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# Effect of Moisture Loss on the Hatchability of Chicken, Duck and Quail Eggs

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**Abstract**

The study investigated the effect of moisture loss on the Hatchability of chicken, Duck and Quail eggs. A total of 480 eggs; 120 from Rhode Island Red (RIR) chicken, 60 from Zending duck and 300 from Japanese quail were collected and set in the same incubator with 3 replications to compare hatchability results among the species. Moisture loss percentage was highest (P<0.01) in quail eggs (16.19%), intermediate in chicken eggs (7.76%) and lowest in duck eggs (7.24%). Among 3 genotypes, at all (0, 7 and 14 days) ages, eggs weight was highest (p<0.01) in Zending duck (60.50g), intermediate in RIR chicken (59.188) and lowest in quail (9.55g). Egg weight loss at 7 and 14 days of incubation were highest in quail, intermediate in chicken and lowest in duck. There was no appreciable differences of hatchability on set eggs and fertile eggs among species (p>0.05). Apparently, the hatchability on fertile eggs was similar and higher in chicken (58.3%) and quail (58.9%) and slightly lower in duck (53.7%). However, hatchability on set eggs was highest in quail (58.3%) intermediate in chicken (43.3%) and lowest in duck (40.7%). Chick weight at hatchings was highest (p<0.01) in duck (37.55g), intermediate in chicken (34.56g) and lowest in quail (5.61 g). Chick weight as per cent of egg weight was found highest (p<0.01) in duck (62.07%), intermediate in chicken (58.40%) and lowest in quail (54.24%). There were some relations among the different hatchability results depending on species. There were marked variations in moisture effect among the species. It was clear that hatchability not only affected by species but moisture loss also played an important role on hatchability. It was concluded that under similar environment, hatchability on fertile eggs were similar and higher in quail and chicken and lower in duck. But hatchability on set eggs was highest in quail, intermediate in chicken and lowest in duck. It imply that some losses of moisture with various level may be necessary to enhance egg hatchability is required to support hatching results in different species of poultry.

**Key words**: Chicken, Duck and Quail egg, Egg hatchability and Moisture loss

## Introduction

The hatchery man is interested in number of saleable chicks out of the egg purchased. Recently, demand for quality chicks is very high throughout the year. At present hatchery industry can not meet the increasing demand. Therefore, the year round availability of quality chicks at a reasonable price to be encouraged in commercial hatcheries. The principal objective of the commercial hatchery is to secure the maximum number of quality day old chicks out of the eggs set for hatching.

Two major concerns are the fertility of eggs and the hatchability of careless fertile eggs. The incubation procedures including proper following of the requirements of temperature, humidity, turning of eggs are important for maintenance and improvement of hatching of eggs. In order to obtain a sufficient number of eggs to fill an incubator, eggs are usually accumulated under storage for 3 to 10 days before incubation (Kuurman *et al.,* 2002). In order to prevent embryonic development during the storage period, eggs must be stored at low temperature. For eggs stored for less than 4 days, egg room temperature should be 20°C-25°C, whereas for those stored 4-7 days, temperature should be maintained between 16°C and 17°C, and for eggs stored for more than 7 days, temperature should be lowered to 10°C-12°C (Meijerhof, 1992). Storage causes egg water loss by evaporation, the rate which is influenced by storage temperature and relative humidity. Studies of the research objectives were to comparison of egg hatchability and associated traits among chicken, duck and quail eggs and to find out the relationships of moisture loss with hatchability in 3 different species of poultry.

## Materials and Methods

### *Collection and storing of hatching eggs*

There are 480 hatching eggs (120 RIR chicken, 60 Zending duck and 300 Japanese quail) were collected from Bangladesh Agricultural University (BAU) Poultry Farm, Mymensingh. The eggs were put on collecting trays keeping the large end up and stored in the cold room at 18°C-20°C with 75-80% RH for 7 days. To keep the actual records on temperature and relative humidity, dry and wet bulb thermometer was hung about 1 meter above the eggs.

### *Selection and care of hatching eggs*

After daily collection, the eggs were scrutinized on the basis of their physical characteristics such as size, shape, weight, shell texture and cleanliness of the shell. The good size eggs, uniformly calcified, clean and sound shell (without any type of crack) were selected randomly.

