

*Original Research***Effect of Acute Heat Stress on Hatchability Parameters of Broiler Breeders****Aswathi Plantharayil Bharathan\* and Subrat Kumar Bhanja**

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**Abstract**

Broiler breeders are highly susceptible to heatstress due to heavy body weight and limited heat dissipation mechanisms. Impact of acute heat exposure on hatchability parameters of broiler breeders' birds was studied. Broiler breeder birds (CARI SML cockerels 40 and hens 120) at 30 weeks of age were divided into control and HT groups. Control was exposed to THI<80 (Temp 30°C, RH 50-55%) and HT birds were exposed to THI>90 (Temp 37°C & RH 70-75%) for 6 hrs daily for 10 days. After that both HT and C were maintained under similar conditions (THI<80), AI started and hatching eggs were collected for 10 days. Even after completion of heat stress period, but within 13 days in HT, change in HDEP (-5.21%), hatchability on FES (-2.51%) and day-old chick weight (-5.31%) were observed. In conclusion, heat stress has negative impact on the hatchability parameters of broiler breeders.

**Key words:** Broiler Breeders, Fertility, Hatchability, Heat-Stress, Psychrometric

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**Introduction**

An increase in the environmental temperature effecting heat stress in birds is one of the most important factors that may hold back the growth of poultry sector. The global surface temperature is expected to rise 1.4°C to 5.8°C by 2100 (IPCC, 2007) which is a major concern of poultry industry too. When an imbalance is created between various environmental factors like temperature, humidity, sunlight, thermal irradiation, housing systems etc. along with increased physiological stress in terms of high meat and egg production performance, birds will try to cope with the stress by altering the normal physiological and behavioural activities (Duangjinda *et al.*, 2017; Hassan *et al.*, 2018; Wang *et al.*, 2018). During thermal stress, birds will try to reduce heat production by reducing feed intake which may rapidly get reflected in their growth and production performance (May and Lott, 1992; Rowland *et al.*, 2018; Khatlab *et al.*, 2018).

Though there are many studies regarding various factors influencing egg quality, fertility, hatchability, embryonic mortality and hatch weight like age of broiler breeders, egg storage (Tona *et al.*, 2004; Luquetti *et al.*, 2004), egg weight (Ulmer-Franco *et al.*, 2010) etc but data regarding the hatchability performance of broiler breeders after an acute thermal stress is scarce. An experiment was designed to study the post-effects of acute thermal stress on broiler breeders in a controlled environment provided by psychrometric chamber on hatchability parameters and hatch weight of broiler chicks.

### Materials and Methods

Broiler breeder birds (CARI SML cockerels 40 and hens 120) at 30 weeks of age were divided into control and treatment groups based on body weight. The control birds (C) were kept at ambient temperature (THI<80; temperature 30°C, RH 50-55%) throughout the experimental period; treatment group - high temperature exposed birds (HT) was housed in the psychrometric chamber and prior to the initiation of heat exposure, the HT birds were maintained at THI<80 (Temp 30°C, RH 50-55%) for a period of 3 days for acclimatization in chamber. After this period, the HT group was exposed to a temperature of 37°C and RH 70-75% (>THI=90) for 6 hours (10.00 AM to 4.00 PM) daily for a period of 10 days considering extreme high summer temperature in broiler rearing regions in tropics. After 10 days, both the groups were maintained at THI<80; temperature 30°C, RH 50-55% and artificial insemination (AI) started as per ICAR-CARI schedule ie after first 2 days of AI, fertile egg collection started, on every 3<sup>rd</sup> day, AI repeated. Semen collected from cockerels of control and HT groups was used for inseminating hens of respective groups. The collected eggs were shifted to hatchery on the same day of laying and stored in egg storage room (>20°C) after cleaning and sanitation until setting. Hatching egg collection was done for 10 days after doing first two consecutive AIs. Hen day egg production (HDEP) calculated.

Various hatchability parameters were studied as mentioned-

- (i) Fertility percentage was calculated using the formula = (No. of fertile eggs/Total no. of eggs set) x 100.
- (ii a) Hatchability percentage (on total egg set TES basis) = (No. of chicks hatched/Total no. of eggs set) x 100.
- (ii b) Hatchability percentage (on fertile egg set FES basis) = (No. of chicks hatched/Total no. of fertile eggs set) x 100.
- (iii) Embryonic mortality - Mortality during different stages of incubation was monitored through candling and confirmed the assumptions through break out analysis of the candled-out eggs.
- (iv) Early or late hatch percentage: Early and late hatch percentage was monitored during the peri-hatch period
- (v) Chick weight: Individual weight of day-old chicks was recorded soon after pulling the hatch from pedigree hatch boxes. Wing-bands were put on for individual identification of chicks.

