Effect of Broiler Breeder’s Age on Incubation and Chick Quality Parameters

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Abstract
This study was carried out to evaluate the age effect of broiler breeders on incubation and chick quality parameters. Three different age groups of broiler breeders were selected for the study. Six hundred eggs from each age group were collected. The experiment was composed with four replicates from each group and each replicate consisted of 150 eggs. Incubation and chick quality parameters were measured and eggs breakout analysis was done. Egg shape indexes were significantly different (P < 0.05) among groups and older flock had the favorable (74.37%) egg shape index. Moisture loss of eggs, hatchability, hatch of fertile were significantly different (P < 0.05) among groups. The median aged flock had the highest percentage of hatchability (90.5%) and hatch of fertile (94.59%). Breakout data analysis revealed middle and late stage dead of embryo were significantly different (P < 0.05). Median aged flock had the lowest dead embryo percentage. Chick quality parameters except chick yield were significantly differed (p < 0.05). In conclusion, age group difference of broiler breeders is a fair predictor of incubation and chick quality parameters while older aged flock shows best quality chicks among three groups.

Key words: Chick, Hatchery, Breeder, Incubator, Hatchability, Chick Yield

Introduction
The poultry industry in Sri Lanka primarily consists of two major segments such as, egg and meat production. About 70% of the contribution to livestock sub-sector in Sri Lanka comes from chicken meat and eggs. The industry today is in the hands of the private sector and is confined mostly for the implementation of poultry health management programs, research and policy development for further consolidation of the industry. The branded chicken meat segment is dominated by large-scale meat producers. The chicken meat industry is dominated by broiler meat, which is produced on a large commercial scale by local manufacturers. Broiler meat production has increased rapidly in the last two
decades in line with the higher demand compared to other meats (DAPH, 2014). Day-old chicks (DOC) are the end product of the hatchery and the most important input for the poultry farms. A good-quality DOC is hence a crucial hinge between the hatchery and the farm (Petek et al., 2010). The DOCs form an important input for the farmer who requires chicks with good feed conversion efficiency and low mortality. For economic reasons, the major objective of a hatchery is to obtain a high hatchability while the farmers need chicks with high growth performance (Geidam et al., 2008). The commercial hatcheries are in a position to maximize its output of viable day-old chicks, as this is one of the critical factors which determines its economic viability. More precisely, all activities in the hatchery are aimed to maximize the hatchability, chick quality and chick uniformity. These targets should be reached at minimal cost. As the hatchery is a central hub in the integrated poultry production, the success of the hatchery depends on the quality of all preceding steps of the production chain (Verrees and Smet, 2010). The poultry industry always looks for many ways to increase its productivity such as possibility of increasing the hatchability, hatch of fertile, number of marketable day-old chicks and their quality by improving chick uniformity. Further, it has been observed that incubation and chick quality depend on age of breeders. In these ways, companies have been evaluating the productive age group of parent flock of broilers to increase the chick quality. Currently, the commercial breeder farms maintain three different age groups of parent flock such as young, median and old. Thus, this study was aimed to evaluate the effect of broiler breeder’s age on incubation and chick quality parameters.

Material and Method

Experimental Location and Grouping of Breeder Flocks

The experiment was conducted at the commercial hatchery, Bairaha Farms PLC at Pasyala, Sri Lanka. Three different age groups of commercial Cobb 500 broiler breeder stock (MX male x Cobb 500 Female) were selected and grouped (based on age) as, younger (26-35 wks. of age) designated as X, median age (36-45 wks. of age) designated as Y and older (46-65 wks. of age) designated as Z. A total of one thousand and eight hundreds eggs (1800) were obtained from all three age groups representing six hundreds eggs from each group. The experiment was composed with three age groups each with four replicates and each replicate consisted of 150 eggs. Eggs were incubated at Petersime (Model no: 1152) commercial multi-stage (MS) incubator.

