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Influence of incubation temperature on emu (*dromaius novaehollandiae*) egg hatchability

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ABSTRACT

The study was conducted to assess an effect of incubation temperature (97.5° F, 98.0° F and 98.5° F) on hatching performance of emu eggs. A total of 150 eggs were divided into 3 equal groups (1, 2 and 3) differing in the incubation temperature (97.5° F, 98.0° F and 98.5° F in dry bulb respectively). Significant differences between the groups were observed for dead in shell. Raising the temperature to 98°F in G 2 and 98.5° F in G 3 led to reduce hatchability indices, primarily due to an increased rate of embryonic mortality found in both groups. Significantly different ($P<0.05$) mean±SE % of total egg hatchability and fertile egg hatchability were observed for G I, G 2 and G 3, respectively. The mean±SE incubation period (days) were 50.11±0.66, 49.87±0.12 and 49.77±0.13 for G 1, G 2 and G 3, respectively. The shortest incubation period recorded in this study was 49.77 days (G 3) at highest incubation temperature (98.5° F), while highest incubation period was 50.11 days at lowest incubation temperature (97.5° F). A reversed trend was observed in hatching time, which expanded, in G 2 and G 3, compared with G 1. From this study, it can be concluded that the best hatching performance was achieved at 97.5°F (G1) incubation temperature. Application of higher incubation temperature led to increased % of dead embryos, decreased hatchability, shortened the duration of artificial incubation and increased hatching duration.

Key words: Embryonic mortality, Emu, Hatchability, Incubation temperature

The emu *(Dromaius novaehollandiae)*, native of Australia, belongs to ratite group. It is reared commercially in many parts of the world for their meat, oil, skin and feathers, which are of high economic value. Emu was introduced into India during the year 1996 and becoming popular mainly due to hardy nature of this bird, adaptable to harsh climatic conditions and high economic returns.

Artificial incubation of emu eggs needs to aim at creating condition such as humidity and incubation temperature to stimulate the natural condition. The average hatchery sequence for the chick to break into aircell is at 47 day of incubation while to pip the eggshell is at 49 day and to complete hatching at 50 day. However, the time interval is subject to biological variations (Adewumi *et al*. 2008).

Emu breeding has become increasingly popular all over the world. One of the factors limiting breeding of emu birds is the lack of standardized egg incubation technique (Majewska 2001). According to Minnar and Minnar (1998), the best hatchability indices can be achieved at incubation temperature of 97.5°F and relative humidity of 24 to 35 %. Stewart (1992) reported that the incubation temperature should be slightly higher, in the range of 97.5°F to 98.0°F, with humidity reaching as much as 40%. Majewska (2001) carried out emu egg incubation at 97.5°F and relative humidity 35% and achieved between 70% and 82% hatchability from fertilized eggs. Kinder (1993), on the other hand, recommended the incubation temperature at 98.0°F to hatch emu eggs. Szczerbinska *et al*. (2003) achieved 75.8% hatchability of emu eggs at 75.52° F incubation temperature. The temperature of 96.5 to 97.0°F dry bulb and 78.0° to 80.0°F wet bulb were set by Rao *et al.* (2005) to incubate the emu eggs.

The technology of artificial incubation of emu eggs has not been fully explored so far, and further studies are needed to determine which incubation parameters of temperature, humidity, or egg rotation, suggested by many authors should be applied. Since the literature lacks comprehensive comparative studies, the present study was carried out to determine an effect of temperature applied during hatching

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on the indices of emu egg hatchability.

