The Effect of Hen Hatching Eggs Characteristics and Time of its Storage on Embryonic Mortality during Incubation

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Abstract
Hatching eggs of hens' hybrid combination Shaver Starcross 288 were used to monitor effect of eggs characteristics and time of its storage on embryonic mortality during incubation. During experiment embryonic mortality of 26.604 pieces of hatching eggs in total was evaluated at age 28, 40, 52 and 64 weeks. Hatching eggs of average weight 60-65 grams are most appropriate for hatching. Hatching yields from small (50-55 g) as well as from large eggs (70-75 g) are worse and embryonic mortality is higher. Embryonic mortality during incubation was highest in the third stage of incubation (last week of incubation). The best shapes of hatching eggs to achieve the best hatching results are within the shape index 70-75. Any deviation towards a pointed or round eggs lead to increased embryonic mortality. Upon storage of hatching eggs under standard conditions the differences in hatching results and embryonic mortality during the first 10 days were statistically insignificant. Significantly decreased hatchability and increased embryonic mortality was on the rise after 10 days of storage. The storage time of hens hatching eggs in compliance with all storage conditions may be extended to 10 days.

Keywords: egg weight, egg shape, embryonic mortality, hatching egg, incubation.

1. Introduction

The avian egg is a biological system, intended to ensure the well-being of the embryo and its successful hatching into a fully developed chick. Egg characteristics greatly influence the process of incubation by interacting with the chain of both physiological and energetic features of the developing embryo. Any breach in this chain of interactions may result in the mortality of the embryo [1].

Various breeding practices and handling of eggs from egg laying to hatching, particularly pre-incubation storage condition, temperature, along with the age of breeding flock have been the most common variables used to manipulate fertility, hatchability, liveability and quality of day old chicks [2,3].

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Egg weight increases with breeder age, and eggs of different sizes have different physical and chemical qualities that affect hatchability and chick quality. Chick weight at hatching is strongly related to egg weight. Heavier chicks may present higher body development and smaller yolk sacs due to higher development during incubation, or less developed bodies and larger yolk sacs, allowing them to survive longer before exogenous feed is provided [4].

The principal objectives of the commercial hatchery are to secure the maximum number of quality day-old chicks out of the eggs set for hatching. Several researchers reported that genotype of breeder hen had significant effect on hatchability of egg [5].

Egg storage is a common practice and often required in commercial incubation, aiming at avoiding the mixture of eggs from different flocks and breeder ages, or of eggs from flocks with undetermined health status. It also allows incubating a larger number of eggs to supply a

scheduled demand. Storage management includes several factors that may affect hatchability and hatchling quality [6].
The present study aimed at evaluating egg weigh, egg shape index and storage time in hens from various age on embryonic mortality.

2. Materials and methods

The experiment we realised at Shaver Starcross 288 hens in 28, 40, 52 and 64 weeks of age.
Throughout the study, birds were maintained in normal environmental conditions and housed in system deep litter (1/3) and slatted floor (2/3).
During the egg production period, hens were fed *ad libitum* feed mixture HYD-11 for breeding hens.
The eggs were numbered and weighed individually and later grouped into 5 categories as follows: 50-59g, 55-60g, 60-65g, 65-70g and 70-75g. There were 5 treatments with 4 replicates per treatment.
The lengths and widths were obtained using an electronic sliding calliper (precision 0.01mm), so that an egg shape index, defined as the ratio between length and width multiplied by 100 [7] could be calculated. Hatching eggs in weight from 55 to 65 g were grouped into 5 categories: 66-69%, 69-72%, 72-75%, 75-78% and 78-81%. There were 5 treatments with 4 replicates per treatment.
Eggs were stored from 8 to 12°C and 60 to 75% relative humidity and grouped according to storage time 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 and 14 days of storage. There were 14 treatments with 4 replicates per treatment.
Data were analyzed using analysis of variance. Significant difference was used at 0.05 and 0.01 probability level and differences between groups were tested by the Scheff's test at the levels of significance.

3. Results and discussion

Table 1 presents the effect of different egg weight on embryo mortality.
Embryonic mortality ranged from 9.71% in eggs 56-60 g to 16.74% in eggs 70-75g. We found that hatching eggs of average weight from 55 to 60 and from 60 to 65 grams are most appropriate for hatching of chickens. For hatching eggs from 70 to 75 g we found highest embryonic mortality.
Comparing embryonic mortality among each weeks of hen age, we found that had slowly increasing from 10.21 in hens aged 28 weeks at 13.87% in hens of age 64 weeks (Figure 1).
We can say, that in the category of large eggs (70-75g) increased embryonic mortality during the hatching by changes in the ratio of albumen to the yolk in eggs.