Egg Loading Process to Incubator

Eggs were candled using egg grading machine to select the ideal eggs for incubation. One hundred and fifty eggs (150) from separate age group were set in a single setter tray of MS Petersime incubator and numbered from 1 to 150 separately and initial egg weight, length and width were measured using
electronic balance and Vernier scale. Eggs from younger (X), median (Y) and older (Z) aged flock were tagged accordingly. These trays were placed middle part of MS setter trolleys and eggs were stored for one day at 19 °C. Setter trolleys were taken out from the cool room and eggs were fumigated for 20 minutes with formaldehyde gas before the incubation. Fumigated trolleys were loaded into Petersime MS incubator. Incubation conditions were provided according to the incubator manufacturer’s recommendations.

Production Process of Hatchery
Temperature and relative humidity were maintained at 99 °F and 86%, respectively. Temperature, relative humidity and egg turning were recorded in the check list once an hour. On the 240 hour of incubation, eggs were individually candled in the transfer-room (around 24 °C and 60% relative humidity), using a hand held candling lamp. “Clear” eggs were removed and broken out for macroscopic examination to determine early-dead embryos (< 7 day). On 432 hour of incubation, MS incubated eggs were transferred from setter to hatcher. After 432 hour of incubation, individual eggs were weighed according to their respective numbers and weight losses of eggs were calculated. At the end of 510 hour, the hatch was pulled out. Live hatched chicks were counted and recorded, separately. Egg break out analysis was carried out to find out the reasons of failure to hatch. Un-hatched eggs were opened, and examined macroscopically. Dead chicks were recorded separately. From each replicate, a total of 60 randomly sampled chicks were weighed individually using a sensitive beam balance. Chick length was taken by measuring the length of stretched chick from tip of the beak to the middle toe using a chick ruler and recorded in centimeters (cm). Hatch of fertile was estimated. Pasgar scoring method was followed to analyze the chick quality.

Data Analysis
Data were statistically analyzed using two sample t-test in SAS (ver. 9.0). Mean separation was carried out to find out the best age group using LSD. Significant level was declared at p=0.05. Following standard formulas were used to estimate the different parameters.

Moisture Loss (%) = \( \frac{(\text{Egg setting weight} - \text{Egg transfer weight}) \times 100\%}{\text{Egg setting weight}} \) (Petek et al., 2010)

Hatchability % = \( \frac{\text{Number of sealable chick} \times 100\%}{\text{Number of eggs}} \) (Petek et al., 2010)

Hatch of fertile % = \( \frac{\text{Number of sealable chick} \times 100}{\text{Number of true fertile eggs}} \) (Anon., 2004)
Chick yield % = \frac{\text{Average chick weight at hatch}}{\text{Average egg weight at the point of set}} \times 100 \quad \text{(Ali and Druggelte, 2015)}

Results and Discussion

Initial Egg Weight and Egg Shape Index

The initial egg weight and egg shape index of different age groups of breeder flocks are shown in Table 4.1. Initial egg weight showed a significant difference ($P < 0.05$) among three age groups. The older and young flock had the highest and lowest egg weight, respectively. As expected and reported earlier, egg weight gradually increases with the age (Tona et al., 2004; Vieira et al., 2005; Yildirim, 2005). Studies reported that egg weight has an effect on hatchability, embryonic deaths and hatchling weight of chicks. Medium sized (41-45g) eggs were suitable for better hatchability and lower embryonic deaths. However, large sized (>45g) eggs were suitable for better hatchling weight (Rashid et al., 2013). The egg shape index (SI) was significantly different ($P<0.05$) among different age groups. However, egg shape index of group X and Y were not significantly different ($P>0.05$). The highest and lowest SI was recorded in X and Z groups, respectively. Eggs are characterized using SI as sharp, normal (standard) and round if they have an SI value of < 72, 72 -76 , and > 76, respectively (Sarica and Erensayin, 2004). Accordingly, eggs taken from older flock in the present study (SI=74.37) had the standard shape compared to other two groups.