### *Cleaning and disinfection of hatching eggs*

Smooth and fine duster was used to remove the dirty materials adhered to shells of eggs before washing. Finally, the clean eggs were fumigated by paraformaldehyde (10 gm $m^{-3}$ for 20 minute).

### *Disinfection and fumigation*

The incubator was properly cleaned and disinfected with detergent before setting the eggs in incubator. Before 1$^{st}$ set of eggs, the incubator was fumigated by paraformaldehyde as per recommendation (3x strength for 30 min., lx = 10 g $m^{-3}$). No fumigation was performed after setting the eggs in the incubator.

### *Eggs traying in setter*

Eggs were set into the Octagon (Home type) incubator.

Each setter capacity was 250 eggs. Eggs from three different species (chicken, duck and quail) were set in the same incubator having same temperature, humidity, turning and ventilation.

***Turning of eggs***
The eggs were turned 6 times in 24 hours manually after setting.

***Control of temperature***
Temperature was controlled by automatic program as per recommendation by Octagon hatchery manual. Setter temperature was 37.5°C while hatcher temperature was 36.7°C. The temperature maintained during incubation period is given below:

| Day | Temperature ($^0$C) | Humidity | Incubator |
|---|---|---|---|
| 01-10 | 37.8 | 75 | Setter |
| 10-12 | 37.5 | 75 | " |
| 12-14 | 37.0 | 75 | " |
| 14-above | 36.7 | 80 | " |
| Normal Run | 36.7 | 80 | " |
| 18-21 days | 36.5 | 80 | Hatcher |

In the case, when incubator was full sets of eggs, the temperature and humidity were kept unchanged. However when new sets of eggs were placed, temperature was adjusted based on the previous set of eggs in the incubator.

***Control of humidity***
During incubation, humidity was maintained as per recommendation given by Octagon manual. Relative humidity in setter and hatcher were 75% and 80%, respectively.

***Weighing of eggs***
At all ages (0, 7 and 14 days), egg weigh records were kept properly, and then the percent moisture loss was calculated. Average egg weight was also calculated at all three days of incubation.

***Transfer of eggs***
Chicken, duck and quail eggs were transferred from setter to hatcher at 18$^{th}$, 24$^{th}$ and 14$^{th}$ days of incubation, respectively.

***Hatching records***
Te following records was kept throughout the experimental period.

***Candling of eggs***
Candling was done at 10$^{th}$ days of incubation period with the help of an electric candler to identify the clean or infertile eggs or dead embryos, if any.

***Fertility records***
During candling, infertile eggs were separated from the fertile eggs. After completion of hatch, unhatched eggs were examined again to calculate fertile eggs, if any.

***Records of baby chicks hatched and separation of normal and abnormal chicks***
On the 22$^{nd}$, 29$^{th}$ and 18$^{th}$ day of incubation in chicken, duck and quail respectively, the chicks hatched out of total eggs were separated and recorded as normal and abnormal chicks. The chicks belongs to the abnormal were discarded. Abnormal chicks were lame, blind, poorly feathered, open naveled, micromelia, organ less etc. After discarding all abnormal chicks the rest were considered as normal and healthy chicks.

***Day old chick weight***
The day old chick weight was taken in gram using an electronic digital balance and then average was calculated.

***Record keeping and data transformation***
The following data were calculated from the records kept during the experimental period:

**Calculation of moisture loss**
Moisture loss (%) =

$$\frac{\text{Initial weight - weight at 14 days}}{\text{Initial weight}} \times 100$$

***Calculation of hatchability***
Hatchability was calculated by adopting the following procedure:
Total number of chicks hatched
1) Hatchability on fertile eggs (%) =

$$\frac{\text{Total number of chicks hatched}}{\text{Total number of fertile eggs}} \times 100$$

2) Hatchability on fertile eggs (%) =

$$\frac{\text{Total number of chicks hatched}}{\text{Total number of egg set}} \times 100$$

**Calculation of chick weight as per cent of egg weight**

$$\text{Chick weight (\%)} = \frac{\text{Egg weight - Chick weight}}{\text{Egg weight}} \times 100$$

***Statistical analysis***
All data either recorded or calculated and analyzed by Completely Randomized Design (CRD). Analysis of variance was performed to partition variance into species and error for comparing data among the species. Significance differences were isolated by calculating Least Significant Difference (LSD) for comparison. A Genstat computer package was used to analyze the data.