MATERIALS AND METHODS

The study was conducted in 4- to 5-years old 10 pair emu birds at JM emu farm, Maravanur, Trichirappalli district, Tamil Nadu. The birds were weighed before the start of the study and the mean (±SE) body weight (kg) of the birds were 41.27±1.13. All the emu birds were maintained under similar captive condition of feeding and management. One male: 1 female breeder was placed in a separate pen with a floor space of 900 sq.ft. Birds were offered with breeder mesh (Table 1) and water *ad libitum.* The nutritional value of the mix corresponded to dietary requirements of the birds in the reproductive season; it had energetic value of 2640 K.cal/ kg, protein content of 19.8%, high level of exogenous aminoacids (lysine- 1%, methionine- 0.30%); vitamins (A – 15,747 IU, D_3 – 3,800 IU, and E– 41 mg), as well as minerals, especially calcium, available phosphorus and choline chloride (respectively 3.3% 0.42% and 0.05%), which was in accordance with recommendations by Rao *et al*. (2005).

Eggs were collected immediately after laying and stored at room temperature for 24 hours. The collected eggs were not treated with any chemical or wash. Eggs were checked for morphology and abnormally shaped eggs were removed. Soft shell, cracked and pecked eggs were also removed from the collection.

Hatchability evaluation was carried out in 150 eggs which were divided into 3 equal groups (I, 2 and 3) differing in the incubation temperature (97.5° F, 98.0° F and 98.5° F in dry bulb respectively) for 49 days during which the eggs were turned every hour. Relative humidity of 84.0° F in wet bulb was set in all the 3 groups. After 49 days, these eggs were transferred to the hatcher, where the same temperature and relative humidity were maintained. All the non-hatched eggs were opened on 53-day of incubation to investigate the cause of hatching failure.

Table 1. Formulation and chemical composition of emu feed(kg/100 kg)

Ingredients	Breeder(43 weeks & above)
Maize	50.0
Soya bean meal	25.0
De oiled rice bran	15.7
Di-calcium phosphate	1.5
Calcite powder	1.5
Shell grit	6.0
Salt	0.3
Total	100.0
Chemical composition	
CP	19.8
ME (KCal/kg)	2640
Calcium (%)	3.3
Phosphorus (%)	0.42
Lysine (%)	1.0
Methionine (%)	0.30

Incubation problems can be categorized into infertility eggs, early embryonic mortality (up to 14 day of incubation), late embryonic mortality (29–50 day of incubation) and dead in shell (at time of hatching) (Adewumi *et al*. 2008). Data on early embryonic mortality, late embryonic mortality, dead in shell, total egg hatchability, fertile egg hatchability, incubation period and hatching duration were recorded in this study.

The values obtained were analyzed by analysis of variance (ANOVA) using SPSS computer software 10.00 (SPSS, 1999).

RESULTS AND DISCUSSION

The results of the study are presented in Table 2. The mean±SE value of early embryonic mortality (0.06±0.07, 0.04±0.06 and 0.04±0.06), late embryonic mortality (0.06±0.07, 0.12±0.10 and 0.14±0.12) and dead in shell (0.02±0.04, 0.08±0.07 and 0.16±0.09) were recorded for G I, G 2 and G 3, respectively. The difference between the groups was differed significantly ($P \leq 0.05$) for dead in shell, while non significant for early embryonic mortality and late embryonic mortality ($P>0.05$). Highest percentage of embryonic mortality was found in G 3 (34%) and G 2 (24%) compared to G I (14%) (Table 2). Interpretation of the results was also difficult due to the lack of studies on the causes underlying embryos death; not much could be done beyond some comparisons with other species of domestic birds.

Table 2. Hatching performance (mean±SE) of emu eggs in relation to the incubation temperature

Parameters	Group		
	G I (97.5° F)	G 2 (98.0° F)	G 3 (98.5° F)
Number of set eggs	50	50	50
Rate of fertile eggs (%)	12.0 (6)	14.0 (7)	14.0 (7)
Early embryonic mortality	0.06 ±0.07^{NS} (3)	0.04 ±0.06 ^{NS} (2)	0.04 ±0.06 ^{NS} (2)
Late embryonic mortality	0.06 ±0.07 ^{NS} (3)	0.12 ±0.10 ^{NS} (6)	0.14 ±0.12 ^{NS} (7)
Dead in shell	0.02 ±0.04* (1)	0.08 ±0.07* (4)	0.16 ±0.09* (8)
Dead embryos (%)	14.0 (7)	24.0 (12)	34.0 (17)
Chicks hatched out (no.)	37	31	26
Hatching duration (min)	502.34 ±18.62**	636.94 ±20.43**	770.78 ±30.75**
Incubation period (days)	50.11 ±0.66 ^{NS}	49.87 ±0.12 ^{NS}	49.77 ±0.13 ^{NS}
Total egg hatchability (%)	74.00 ±7.92*	62.00 ±6.05*	52.00 ±7.14*
Fertile egg hatchability (%)	84.09 ±6.32*	72.09 ±6.97*	60.47 ±8.25*