Data generated from above study was subjected to one-way ANOVA (Snedecor and Cochran, 1994) and the statistical difference among the mean values was found using Duncan’s Multiple Range Test (DMRT, Duncan, 1955). The probability value <0.05 and <0.01 were considered significant at 5% and 1%, respectively.

**Results and Discussion**

Various observations made in this study are given in Table 1 & 2. HDEP after heat exposure found to be reduced in HT than the control (-5.21%). It has already been reported that acute heat stress has deleterious effects on the feed intake in turn affecting the egg number of broiler breeder hens (Aswathi *et al.*, 2018). HT group has shown reduction in fertility percentage (-7.22%) and hatchability on FES (-2.51%). Rao *et al.* (2015), Shanmugham *et al.* (2015) and Aswathi *et al.* (2019) were reported the impact of heat stress on the quality deterioration of semen in breeder stock that may lead to reduced fertility among breeder males. Internal and external egg quality deteriorations happening as a result of heat stress may also contribute to reduced fertility and hatchability (Kirunda *et al.*, 2001). Day old chick weight was also found to be lower (-5.31%) for HT chicks than control chicks. This may be due to lower hatching egg weight of HT birds, Sgavioli *et al.* (2015) and Zhu *et al.* (2017) also reported similar findings.

**Table 1:** Effect of heat stress on the hatchability parameters of broiler breeders after heat exposure

|           | HDEP* (%) | Fertility (%) | Hatchability (%) |       | Egg wt (g) | Day old chick wt. (g) |
|-----------|-----------|---------------|------------------|-------|------------|-----------------------|
|           |           |               | (TES)            | (FES) |            |                       |
| Control   | 51.53     | 83.87         | 63.92            | 89.08 | 58.66      | 41.62 <sup>b</sup>    |
| Treatment | 46.32     | 78.22         | 69.36            | 87.84 | 56.46      | 39.41 <sup>a</sup>    |
| SEM       | 1.76      | 1.8           | 2.6              | 2.67  | 0.73       | 0.65                  |
| P value   | 0.145     | 0.094         | 0.398            | 0.865 | 0.126      | 0.024                 |

Means bearing different superscripts (a,b) in a column within the period indicate significant difference in values (P<0.05); \* HDEP was calculated from 3<sup>rd</sup> day after heat exposure, i.e. after 2 consecutive artificial inseminations on day 1<sup>st</sup> and 2<sup>nd</sup> of post exposure.

**Table 2:** Effect of heat stress on hatchability of broiler breeder birds after heat exposure

|           | Late hatch (%) | Embryonic mortality (%) |       |       |       |
|-----------|----------------|-------------------------|-------|-------|-------|
|           |                | Total EM                | Early | Mid   | Late  |
| Control   | 3.44           | 9.99                    | 4.26  | 1.32  | 4.41  |
| Treatment | 2.27           | 12.45                   | 2.91  | 1.93  | 7.62  |
| SEM       | 0.45           | 2.32                    | 0.87  | 0.24  | 2.17  |
| P value   | 0.347          | 0.694                   | 0.554 | 0.055 | 0.882 |

Means bearing different superscripts (a,b) in a column within the period indicate significant difference in values (P<0.05).

No significant difference in embryonic mortality or percentage late hatch could be detected. But total embryonic mortality was higher in treatment group. Zhu *et al.* (2017) also reported similar finding where

hatchability (-14.50%), early embryonic mortality (+4.77%), mid and late embryonic mortality (+2.63%), hatch weight of chick (-7.06%) showing significant changes when maternal heat stress was given at  $32\pm 1^{\circ}\text{C}$  for 10 weeks. Percentage late hatch was 1.17% higher in control but more average embryonic mortality (+2.46%) was observed in HT group (early +1.34%, mid +0.6% and late +3.21%). In this study, low hatchability of fertile eggs from HT birds is correlated with the high embryonic mortality happened during the mid and late incubation periods. Maternal hyperthermia might be the reason for reduced egg weight, slow embryonic growth and smaller chicks due to low nutrient availability in small eggs (Zhu *et al.*, 2017). Similar type of reduction in hatchability in heat exposed quails ( $35.8\pm 0.6^{\circ}\text{C}$  and  $59.2\pm 4.5\%$  RH, THI=76-80) was reported by El Tharabany (2016) where the hatchability at THI 76-80 was 74.5% against 80% (THI 70-75) and 80.5% (THI 70-75) of medium and low THI.

### Conclusion

Acute heat stress can result in less egg number, reduced fertility and hatchability, embryonic mortality and low chick weight. High temperature prior to or during breeding season may result in reduced number of progenies and low chick quality.

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