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EFFECTS OF PRE-INCUBATION WARMING ON EMBRYONIC DEVELOPMENT AND SOME HATCHABILITY TRAITS IN DANDARAWI EGGS

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SUMMARY

The effects of exposing Dandarawi fertile eggs to warm air before incubation on embryonic development, mortality and hatchability were studied. Seven hundred and fifty fertile eggs were used in this trial. Eggs were collected and stored at 16ºC for five days. Eggs were taken out the storage room and set for 12 hours in ambient air temperature (28ºC). Individual egg weights were recorded, then eggs were divided into five treatment groups (n=150 of each group). The first group (G1) was left for an additional 24 hours at room temperature and served as control. While, the other four groups (G2, G3, G4 and G5) were exposed to a temperature of (38-38.2ºC) for the respective durations of 6, 8, 10 and 12 hours, respectively, then to the ambient temperature (28ºC). After the 36 hours from taking the eggs out the storage room, all groups were set in the incubator. A sample of eggs from each group (n= 12 of each once) was cracked to record embryos' relative weights at 6, 12 and 18 d of incubation.

Eggs exposed (P<0.05) to warm air prior to incubation had higher embryos weights at 6 and 12 d of incubation compared to the control. At hatch, no significant differences in hatchling weights were observed. Warming eggs before incubation decreased embryonic mortality, pepping chicks and improved hatchability (P<0.05).

In conclusion the pre-incubation warming for 10 or 12 hrs reduces embryonic mortality, pepping chicks and improves hatchability in Dandarawi eggs.

Keywords: Pre-incubation warming, hatchability parameters, embryo development

INTRODUCTION

In poultry species, fertile eggs must be stored at cool temperatures (below 20ºC) until they can be set into an incubator. This low temperature is required to make the embryo survive until the optimal temperature is provided during incubation to sustain normal embryonic growth. Egg storage at cool temperature is necessary to stop bacterial growth and embryonic development. Recent studies, using microscopic techniques to differentiate embryonic developmental stages, demonstrated that storing chicken fertile eggs at 14ºC induces diapause (Fasenko *et al.*, 1992).

Before setting the eggs in the incubator, eggs need to be warmed in order to gradually acquire the incubation temperature. A number of different pre-incubation warming profiles were suggested to increase the internal egg temperature from the storage temperature to the incubation temperature. Gradual pre-incubation warming prevents thermal shock to the embryo and condensation on eggs at the onset of incubation. On the other hand, Wilson (1991) and Renema *et al.* (2006) suggested that hatching eggs should be warmed rapidly to reach the incubation temperature. The rapid increase in eggs temperature is thought to reduce embryonic mortality and abnormal embryonic growth that might result from slow pre-incubation warming.

Funk and Biellier (1944) suggested that embryos continue morphological development at a temperature above 27°C. Although no morphological development may be recognizable at a temperature below 27°C, Arora and Kosin (1968) showed that mitotic activity in the embryo increased when the temperature increased from 7.2 to 18.3°C. We hypothesize that due to an increase in the mitotic activity during pre-incubation warming; the embryo is able to compensate for cell death that occurred during storage, which improves embryo viability.

Pre-incubation warming is the warming of eggs prior to placement. During prolong storage the periodic or intermittent warming of eggs can improve hatchability particularly for birds that have a low rate of hatchability (Kosin, 1956: Becker and Bearse, 1958). Reijrink *et al*. (2010) reported that embryos of the 24-h pre-incubation warming (37.8°C) were more advanced than embryos of the 4-h pre-incubation warming (37.8°C) throughout incubation, which resulted in a shorter incubation duration when pre-incubation warming was excluded. Because embryonic development of the 24-h pre-incubation warming was advanced throughout incubation, it is surprising that the amnion weight of this pre-incubation warming was lower than the 4-h pre-incubation warming at d 7 of incubation. The reason for this may be related to the higher egg weight loss during incubation of the 24-h pre-incubation warming.

The aim of this study was to investigate effects of pre-incubation warming for Dandarawi chicken hatching eggs on embryonic development and mortality and hatchability.

MATERIALS AND METHODS

Experimental Design:

This experiment was carried out at the Poultry Research Farm, Faculty of Agriculture, and Assiut University, Egypt. Hatching eggs were collected from a 34-week old Dandarawi chickens. Eggs were

collected 4 times daily for five consecutive days and stored at 16°C and 70% RH until treatments. Abnormally shaped eggs were eliminated. Eggs of each day of collection were randomly and equally divided into five groups to eliminate any bias due to duration of egg storage. Eggs were taken out from the storage room and set for 12 h. in ambient air temperature (28ºC). Hatching eggs were individual weighed and assigned to five treatment groups (n=150 of each group). The first group (G1) was left for an additional 24 hours at room temperature and served as control. While, the other four groups (G2, G3, G4 and G5) were exposed to a temperature of (38-38.2ºC) for the respective durations of 6, 8, 10 and 12 h., receptively. Then they were exposed to room temperature (28ºC) for the durations of 18, 16, 14 and 12 h., respectively. At this point, all groups have spent 36 h. outside the storage room. Hatching eggs were set in the incubator (Petersime) in the same time. The dry and wet-bulb thermometers were set at 37.4±0.2°C and 28.9±0.2°C, respectively. At 19 days of the incubation period, hatching eggs were moved to the hatcher which was set at 37.2±0.2°C and 30.0±0.2°C for dry and wet-bulb thermometer, respectively. Eggs were turned once per hour through an angle of 90 from d 2 to 18 of incubation and then they were transferred to the hatcher.