<table>
<thead>
<tr>
<th>Egg Parameters</th>
<th>X (26-35 wks.)</th>
<th>Y (36-45 wks.)</th>
<th>Z (46-65 wks.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial egg weight (g)</td>
<td>52.33 ± 3.88c</td>
<td>59.33 ± 4.07b</td>
<td>70.13 ± 4.51a</td>
</tr>
<tr>
<td>Egg shape index</td>
<td>77.45 ± 0.44a</td>
<td>77.42 ± 0.17a</td>
<td>74.37 ± 0.38b</td>
</tr>
</tbody>
</table>

Data are presented as LS mean ± SE; \(^{a,b,c}\)Means within the same row with different superscript are significantly different ($P<0.05$); X=Younger breeder flock, Y=Median aged breeder flock, Z=Older breeder flock

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**Evaluation of Incubation, Chick Quality Parameters and Egg Breakout Analysis**

The change of incubation, chick quality parameters and egg breakout analysis among different breeder age groups are shown in Table 2. The moisture loss, hatchability and hatch of fertile showed a significant different ($P<0.05$) among age groups. The highest moisture loss, hatchability and hatch of fertile were recorded in group Y. Our findings were similar with reported values by Tona et al. (2004) who reported hatchability and hatch of fertile decreases with the age of breeders. The amount of water and gases exchange depends on eggshell characteristics and a pressure difference between egg and surrounding environment.

**Table 2:** The Change of Incubation, Chick Quality Parameters among Different Age Groups of Breeder Flock

<table>
<thead>
<tr>
<th>Analysis of Parameters</th>
<th>X (26-35 wks.)</th>
<th>Y (36-45 wks.)</th>
<th>Z (46-65 wks.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Incubation Parameters</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moisture loss %</td>
<td>9.36 ± 0.36$^c$</td>
<td>10.38 ± 0.38$^b$</td>
<td>10.32 ± 0.62$^b$</td>
</tr>
<tr>
<td>Hatchability %</td>
<td>81.99 ± 0.04$^b$</td>
<td>90.50 ± 0.03$^a$</td>
<td>83.50 ± 0.01$^b$</td>
</tr>
<tr>
<td>Hatch of fertile %</td>
<td>88.29 ± 0.03$^b$</td>
<td>94.59 ± 0.03$^a$</td>
<td>88.98 ± 0.01$^b$</td>
</tr>
<tr>
<td><strong>Egg Breakout Analysis (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early dead (0-7 days)</td>
<td>3.50 ± 0.57$^a$</td>
<td>2.75 ± 0.95$^a$</td>
<td>4.25 ± 1.5$^a$</td>
</tr>
<tr>
<td>Middle stage dead (8-14 days)</td>
<td>8.75 ± 4.34$^a$</td>
<td>2.75 ± 3.5$^b$</td>
<td>6.25 ± 2.62$^a$</td>
</tr>
<tr>
<td>Later stage dead (15-21 days)</td>
<td>3.0 ± 0.81$^b$</td>
<td>2.0 ± 1.15$^c$</td>
<td>4.25 ± 1.25$^a$</td>
</tr>
<tr>
<td><strong>Chick Quality Parameters</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chick weight (g)</td>
<td>36.39 ± 3.11$^c$</td>
<td>41.27 ± 3.06$^b$</td>
<td>49.11 ± 3.64$^a$</td>
</tr>
<tr>
<td>Chick length (cm)</td>
<td>17.79 ± 0.58$^c$</td>
<td>18.32 ± 1.04$^b$</td>
<td>18.89 ± 0.57$^a$</td>
</tr>
<tr>
<td>Chick yield %</td>
<td>69.53 ± 0.01$^a$</td>
<td>69.55 ± 0.01$^a$</td>
<td>70.03 ± 0.01$^a$</td>
</tr>
<tr>
<td>Pasgar score</td>
<td>9.51 ± 0.20$^a$</td>
<td>9.55 ± 0.14$^a$</td>
<td>9.46 ± 0.11$^a$</td>
</tr>
</tbody>
</table>

*Data are presented as LS mean ± SE. $^a$,$^b$ Means within the same row with different superscript are significantly different ($P<0.05$). X=Younger breeder flock, Y= Median aged breeder flock, Z= Older breeder flock*
Many reports indicated that the average egg weight loss should be between 12 to 14% to obtain the highest hatchability of chicken eggs. Loss of egg weight should be ranged between 6.5 and 14.0% of the initial egg weight to obtain an adequate air cell before the embryo internally pips (Graybill et al., 1991; Molenaar et al., 2010; Walsberg, 1980). However, in the present study, the loss of egg weight ranged within the accepted level to have the adequate air cell size but lower to obtain the highest hatchability.

