	1.93± 0.08^{b}	2.60± 0.08^{a}
Egg loss after 6-day of incubation (%)	5.26 ± 0.16^{d}	6.37± 0.11^{c}	7.12± 0.12^{b}	8.26± 0.13^{a}
Egg loss after 12-day of incubation (%)	8.75 ± 0.37^{c}	10.41± 0.24^{b}	10.57±0.28^{ab}	11.36 ±0.29^{a}
Egg loss after 18-day of incubation (%)	10.95± 0.24^{c}	12.46± 0.16^{b}	12.82±0.18^{ab}	13.36 ±0.19^{a}

* Means (±SE) with the same letter in every row are not significantly different (P≤.05).

Embryonic and Yolk Sac Percentage

Table (2) shows that, at the end of the 18 *th* day of incubation, embryos from the older hens were significantly (P≤.05) smaller than those from the younger hens. Similar results were obtained by Mickey *et al.* (1996). The freshly incubated eggs had a higher embryonic percentaage than the eggs stored at both storage temperatures, (Table 3). The longer the storge period after the first 5 days, had the lower embryo percentage (Table 4). These differences were statistically significant (P≤ .05).

Fertility

Average of fertility (Table 5) was 90.5% and 84.8% in eggs from the younger hens (45-WK of age) and older hens (56-WK of age) respectively . These findings are consistent with the conclusion of other researchers (Pierson *et al.*, 1988; Fasenko *et al.*, 1992 ; Brillard, 1993 ; and Bramwell *et al.*, 1996). They reported that , decreased fertility in older hens is due to the sperm storage and transport problem in the female oviduct . It is also possible that the number of sperm receptors on the ovum may decrease during hen senescence. As males age, the decline in fertility is concomitant with a reduction in the number of spermatozoa in the ejaculate and the volume of semen produced (Lake , 1989 ; and Sexton *et al* ., 1989) .

The decline in fertility in this study may be due to the decrease in apparent fertility as storage time increases. The increased duration of egg storage increase the percent of eggs that will never start to develop and

Table 5 . Effect of flock age , storage time and storage temperature on eggs during incubation

Flock age	Treatment	Fertility %	Hatchability %	6-day dead embryo %	12-day dead embryo %	18-day dead embryo %	Unhatched egg %	Total of dead embryo %
45 week	unstored egg	90.50	84.62	0.00	0.00	1.54	1.54	1.54
	5 days at room temp.		77.33	10.67	2.67	5.33	2.67	18.67
	10 days at room temp.		32.94	38.82	3.53	7.06	11.77	49.41
	15 days at room temp.		2.86	66.67	6.67	4.76	5.71	78.10
	5 days in cold room		72.00	5.33	1.33	4.44	6.67	11.10
	10 days in cold room		71.77	10.59	2.35	7.06	4.71	20.00
	15 days in cold room		26.67	27.62	5.71	10.48	13.33	63.81
56 week	unstored egg	84.80	60.00	4.62	1.54	4.62	9.23	10.78
	5 days at room temp.		56.00	13.33	2.67	6.67	5.33	22.67
	10 days at room temp.		29.41	36.47	7.06	8.24	8.24	51.77
	15days at room temp.		19.16	56.19	1.91	5.71	6.67	63.81
	5 days in cold room		53.33	12.00	1.33	9.33	10.67	22.66
	10 days in cold room		34.12	32.94	4.71	7.06	11.77	44.71
	15 days in cold room		14.29	40.00	0.95	9.52	18.10	50.47

therefore, will be classed as infertile. Similar results were obtained by Wilson *et al.* (1984) who reported that the apparent fertility decreased as storage time increased. Landauer (1967) suggested that a longer duration of egg storage increases the percent of eggs that will never start to develop, following storage, and therefore, will be classed as infertile.