Hatching parameters:

Eggs were individually weighed and labeled in order to identify the hatchlings with the eggs for each treatment (in pedigree baskets). On d 6 and 12 of incubation, eggs were examined by candling to identify clear eggs and embryonic mortality. Eggs with embryonic development were considered fertile. After 510 hrs of incubation, the number of hatched chicks was recorded, weighed and it was expressed as percentage of egg weight, while all unhatched eggs were opened to determine embryonic mortality and pipped from d 13 to 21. The hatchability was calculated as the number of chicks hatched per fertile eggs set. The chicks at the hatch were individually weighed and it's were calculated as percentage of egg weights. Embryonic mortality was calculated as a percentage of fertile eggs and divided into 4 categories: embryonic mortality from d 0 to 6, from d 7 to 12, from d 13 to 21, and pepping.

At 6, 12 and 18 days of incubation, the twelve eggs were cracked from each group (The total number 36 eggs of each group) to identify embryos' absolute weights. The embryonic relative weights were calculated as a percentage of egg weights before incubation.

Statistical Analysis:

The data were analyzed by ANOVA using the GLM procedure of SAS (SAS Institute, 1996). When treatment effects were significant, differences between least squares means were tested using Duncan's multiple-range test, and the differences were considered significant at the level of $P \leq 0.05$.

RESULTS AND DISCUSSION

The results presented in Table (1) show that at 6-d of incubation, warming hatching eggs for more than 6 hours prior to incubation (G3, G4 and G5) resulted in higher embryos weights ($P<0.05$) compared to the control group (G1). Eggs from G2 had intermediate embryos weight which did not differ from those of G1, G3 and G4 ($P\geq0.05$). At 12-d of incubation, all warmed groups had higher embryos weight than the control group. These differences were disappeared on day-18 of incubation except for eggs from G5 which had higher embryos weight ($P\leq0.05$) compared to the other groups.

At hatch, no significant differences were observed among different treatment groups in hatchling weight. The increase in embryos weights observed in warmed groups at 6 and 12-d of incubation can be attributed to an early initiation of embryonic development when the optimal temperature (38-38.2ºC) for embryonic growth was provided before setting the eggs in the incubator. This assumption is supported by the absence of any differences in hatchling weights.

Table 1 . Effects of pre-incubation warming on embryos' absolute and relative weights (Means ± SE) at 6, 12 and 18 days of incubation and hatchling absolute and relative weights (chick weights at hatch as percentage of egg weights)

Items Treat	Embryo absolute weight (g)			Embryo relative weight (%)			Hatchling absolute weight (g)	Hatchling relative weight (%)
	6 d of incubation	12 d of incubation	18 d of incubation	6 d of Incubation	12 d of incubation	18 d of incubation		
G1	0.59^{c} ±0.02	6.09^{b}±0.30	22.57^{b}±0.58	1.24^{c} ±0.06	13.52^{c}±0.69	47.41^{b}±0.78	28.90±0.35	61.88±0.52
G2	0.67^{bc}±0.01	7.30^{a}±0.25	22.40^{b}±0.42	1.49^{bc}±0.07	15.78^{b}±0.66	47.94^{b}±0.97	28.86±0.30	61.26±0.82
G3	0.73^{ab}±0.02	7.15^{a}±0.10	22.60^{b}±0.24	1.51^{bc}±0.05	15.29^{b}±0.44	48.09^{b}±0.77	28.67±0.34	60.30±0.92
G4	0.75^{ab}±0.04	7.22^{a}±0.29	23.22^{b}±0.46	1.54^{b} ±0.06	15.26^{b}±0.68	48.02^{b}±0.66	28.66±0.66	61.33±1.18
G5	0.82^{a}±0,.07	8.00^{a}±0.41	24.77^{a}±0.70	1.82^{a} ±0.17	17.03^{a}±0.94	51.71^{a}±0.62	28.74±0.26	61.96±0.75

$^{a—c}$ Means ± SE within each column with different superscripts are significantly different ($P\leq0.05$).

G1= Control.

G2 to G5 = The eggs were exposed to a temperature of 38.2°C (101°F) for the respective durations of 6, 8, 10 or 12 hrs before setting in the incubator.

