

Effect of Temperature on Hatchability Parameters of Cobb Broiler Eggs

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ABSTRACT

The aim of this study was to determine the effects of incubation temperature (34.2; 35.2; 36.4; 37.5°C) on percentage of water loss, percentage hatch of fertile eggs, and total embryonic mortality rate on Cobb 500 Broiler eggs. We found that the percent water loss increases as the incubator temperature increased. The highest percent hatchability was obtained from 36.4 and 37.5°C. As incubation temperature increased, the percent of embryonic mortality decreased. In summary, the study indicated that under Stillwater, OK altitude conditions 36.4 and 37.5°C are the ideal temperatures for successful hatching of fertile broiler eggs due to highest percent hatchability and lowest percent mortality rate in eggs incubated at 60% RH.

Keywords: Incubation, hatchability, mortality, temperature, water loss.

INTRODUCTION

Temperature is one of the physical factors that impact the success of incubation. Studies conducted in the past indicate that optimum hatching temperature for chicken eggs slightly varies depending on the altitude of a location, breed of the chicken, and some other physical factors such as humidity level. Maintaining ideal temperature inside an incubator is one key factor in the success of hatching poultry eggs. Therefore, it is essential to determine and use a temperature that promotes the highest hatchability (Swann & Brake, 1990; French, 1994, 1997) and the best quality chicks (Wilson, 1991; Decuyper & Mitchels, 1992), known as optimum incubation temperature.

Heat is one of the environmental factors necessary to start embryo development and to ensure that development proceeds at the correct pace (Tullet, 1995). The optimum temperature for hatching is between 37 and 38°C for eggs in a forced draft incubator (Lundy, 1969, Visschedijk, 1991). Variations in incubation temperature may have profound effects on embryonic growth and metabolism (Zhang and Whittow, 1992). Using a lower incubation temperature during the latter third of incubation would allow normal hatch, reduce water loss but increase the incubation period (Wilson, 1991). When incubator temperature is too low or too high, the hatchability and chick quality decreases, hatching time changes and more anomalies occur (Romanoff, 1960). Prolonged reductions in incubation temperature are known to result in significant increases in embryo mortality.

The effect of incubation temperature on chicken egg hatchability and chick quality may be related to its influence on the length of incubation and amount of water loss during incubation. However, such effects depend on how long and how intense is the shift from optimum temperature. Givisiez *et al.* (2000) indicated that an increase of 1°C (38.8°C) above the optimum incubation temperature (37.8°C) starting at day 13 of incubation causes a significant reduction in the hatching rate of incubated broiler eggs. However, reduction of temperature by 1 °C (36.8 °C) failed to exhibit any impact on hatchability.

Incubation temperature correlates directly to the duration of in ovo development both in turkeys (French, 1994) and broilers (Byerly, 1938; Decuypere *et al.*, 1979). The development is delayed in temperatures below optimum and accelerated in temperatures above optimum (Romanoff, 1960; Wilson, 1991). Such difference in embryo development rate as a result from changing the incubation temperature seems to explain body weight differences reported by some authors (Givisiez *et al.*, 2000; Decuypere *et al.*, 1979; Swan & Brake, 1990).

Water loss from an egg is a normal process that occurs during incubation. Usually, 12 to 14% of water is lost from broilers and turkeys eggs (Rahn *et al.*, 1981). However, too low or too high water loss influences embryo development (Rahn & Ar, 1974), and consequently, egg hatchability (Meir *et al.*, 1984). Temperature maintained inside the incubator directly influences the extent of moisture loss from an egg. Incubation temperatures above the optimum cause excessive egg water loss (higher than 14%), leading to embryo mortality by dehydration. On the other hand, temperatures below the optimum decrease hatchability due to reduced water loss (< 12%), which causes an over-hydration of the embryo and an impairment of gas exchange through the air cell (Romanoff, 1930). Therefore, the objective of this study was to determine the effect of incubation temperatures on egg water loss, hatchability, duration of hatch, embryonic mortality, and salable chicks of Cobb broiler eggs by using four incubators each with independent control system.