Hatchability

Hatchability results are shown in Table 5. The eggs from the 45-wk old flock had higher hatchability than the eggs from the older flock. The hatchability of unstored eggs from the younger and older hens were better than the other treatments.These findings are consistent with the conclusion of other researchers (Krik *et al.*, 1980; Meijerhof, 1994 and Reis *et al.*, 1997) , who suggested that, where there is an option, eggs from younger flocks should be stored rather than those from the older flocks. Present results also suggest that, under the condition of this investigation, eggs from the younger and older flocks hatched best if they were incubated at the same day of lay, specially when the storage temperatures were high.

The prolonged storage time and the high storage temperature causes a decline in hatchability. This decline may be due to the decline in fertility and increase in embryonic mortality until 18 days of incubation. The eggs from the 56-wk old flock had higher embryonic mortality than the eggs from the 45-wk old flock (Table 5) for the different treatments. These results could be explained by differences in albumen quality. The older flock might have initially lower albumen quality (Sauveur, 1988) and storing the eggs at higher temperature probably allowed the albumen quality to decline (Walsh,1993) to a point at which CO_2 may escape too quickly. This would compromise the buffering capacity of the egg (Heath,1977). Therefore, as suggested by Walsh (1993), the loss of CO_2 may cause rapid change in the acid-base balance of the embryo , resulting in death .

Also the prolonged storage of eggs causes an increase in hatching time (Bohren *et al.*, 1961). This was true in this investigation (Table 4). This means that, the embryo is underdeveloped at the time when gasses may be needed for physiological stimulation to begin hatching (Christensen *et al.*, 1993; and McNabb *et al.* ,1993) .

In commercial production eggs must be set more frequently and the storage period of hatching eggs must be less than 5 days .

Also, when the storage temperatures are too high but needed , the stored eggs would be from the younger flocks .

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تأثير عمر أمهات التسمين ودرجة حرارة التخزين وطول مدة تخزين البيض على بعض خواص البيض خلال فترة التفريخ

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الغرض من هذه الدراسة هو معرفة تأثير عمر الأمهات وطول مدة التخزين ودرجة حرارة التخزين على التطور الجنينى - النفوق الجنينى على اعمار مختلفة خلال مدة التفريخ - الفقد فى وزن البيض خلال مدة التفريخ ومعدل الفقس. ولقد تم تفريخ البيض المأخوذ من أمهات عمر ٤٥، ٥٦ أسبوع بعد التخزين لمدة صفر يوم (طازج)، ٥، ١٠، ١٥ يوم سواء تم تخزين البيض على درجة حرارة الغرفة العادية (٢٤ - ٣٠ °م) أو الثلاجة (١٨ - ٢٠ °م) وإتضح من النتائج التالى:

١. البيض الغير مخزن أعطى أعلى نسبة فقس مقارنة بالبيض المخزن .
٢. إنخفض الفقس بدرجة كبيرة بعد التخزين لمدة ١٠ أيام على درجة حرارة الغرفة العادية بينما كان التأثير قليلاً عندما تم تخزين البيض فى غرفة مبردة .
٣. لم تتأثر نسبة الفقس أو كان التأثير قليلاً للبيض الذى تم تخزينه لمدة ٥ أيام سواء فى درجة حرارة الغرفة العادية أو الغرفة المبردة .
٤. إزداد النفوق الجنينى على عمر ٦ أيام مع زيادة طول مدة التخزين فلقد وصل النفوق الجنينى إلى ٦٦٪، ٥٦٪ بعد ١٥ يوم تخزين للبيض المأخوذ من أمهات عمر ٤٥ ، ٥٦ أسبوع على درجة حرارة الغرفة العادية على التوالى .
٥. البيض المأخوذ من أمهات عمر ٤٥ أسبوع أعطى أعلى نسبة فقس مقارنة بالبيض المأخوذ من أمهات عمر ٥٦ أسبوع فيما عدا البيض المخزن على درجة حرارة الغرفة العادية لمدة ١٥ يوم، بغض النظر عن مدة التخزين فإن نسبة الفقس كانت أعلى فى البيض المأخوذ من أمهات عمر ٤٥ أسبوع .