

EFFECT OF TURNING DURATION OF INCUBATED EGGS ON HATCHABILITY, EMBRYONIC MORTALITY AND CHICK'S VIABILITY

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SUMMARY

The aim of this study was to identify the optimal turning duration of Dandarawi hen incubated eggs on embryo mortality, hatchability, one-day chick weight and viability of chicks at 14 days of age. Collected eggs from Dandarawi hens at 36 weeks of age were stored for 7-d at 16°C and 75% RH and then were incubated for 21-d under standard incubation conditions using different turning durations. Eggs were turned from d 2 till d 12 (T12), 13 (T13), 14 (T14), 15 (T15), 16 (T16), 17 (T17) or 18 (T18) of incubation. Eggs were turned once per hour through an angle of 90°. Three replicates of 100 eggs each per turning treatment per 3 incubation settings (total of 2,100 eggs) were studied. The results showed that turning eggs till d 12 of incubation of Dandarawi hatching eggs gave better hatchability and lower embryonic mortality and pepping chicks than turning eggs till d 13, 14, 15, 16, 17, and 18 of incubation. One-day old chick and chick weight as a percent of egg weight did not differ between the different treatments of turning duration. Viability of chicks at 14 days of age were lower ($P \leq 0.05$) for eggs turned till d 16 and 17 of incubation as compared to the other treatments which did not differ significantly.

In general, turning Dandarawi hatching eggs till d 12 of incubation gave better hatchability and lower embryonic mortality and pepping chicks. Moreover, it did not have any significant effect on the viability of chicks at 14 days of age.

Keywords: *Dandarawi hatching eggs, turning frequency, hatchability parameters, chick's viability*

INTRODUCTION

Egg turning requirements during incubation involve parameters such as frequency, axis of setting and turning, turning angle, planes of rotation, and stage of incubation requiring turning (Wilson, 1991). Some of the benefits of egg turning during incubation include reduction in malpositioning of the embryo (Robertson, 1961), prevention of abnormal adhesion of the embryo or embryonic membranes to the shell membrane (New, 1957), and the complete and timely closure of chorioallantoic at the small end of the egg (Deeming, 1989a, b). Turning is required to ensure proper utilization of albumen by the developing embryo within the normal incubation period (Randle and Romanoff, 1949). These benefits have been related to influences on embryo physiology such as protein accumulation in amniotic fluid, growth rate of the area vasculosa, gas exchange (Deeming, 1989a,b; Wilson, 1991; Tona *et al.*, 2003c), and thyroid hormone levels (Tona *et al.*, 2003b).

Considerable research has been directed at determination of the times during incubation when turning eggs was most critical to obtain maximum hatchability. In an early study, Card (1926) maintained eggs turned solely during the first 6-d of incubation hatched almost as well as eggs turned throughout incubation.

New (1957) turned eggs twice daily from 4 to 7-d and found that these eggs hatched as well as those turned throughout incubation. Deeming (1989a) agreed with New (1957) they found that the most critical period for turning was from 3 to 7-d of incubation, but these authors did not investigate the 0-to-2-d period. Elibol and Brake (2004) reported the most critical period for turning broiler hatching eggs to be the first week of incubation, with differential effects being observed due to an absence of turning from 0 to 2-d (primarily increased early dead) vs. d 3 to 8 (primarily increased late dead).

In contrast, Kaltofen (1961) suggested that turning was most important during the second week of incubation. It has also been reported by several authors that turning after 13-d of incubation had little, if any, beneficial effect (Wilson and Wilmering, 1988; Wilson, 1991; Deeming, 2002). Lourens and Deeming (1999) also reported that stop turning eggs after 15-d of incubation had no adverse effect on hatchability, and it has been stated that there is no strong research evidence to suggest that turning after 15-d of incubation in the domestic fowl has any particularly critical role in embryonic development or hatchability (Deeming, 2002). Wilson (1991) concluded that 3 periods (1 to 3, 4 to 7, and 7 to 14-d) appeared to be the most critical for the turning of chicken eggs. In contrast, Wilson and

Wilmering (1988) reported that cessation of the turning of broiler hatching eggs after 13 d of incubation decreased hatchability of eggs from a 56-wk-old flock. Also, Tona *et al.* (2001) reported that cessation of turning at 15, 16, or 17-d of incubation decreased hatchability compared with turning to 18-d.