The effects of pre-incubation warming on embryonic mortality and hatchability are shown in Table (2). In general, warming hatching eggs reduced embryonic mortality and improved hatchability ($P\leq0.05$). The lowest incidence of mortality occurred

in G4 and G5, while the highest mortality occurred in control group (G1). The number of pepping eggs was smaller in G4 and G5 compared to that in G1 and G2. As a result, G4 and G5 had better hatchability percentage compared with other groups. The higher embryonic mortality observed in untreated eggs can be attributed to increased cellular death before setting the eggs in the incubator. Renema *et al*. (2006) reported that holding hatching eggs to a temperature below 35ºC may increase embryonic mortality and abnormal embryonic development. Another suggestion is that embryos were growing at a slower rate when eggs were held at a temperature of 28ºC for a period of 36 h which might have resulted in abnormal embryonic development that led to death during the incubation period.

We conclude from the current study the pre-incubation warming for 10 or 12 h. is beneficial effect on hatchability in Dandarawi eggs due to reduction in embryonic mortality during the first 6 d of incubation and pepping chicks but does not affect chick weight at hatch.

Table 2. Effect of Pre-incubation warming (Means ± SE) on hatchability and embryonic mortality

Items Treat	Hatchability (%)	Embryonic mortality (%)			
		0 to 6 d of incubation	7 to 12 d of incubation	13 to 21 d of incubation	Pipping
G1	68.0^{c}±1.2	7.0^{b} ±0.6	5.0^{a}±0.6	11.0^{a}±0.6	9.0^{a} ±0.5
G2	78.0^{b}±0.3	8.0^{ab}±0.4	0.0^{c}±0.0	5.0^{c}±0.1	9.0^{a} ±0.5
G3	79.3^{b}±0.7	9.0^{a} ± 0.5	3.0^{b}±0.6	0.7^{d}±0.1	8.0^{ab}±0.6
G4	88.0^{a}±1.2	3.0^{c} ±0.6	3.0^{b}±0.2	5.0^{c}±0.3	1.0^{c} ±.0.1
G5	86.3^{a}±0.3	0.0^{d} ±0.0	0.0^{c}±0.0	6.7^{b}±0.4	7.0^{b} ±0.2

$^{a—c}$ Means ± SE within each column with different superscripts are significantly different (P≤0.05).

G1= Control.

G2 to G5 = The eggs were exposed to a temperature of 38.2°C (101°F) for the respective durations of 6, 8, 10 or 12 hrs before setting in the incubator.

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تأثير تدفئة بيض دجاج الدندراوي قبل وضعة في المفرخة علي نمو الأجنة وبعض صفات الفقس

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أجريت هذه التجربة لدراسة تأثير تعريض بيض الدندراوي لدرجات حرارة دافئة قبل وضعة في المفرخة علي نمو الأجنة ومعدل نفوقها ونسبة الفقس. وتم استخدام سبعمائة وخمسون بيضة مخصبة في هذه التجربة ، تم جمعها علي مدار خمسة أيام متتالية وتخزينها علي درجة حراره 16 درجة مئوية. وبعد إخراج البيض من غرفة التخزين ، تم تعريضة لدرجة حرارة الغرفة العادية (28 درجة مئوية) لمدة 12 ساعة ليكتسب البيض درجة حراره الجو ، ثم قسم البيض الي خمسة مجموعات بعد وزن البيض فرديا (أشتملت كل مجموعة علي 150 بيضة مخصبة). المجموعة الأولي (الكنترول G1) تم تعريض البيض لدرجة حراره الغرفة (28 درجة مئوية) لمده 24 ساعة إضافية ، بينما عرض البيض لباقي المجاميع الأربع الأخري (G2، G3 ، G4 ، G5) إلي درجة حرارة 38 إلي 38.2 درجة مئوية لمده 6 ، 8 ، 10 ، 12 ساعة علي الترتيب. ثم ترك البيض ليكتسب درجة حرارة الغرفة (28 درجة مئوية) مرة أخري لمدة 18 ، 16 ، 14 ، 12 ساعة علي الترتيب. وبهذا تكون كل مجموعة من هذه المجاميع قد ظلت 36 ساعة خارج غرفة التخزين قبل وضع البيض في ماكينة التفريخ. وقد تم كسر عدد 12 بيضة من كل مجموعة في كل مرة بعد وضع البيض في ماكينة التفريخ وذلك في اليوم 6، 12، 18 لتسجيل وزن الأجنة.

ووجد أن رفع درجة حراره البيض أدي إلي زيادة وزن الأجنة في اليوم السادس واليوم الثاني عشر من التفريخ وذلك بالمقارنة بالمجموعة الكنترول. ولم تلاحظ أي تأثير لرفع درجة حرارة البيض قبل التفريخ علي وزن الكتاكيت الفاقسة ، ولكنها أدت إلي إنخفاض نسبتي النفوق الجنيني والكتاكيت الناقرة وتحسن في نسبة الفقس .

ومن النتائج السابقة توضح تدفئة بيض دجاج الدندراوي لمدة 10 أو 12 ساعة قبل التفريخ يخفض النفوق الجنيني والكتاكيت الناقرة ويحسن نسبة الفقس.