Table 1. Effect of different egg weight (in g) on embryonic mortality (in %)

Group	mean ± SD
50-55g	11.92±1.38
55-60g	9.71±0.67
60-65g	9.95±2.43
65-70g	11.99±1.59
70-75g	16.74 ± 3.91^{A}

^{A} means in a row with different superscript differ significantly (P<0.01)

Egg weight could influence embryonic mortality rate during incubation [8]. De Witt and Schwalbach (2004) [9] observed higher hatchability in large eggs in different breeds, whereas, reduction in reproductive efficiency of broiler breeder with increasing egg weight and other complications due to large eggs have also been reported by [10].
However, it has been indicated that egg weight did not influence embryonic mortality [11].
Table 2 presents the effect of different egg shape index on embryo mortality.

Table 2. Effect of different egg shape (in %) on embryonic mortality (in %)

Group	mean ± SD
66-69	15.25 ± 2.30^{a}
69-72	12.69±1.96
72-75	11.15±1.85
75-78	14.56 ± 2.06^{b}
79-81	21.22 ± 1.79^{A}

^{a,b} means in a row with different superscript differ significantly (P<0.05)
^{A} means in a row with different superscript differ significantly (P<0.01)

The lowest value of embryonic mortality we recorded for hatching egg shape index from 72 to 75%. In contrast, embryonic mortality was highest for shape index of hatching eggs from 79 to 81%.

In comparison of embryonic mortality among each weeks of hen age, we recorded small differences in hens aged 28, 40 and 52 weeks (12.06; 14.10 and 13.13%). In hens of age 64 weeks was value of embryonic mortality significantly higher (20.60%, Figure 2).

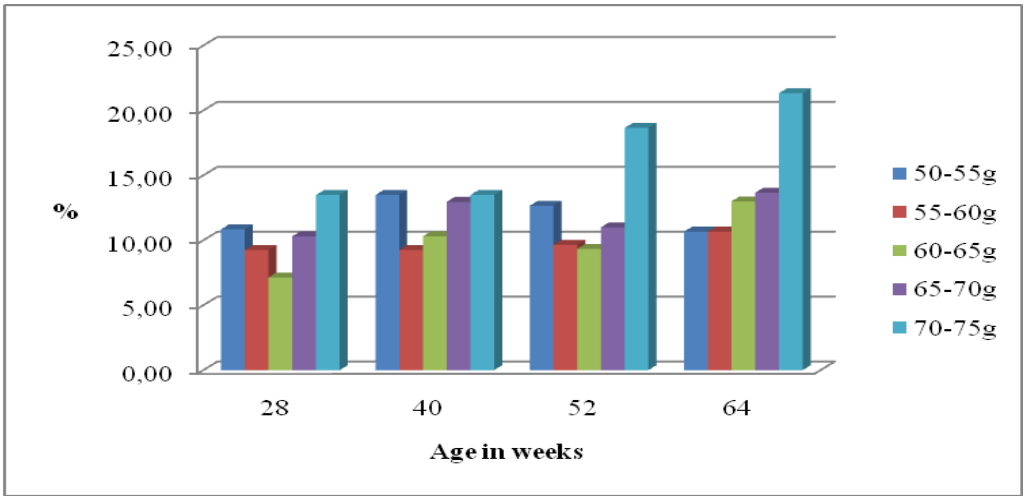

Figure 1. Effect of different egg weight (in g) in various age of hens on embryonic mortality (in %)

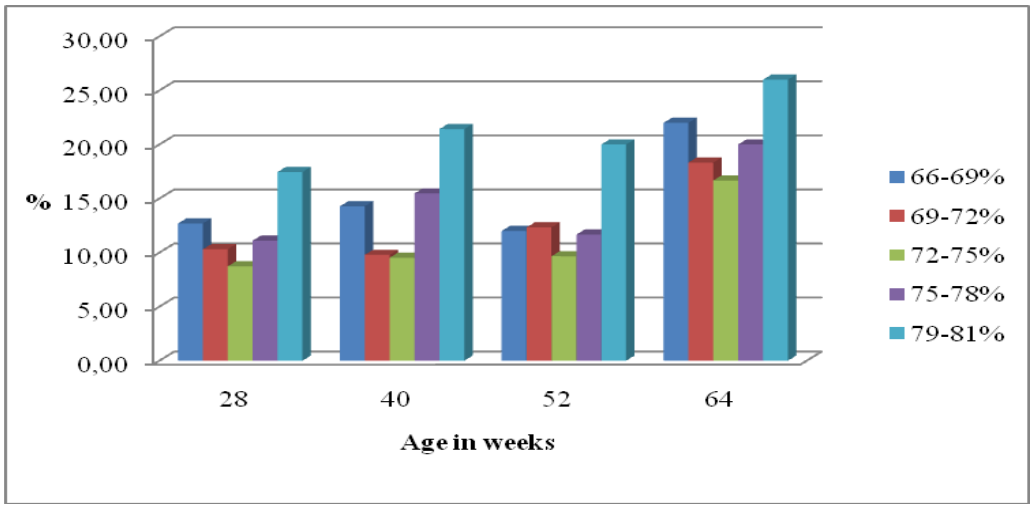

Figure 2. Effect of different egg shape index (%) in various age of hens on embryonic mortality (in %)