From the previously published research, it is not definite how long turning should continue during the hatching period to ensure best hatchability and viability. However, it is a general practice to turn eggs until 18-d. This study aimed to evaluate the effect of turning duration of Dandarawi hatching eggs on hatching parameters and viability of chicks.

MATERIALS AND METHODS

Experimental Design:

This experiment was carried out at the Poultry Research Farm, Faculty of Agriculture, Assiut University, Egypt. Hatching eggs were collected from Dandarawi hens at 34-weeks of age. Eggs were collected 4 times daily for 7 consecutive days and stored at 16°C and 70% RH until incubation. Any abnormal shaped eggs were eliminated. Eggs of each day of collection were distributed equally among the various turning treatments to eliminate any bias due to duration of egg storage. The eggs were incubated in a Petersime setter and hatcher. The setters were operated at 37.4±0.2°C dry-bulb temperature and 28.9±0.2°C wet-bulb temperature. The Hatcher was operated at 37.2±0.2°C dry-bulb temperature and 30.0±0.2°C wet-bulb temperatures. Three replicates of 100 eggs each per turning treatment per 3 incubator sets (total of 2,100 eggs) were studied. The eggs were turned from d 2 until d 12 (T12), 13 (T13), 14 (T14), 15 (T15), 16 (T16), 17 (T17) or 18 (T18) of incubation. Eggs were turned once per hour through an angle of 90°. When turning was stopped before d 18 of incubation, the eggs stayed in turning trays and were kept horizontal until transfer 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 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 from d 12 to 21 plus pipped. Fertile hatchability was calculated as the number of chicks hatched per fertile eggs set at d-12 of incubation.

Chick's viability:

All of the hatched chicks were reared up to 14-d of age at 30 to 32°C on floor pens. The photoperiod was 24 hrs / day during the first 3 days, which was gradually decreased by one hr/week, and a grower diet (2,800 kcal metabolizable energy and 18% crude protein) and water were provided *ad libitum*. The number of dead chicks was recorded daily and then viability was calculated for chicks.

Statistical Analyses:

The effects of turning duration were analyzed by one-way ANOVA with the general linear model (GLM) procedure (SAS Institute, 1996). Significance of differences among means was tested by the Duncan option (SAS Institute, 1996). Statements of statistical significance were based upon $P \leq 0.05$.

RESULTS AND DISCUSSION

The results presented in Table 1 show that the embryonic mortality (EM) percentage from 12 to 21-d of incubation in T12 decreased compared to all other treatments, EM in T13 decreased compared to T14 to T18, and EM in T18 (control) decreased as compared to T14 and T17. However, there were no significant differences in EM between T18 and either T15 or T16. It is worthy to mention that EM was significantly higher in the eggs turned for 14 and 17-d than in the eggs turned for d 12, 13, 15, 16 and 18. Pipping chicks percentage (PC) in T12 was lower than those in all groups including control, however, there were no significant differences in PC between control treatment (T18) and T14, T15, and T16. Nevertheless, PC in control (T18) decreased as compared to T13 and T17. On the other hand, PC was significantly higher in eggs turned for d 17 than in eggs turned for d 12, 13, 14, 15, 16 and 18.

Fertile hatchability of eggs (FH) was significantly higher in eggs turned for d 12 than in those of the other treatments and control group, however, there were no significant differences in FH between control treatment (T18); and T13 and T15. The improvement in FH in T12 seems to be due to the reduction in EM and PC. Also, FH in control (T18) was better than those in T14, T16, and T17. Tona *et al.*, (2001) stated that cessation of turning at 15, 16, or 17-d of incubation decreased hatchability compared with turning to 18-d. However, Tona *et al.*, (2003c) reported that hatchability of eggs was significantly higher in eggs turned 18-d than in those turned at 15-d but not significantly different from those turned at d 12. The higher hatchability in eggs turned for 18-d, compared to turning for 15-d, might have been aided by

the higher hypercapnia and T3 levels in the plasma at internal pipping. High CO₂ level at internal pipping is a potent stimulus for hatching (Visschedijk, 1968; Tullett, 1990). Similarly, T3 has been shown to increase during incubation up to internal pipping (Tona *et al.*, 2003b) and that higher T3 improves hatchability (Tona *et al.*, 2003b).