**, Means in rows are highly significant different ($P \leq 0.01$);
*, Means in rows are significant different ($P \leq 0.05$); NS, non-significant; Figures in the parentheses indicates numbers.

Buttemer *et al*. (1998) reported that increased mortality of embryos was caused by inadequate thermal conditions of incubation. According to the authors, high incubation temperature of chicken eggs resulted increased embryo mortality especially around 16th day of incubation. Borzemska (1984) reported that increased incubation temperature of chicken eggs, persisting for a longer period of time, increases embryo mortality. In the present study, late embryonic mortality and dead in shell were higher in G 2 and G 3 compared to G I. These results indicated that even slightly elevated incubation temperature caused increased rate of embryonic mortality which was in agreement with Adewumi *et al*. (2008) in emu eggs.

Incubation temperature significantly influenced emu egg hatchability. Significantly different ($P \leq 0.05$) mean±SE percentage of total egg hatchability, (74.00±7.92, 62.00±6.05 and 52.00±7.14) and fertile egg hatchability, (84.09±6.32, 72.09±6.97 and 60.47±8.25) were observed for G I, G 2 and G 3, respectively. The best hatching performance was attained in G I, where the temperature 97.5°F was maintained through out incubation. Raising the temperature to 98°F in G 2 and 98.5° F in G 3, led to reduced egg hatchability primarily due to an increased rate of dead embryos. Similar findings were recorded by Szczerbinska *et al.* (2003) in emu eggs at incubation temperature of 97.52°F and 98.06°F. But in the present study higher embryonic mortality (34%) was recorded at 98.5°F than the results reported by Szczerbinska *et al.* (2003) at 98.28°F incubation temperature. In this study, higher incubation temperature (0.22°C) might be the reason for increased embryonic mortality. Rao *et al*. (2005) recorded 58.3% hatchability from fertile emu eggs at 96.5 to 97.0 °F incubation temperature.

The mean±SE incubation period (days) was 50.11±0.66, 49.87±0.12 and 49.77±0.13 for G I, G 2 and G 3 respectively, which was in line with Szczerbinska *et al.* (2003) in emu eggs at incubation temperature of 97.52°F, 98.06°F and 98.28°F. The shortest incubation period recorded in this study was 49.77 days (G 3) at highest incubation temperature (98.5°F), while highest incubation period was 50.11 days at lowest incubation temperature (97.5°F). Deeming *et al.* (1993) reported that decreased 1°C incubation temperature resulted in extended incubation period by 2 to 2.5 days in ostrich eggs. A reversed trend was observed in the case of hatching time, which expanded in G 2 and G 3, respectively, 636.94±20.43 and 770.78±30.75 min compared with G I (502.34±18.62 min). Incubation temperature significantly ($P \leq 0.01$) influenced hatching duration between the groups. According to Szczerbinska *et al.* (2003), higher temperature of incubation resulted in its shortening of incubation period, the chicks set to break shells being unprepared for it, hence considerably extended time of hatching.

From this study, it can be concluded that the best hatching performance was achieved at 97.5°F (GI) incubation temperature. Raising the incubation temperature to 98°F (G2) and 98.5°F (G 3) resulted in reduced hatchability. Incubation temperature significantly influenced its duration of incubation as well as hatching time. Application of higher incubation temperature led to increased percentage of dead embryos, decreased hatchability, shortened the duration of artificial incubation and increased hatching duration.

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