MATERIAL AND METHODS

EGGS HANDLING AND INCUBATION

In this study, 230 fertile eggs (55 - 67g) were obtained from Cobb-Vantress commercial hatchery, Siloam Springs AR. Upon arrival at the study site, Oklahoma State University (OSU), eggs were kept at room temperature overnight. The following day, all eggs were candled. Eggs with broken shell, misshaped and lower than 55 g were removed. Remaining 200 eggs were randomly divided into four experimental groups of fifty eggs and randomly assigned to four incubators with different incubation temperatures: group 1 (35.3°C, N=50 eggs, group 2 (34.2°C, N=50), group 3 (37.5°C, N=50), and group 4 (36.4°C, N=50). All groups were subjected to similar relative humidity (RH), 60% for the first 18 days of incubation. On day 18 of incubation, eggs were candled, weighed and transferred to hatchers. Temperature was left unchanged but RH was raised to 70% the last 3 days of incubation. Throughout the incubation period, temperature and RH in the incubators were monitored and recorded 2 times /day by direct observation of dry and wet bulb thermometers of the incubator, respectively. During post

hatching, a break out analysis was performed on all the remaining unhatched eggs. Observation was made on early, intermediate and late mortality.

PARAMETERS CONSIDERED

The following parameters were analyzed for each experimental group: percentage of water loss up to the transference to the hatcher [(egg weight before incubation – egg weight at transference)/egg weight before incubation \times 100]; percent hatch of fertile (number of hatched eggs/total number of incubated fertile eggs \times 100); total mortality rate [(number of incubated fertile eggs – number of hatched eggs)/number of incubated fertile eggs \times 100]. Non-hatched eggs were opened at the end of the study and embryo stage of mortality determined according to Hamburger & Hamilton (1951). Based on the observation, it was determined early mortality rate (number of embryos dead between 1 and 7 days/number of incubated fertile non-hatched eggs \times 100); intermediate mortality rate (number of embryos dead between 8 and 15 days/number of incubated fertile non-hatched eggs \times 100) and late mortality rate (number of embryos dead between 16 days and hatching/number of incubated fertile non-hatched eggs \times 100).

STATISTICAL ANALYSIS

Data were submitted to one-way analysis of variance (temperature) and subsequently expressed by polynomial functions to justify the differences between the treatment means. Mortality data were evaluated by Fisher's Test (5%). All statistical analysis were performed using SAS (Statistical Analysis System, 2002).

RESULTS AND DISCUSSION

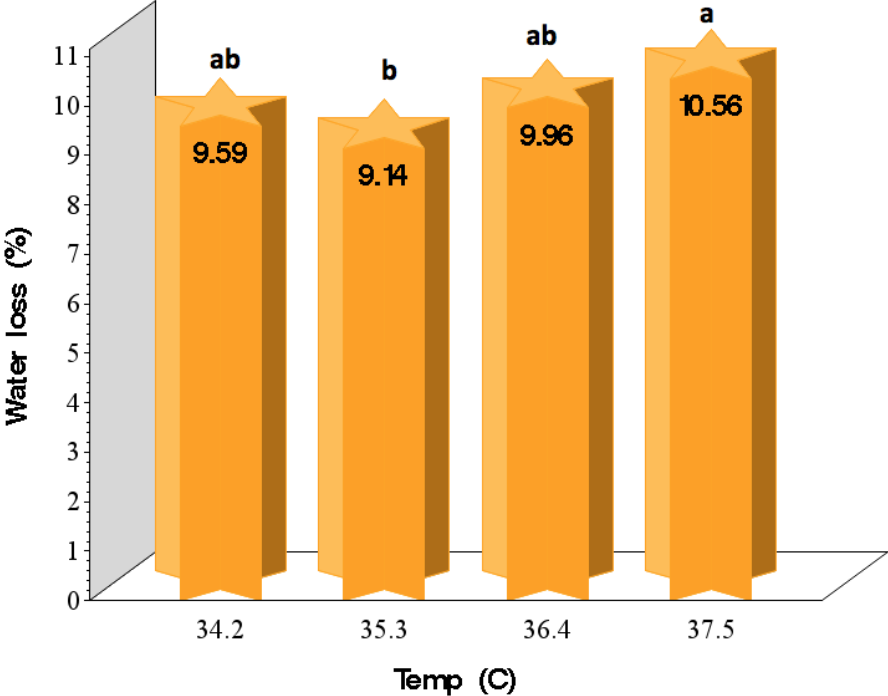


Figure 1: Effect of temperature on water loss. Columns with different letters indicate significant difference.