Three periods of embryonic mortality: early (first 7 days of incubation), middle (8 and 14 of incubation) and late (during the last week of incubation) were observed. The egg breakout analysis revealed that early stage dead of embryo was not significantly different ($P > 0.05$) among different age groups, while middle and later stage dead of embryo differed significantly ($P < 0.05$). Lowest embryonic dead percentage at any stage was observed in group Y while highest was reported in younger and older birds. Some studies reported that egg breakout analysis is useful for hatchery management procedures that provide valuable information in isolating problems in the breeder and hatchery program (Abudabos, 2010; Hamidu et al., 2007). The hatch day breakout analysis involves sampling of unhatched eggs from breeder flocks, and classifying them into the various causes of reproductive failures. Breakout analysis of all breeder flocks is critical in pinpointing problems in setters and hatchers. High number of early dead of embryo indicates prolong storage or storage at elevated temperatures, or inadequate egg collection procedures (Abudabos, 2010). High temperature of embryo, nutritional deficiencies of breeder flocks and contamination are the reasons for high number of middle dead of embryo at the same time setter/ hatcheter temperature and humidity problems, egg transfer damages, egg set upside down, insufficient water loss and nutritional deficiencies of breeder flocks are caused high number of late dead of embryo (Abudabos, 2010). Further, Pedroso et al. (2005) reported that eggs obtained from young breeders, have thick shells and produce smaller chicks that may have less physical strength to break the shell during hatching, resulting in higher embryo mortality which is in agreement with the present findings.

The chick weight and length showed a significant difference ($P < 0.05$) among different age group, but chick yield did not significantly differ ($P > 0.05$). Highest and lowest chick weight and length were observed in group Z and group X, respectively. Some studies reported that hatching weight of chicks is an indicator of chick quality and depends on egg weight and egg weight loss during incubation (Sozcu and Ipek, 2013; Tona et al., 2004). Chick weight may be influenced by egg parameters and age of breeders. Egg weight is a dominant factor affecting chick weight at hatch (Tona et al., 2002). Several authors reported a positive correlation between egg weight and chick weight. On the other hand, egg weight increases with the advance of breeder age (Gualhanone et al., 2012; Raju et al., 1997). In the present study as well, similar pattern was observed with the agreement of previously reported studies. The pasgar score was not significantly different among different age groups ($p > 0.05$) but group Y showed the highest pasgar score (9.55). The pasgar score is used to express the chick quality using a number and it
has been developed by evaluating five morphological criteria such as reflex, navel, legs, beak and yolk sac volume of the chicks. A sample of at least 30 saleable chicks must be assessed to get a representative score for chick quality of a flock of chicks. Some studies reported that best quality chick have a pasgar score of 10 and one point is subtracted for each abnormality observed in morphological criteria stated above (Boerjan, 2002; Boerjan, 2006). Though not significant, the highest pasgar score (9.55) was reported for median age broiler breeders in the present study.

Conclusions

We conclude that there are significant breeder age differences with respect to egg weight, egg shape index, and embryonic dead at mid and late stage of incubation, moisture loss, hatchability, hatch of fertile percentages, chick weight at hatch and chick length. Even though median aged flock shows the best incubation parameters with minimum embryonic dead, higher quality chicks can be produced from eggs taken from older aged breeder flocks. Overall, some of the incubation and chick quality parameters are affected with advancing the breeder age which could be used by commercial hatcheries to improve their hatchery performances of their interest.

References