Tona *et al.* (2003c) showed in a comparison between eggs stored for a long period and those stored for a short period and found that higher pCO₂ and T3 shortened incubation duration and increased hatchability simultaneously in eggs stored for a short duration. The lack of a significant difference between turning until 12 or 18-d on both hatchability and incubation duration despite clear differences in physiological parameters suggests that other intrinsic factors may be at play in the control of hatchability and incubation duration of eggs. Although the eggs used in this study were stored for similar durations, Wilson (1991) found that lower quality eggs, like those laid by older breeders or eggs stored for longer time, were more sensitive to decreased turning compared to good quality eggs. This finding suggests that although the supposed higher metabolic rate indicated by higher pCO₂ and thyroid hormone levels may be associated with turning until 18 d, it did not affect the development of the embryos. In contrast, Lourens and Deeming (1999) also reported that stop turning eggs after 15-d of incubation had no adverse effect on hatchability. However, Wilson and Wilmering (1988) reported that cessation of the turning of broiler hatching eggs after 13-d of incubation decreased hatchability of eggs from a 56-wk-old flock. On the other hand, Elibol and Brake (2006) reported that cessation of turning from 8 to 14-d of incubation had no effect on fertile hatchability (range 88.9 to 89.2%). It is common practice to turn eggs until 18-d of incubation and generally agreed that adequate egg turning during incubation improves hatchability (Elibol *et al.*, 2002).

The results presented in Table (1) showed turning duration had no effect on day-old chick weights and chick weight at hatch as percentage of egg weight. These results are in agreement with those found by Tona *et al.* (2003c) who stated that turning duration (12, 15 or 18-d of incubation) had no effect on weight of one-day old chicks.

Viability of chicks at 14 days of age (VC) was lower for eggs turned at d 16 and 17 of incubation as compared to the other treatments, but no significant differences in VC between control (T18); and T12, T13, T14 and T15 were observed (Table 1). Tona *et al.* (2003c) found that hatchability and percentage of high-quality chicks were lower for eggs turned for

15-d compared with those turned at 12 or 18-d (d 15 is in the period of an increasing functional hypothalamus-pituitary-adrenal axis). Tona *et al.* (2005) hypothesized that discontinuation of turning at d 15 may be an additional stressor that can lead to physiological imprinting and altered responsiveness, leading to lower hatchability and chick quality. Other reports, however, did not show any effect of stopping egg turning at d 15 on hatchability (Deeming, 2002).

Romanoff (1936) noted that incubation conditions are important not only for hatchability but also for postnatal growth. Pearson *et al.* (1996) showed that lack of turning of chicken eggs during the last stages of embryonic development (d 12 to 19) impaired O₂ consumption through the chorioallantoic gas exchanger, resulting in less embryonic growth. Tona *et al.* (2003a, b) showed recently that chicks from different storage duration that have similarly good quality scores may have different post-hatch performance. Although it is tempting to relate this decreased relative growth post-hatch with the lower T3/T4 ratio found in these chicks at hatch, confirming earlier work in which chicks of similar quality also showed lower growth rate combined with a decreased thyroid hormone ratio, the mechanistic explanation still remains unclear. Also, because yolk utilization in unturned eggs is significantly slower than in turned eggs (Deeming, 1989a), it is possible that excessive turning may lead to too rapid utilization of the yolk and therefore result in lower juvenile performance.

In general, it could be concluded that turning Dandarawi hatching eggs till d 12 of incubation of gave better fertile hatchability and lower embryonic mortality and peeping chicks without any negative effect on viability of chicks at 14 days of age.

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Table 1. Effect of turning duration during incubation on fertile hatchability, embryo mortality, day-old chick weights, chick weight at hatch as percentage of egg weight, and viability of chicks