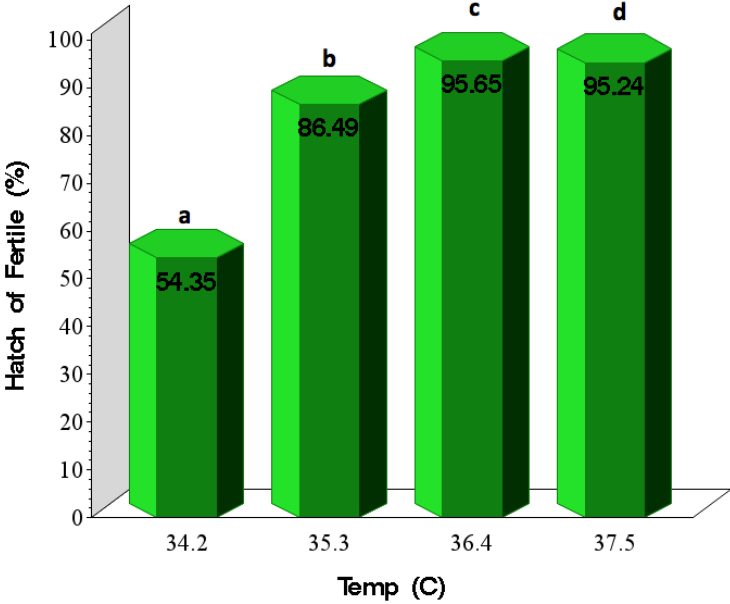


Figure 2: Effect of Temperature on hatch of fertile eggs. Columns with different letters indicate significant difference.

Success in any hatchery depends on the number of chicks that are hatched. Figure 2 shows that at a constant relative humidity (RH) as temperature increases from 34.2 to 37.5°C, the percent of hatched fertile chicks per incubator increases. All 4 temperatures displayed a significant difference in the number of hatched fertile chicks. The incubator set at 34.2°C resulted in a significant decrease of hatchability while 36.4 resulted in the highest rate of hatchability. Under Stillwater, OK altitude conditions, we found that incubator temperatures between 36.4 and 37.5°C are the ideal temperatures for successful hatchability of broiler eggs.

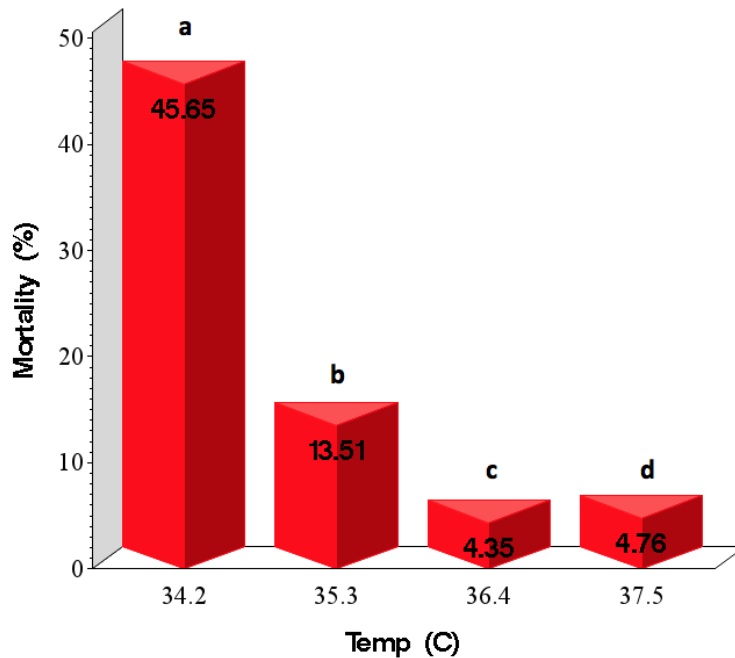


Figure 3: Effect of Temperature on embryonic mortality. Columns with different letters indicate significant difference.

Temperature is one of the three important factors that affect hatchability. Inappropriate temperatures in incubators result in early or late mortality of embryos. Figure 3 shows that as temperature increase from 34.2 to 37.5°C, the percent of embryonic mortality decreases. All 4 temperatures displayed a significant difference in percent of embryonic mortality. 34.2°C displayed the highest mortality of over 45% followed by over 13% at 35.3°C, indicating that incubation temperatures of 34.2 and 35.3°C are too low for successful hatchability broiler chicken eggs.

It is the finding of this study that in Stillwater, OK 36.4 and 37.5°C are the ideal temperatures for successful hatching of fertile broiler eggs due to highest percent hatchability and lowest percent mortality rate in eggs incubated at 60% RH.

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