Kumar and Shingari, (1969) [12], Tsarenko (1988) [13] and Burtov et al. (1990) [14] unanimously recognized that egg of normal morphology hatch better than those that are abnormally shaped. This results probably due to the fact that embryo changes its axial orientation in the egg at latter stage of embryonic development [15,16].

The results show a significant effect of storage time on embryo mortality. We found that with the advancing storage period of hatching eggs from different hens' aged, embryonic mortality irregularly increased (Table 3, Figure 3).

For storage time under standard conditions the differences in embryonic mortality during the first 10 days were statistically no significant.

We observed significantly increase of embryonic mortality after 10 days of storage.

Similar results were obtained by [17], who found that for each 1.0 day in storage time, hatchability was reduced in 1.0% and added 1.0 hour in incubation time.

The storage of eggs prior to setting in the incubator might improve embryo growth in terms of hatchability within all groups. This is because egg storage might improve embryo by better utilization of carbohydrate [18].

Table 3. Effect of different storage time (in days) on embryonic mortality (in %)

Group	mean ± SD
1	15.32±6.67[a]
2	12.73±7.72
3	13.21±4.92
4	15.20±5.48[b]
5	13.96±6.96
6	15.35±5.87[c]
7	17.02±4.72[d]
8	14.13±7.13
9	14.16±4.15
10	16.19±6.40[e]
11	18.53±4.31[f]
12	19.85±6.62[A]
13	21.28±5.98[B]
14	25.62±6.11[C]

[a-f] means in a row with different superscript differ significantly (P<0.05)
[A–C] means in a row with different superscript differ significantly (P<0.01)

4. Conclusions

The most influential egg parameters on embryonic mortality are egg weight and shape index. Medium weight eggs had a lower embryonic mortality than heavier and lighter eggs. Similarly, hatching eggs with a medium egg shape index had a lower embryo mortality compared with eggs lower or higher value of egg shape index.
Egg storage for more than four days should only be used under special circumstances, as long storage times reduce hatchability due to increased embryo mortality.

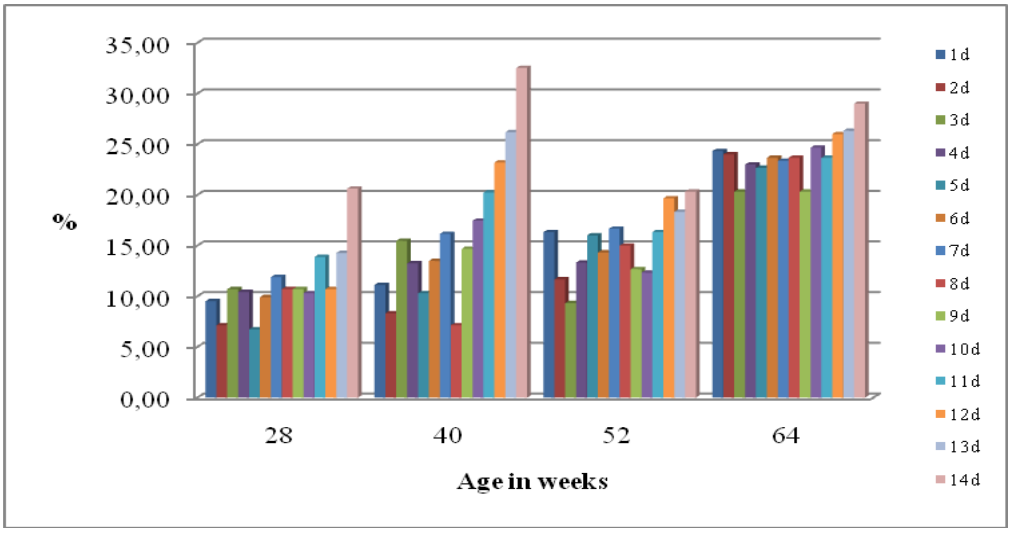

Figure 3. Effect of different storage time (in days) in various age of hens on embryonic mortality (in %)

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