| Items Treat | Fertile hatchability (%) | Embryo mortality (%) | | Egg weight (g) | Day-old chick weights (g) | Chick weight at hatch as (%) of egg weight | Viability of chicks (%) |
|----------------|--------------------------------|-------------------------------------|--------------------------|----------------------|------------------------------------|---|----------------------------|
| | | from 12 to 21-d of incubation | Pipping | | | | |
| T12 | 93.34 ^a ±0.33 | 2.16 ^f ±0.58 | 4.50 ^e ±0.28 | 47.01±0.34 | 29.45±0.30 | 62.65±0.61 | 96.77 ^a ±0.61 |
| T13 | 84.00 ^b ±0.35 | 7.15 ^e ±0.66 | 8.85 ^b ±0.58 | 47.22±0.30 | 29.38±0.33 | 62.22±0.80 | 96.40 ^a ±0.69 |
| T14 | 72.00 ^d ±0.68 | 20.16 ^a ±0.68 | 7.84 ^{bc} ±0.10 | 47.36±0.38 | 29.51±0.37 | 62.31±0.74 | 95.80 ^a ±0.81 |
| T15 | 83.00 ^b ±0.91 | 10.18 ^d ±0.71 | 6.82 ^{cd} ±0.2 | 47.20±0.30 | 29.46±0.29 | 62.42±0.63 | 95.20 ^a ±0.70 |
| T16 | 81.33 ^c ±0.81 | 12.11 ^c ±0.72 | 6.56 ^{cd} ±0.78 | 47.04±0.31 | 29.25±0.35 | 62.18±0.82 | 91.90 ^b ±0.71 |
| T17 | 70.00 ^e ±0.62 | 20.99 ^a ±0.67 | 9.01 ^a ±0.11 | 47.01±0.32 | 29.23±0.36 | 62.18±0.75 | 90.57 ^b ±0.84 |
| T18 | 83.00 ^b ±0.41 | 11.13 ^{cd} ±0.51 | 5.87 ^{cd} ±0.38 | 47.10±0.33 | 29.20±0.37 | 62.00±0.52 | 95.20 ^a ±0.69 |

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

T12 to T18 = Eggs were turned from d 2 to 12, 13, 14, 15, 16, 17, and 18 of incubation, respectively.

تأثير وقت تقليب بيض التفريخ علي نسبة الفقس والنفوق الجنيني وحيوية الكتاكيت

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هدفت هذه الدراسة الي معرفة الوقت الأمثل لتقليب بيض التفريخ لدجاج الدندراوي وتأثيره علي نسبة النفوق الجنيني ونسبة الفقس علي اساس البيض المخصب ، ووزن الكتاكيت عند عمر يوم ، وحيوية الكتاكيت عند عمر ١٤ يوم. تم جمع البيض من دجاج الدندراوي عند عمر ٣٦ اسبوع ، وخرن لمدة اسبوع علي درجة حراره ١٦ درجة مئوية ، ورطوبة نسبية ٧٠% ، وتم تفريخ البيض لمدة ٢١ يوما تحت ظروف التفريخ القياسية مع استخدام فترات مختلفة من التقليب. تم تقليب البيض ابتداءا من اليوم ٢ الي اليوم ١٢ (T12)، و١٣ (T13)، و١٤ (T14)، و١٥ (T15)، و١٦ (T16)، و١٧ (T17)، أو ١٨ (T18) من التفريخ. وتم تقليب البيض مرة كل ساعة بزواوية ٩٠°. واستخدم ثلاث مكررات لكل معاملة تقليب بكل مكررة ١٠٠ بيضة ، وكان عدد البيض الكلي التي تم دراسته لكل معاملات التقليب ٢١٠٠ بيضة تفريخ.

اظهرت النتائج المتحصل عليها ، ان البيض الذي تم تقليبه حتي اليوم ١٢ من التفريخ أعطي أفضل نسبة فقس ، وأقل في نسبتي النفوق الجنيني والكتاكيت الناقرة عن البيض الذي قلب حتي اليوم ١٣ ، ١٤ ، ١٥ ، ١٦ ، ١٧ ، ١٨ من التفريخ. ولم يختلف وزن الكتكوت عند الفقس ونسبة وزن الكتكوت عند الفقس علي اساس وزن البيضة ما بين المعاملات المختلفة في وقت التقليب. انخفضت حيوية الكتاكيت عند عمر ١٤ يوما الناتجة من البيض الذي قلب حتي اليوم ١٦ ، ١٧ من التفريخ عند مقارنتها بالمعاملات الاخرى والتي لم تختلف معنويا فيما بينها. وبصفة عامة تقليب البيض حتي اليوم ١٢ من التفريخ اعطي احسن نسبة فقس وخفض نسبتي النفوق الجنيني والكتاكيت الناقرة ، زد علي ذلك بانه لم يوجد لها تأثير معنوي علي حيوية الكتاكيت.