## Results and Discussion

***Egg weight loss (g)***
At all ages (0, 7 and 14 days), set egg weight were highest ($p<0.01$) in Zending duck (60.50 g), intermediate in RIR chicken (59.18 g) and lowest in quail (9.55 g) (Table 1). Egg weight loss at 7 and 14 days of incubation were highest in quail, intermediate in chicken and lowest in duck, which was almost reverse in comparison with the egg weight used in the present experiment. Higher weight loss was from lightest eggs, intermediate in eggs with intermediate weight and lowest weight losses from heaviest eggs were obtained. The current study, suggesting that weight loss may be inversely proportional

to weight of eggs. Thus, it appears that the egg weight loss with advance of incubation period simply was the function of egg water loss. Such differenence might have been arisen from depth of the eggs. The heaviest eggs have higher diameter, intermediate size eggs had intermediate diameter and lightest eggs had lowest diameter. This study was supported by Ar and Rahn (1980), who examined the loss of mass in eggs during incubation and evidences showed that this was essentially due to loss of water.

It is evident from figure 1 that the egg weight of 3 species almost linearly depleted with the advance of incubation period. Moisture loss in chicken, duck and quail eggs during incubation periods were almost linear fashion. Chick weight was almost linearly increased with the increase of egg weight, whereas moisture loss maintained a negative relation with the increase of egg weight.

***Moisture loss** (%)*

Moisture loss percentage was highest ($p<0.01$) in quail (16.19%), intermediate in chicken (7.76%) and lowest in duck (7.24%) (Table 1). Moisture loss had significant effect on hatchability. The current study revealed that the higher percentage of moisture loss had a positive correlation with the egg hatchability. These results agree with the previous report of Romao *et al*. (2009), who showed that higher moisture loss in Japanese quail eggs during incubation gave highest hatchability in comparison with intermediate and lowest moisture loss. Tullett and Deeming (1987) also suggested a moisture loss between 10 to 11% in domestic fowl eggs during incubation results better hatchability.

***Hatchability** (%)*

There was no appreciable differences of hatchability on set and fertile eggs ($P>0.05$) (Table 2). Apparently, the hatchability on fertile eggs was similar in chicken (58.3%) and quail (58.9%) and slightly lowest in duck (53.7%). However, hatchability on set eggs was highest in quail (58.3%) intermediate in chicken (43.3%) and lowest in duck (40.7%). Difference in hatchability on total eggs and lack of difference on fertile egg among genotype signifies that, hatchability on set eggs was just a function of fertility. This results partially agree with Chaudhry and Alvi (1967), who found that there was no significant difference in hatchability on fertile eggs between Rhode Island Red and New Hampshire ($p>0.05$). These results however contradict with the report of Swan (1977), who found higher percentage of hatchability (both fertile and set eggs) in meat strain than that of egg strains.

**Table 1.** Egg weight and moisture loss results of chicken, duck and quail eggs

| Variable | Incubation period (day) | Species | | | SED | Level of significance+ |
|---|---|---|---|---|---|---|
| | | Chicken | Duck | Quail | | |
| Egg weight (g/egg) | 0 | $59.18^{b}$ | $60.50^{b}$ | $9.55_{a}$ | 1.333 | ** |
| | 7 | $56.24^{b}$ | $58.17^{b}$ | $8.74^{a}$ | 1.097 | ** |
| | 14 | $54.59^{b}$ | $56.09^{b}$ | $8.00^{a}$ | 0.993 | ** |
| Moisture loss (%) | 7 | $4.96^{b}$ | $3.48^{a}$ | $8.48^{e}$ | 0.455 | ** |
| | 14 | $7.76^{a}$ | $7.24^{a}$ | $16.19^{b}$ | 0.995 | ** |

+NS, P>0.05; **P>0.01; abc, values having dissimilar superscripts are significantly different; all SED'S are 6 against error degrees of freedom.

**Table 2.** Hatchability results of chicken, duck and quail eggs

| Variable | Species | | | SED | Level of significance+ |
|---|---|---|---|---|---|
| | Chicken | Duck | Quail | | |
| Hatchability on set egg (%) | 43.3 | 40.7 | 58.3 | 12.02 | NS |
| Hatchability on fertile egg (%) | 58.3 | 53.7 | 58.9 | 13.62 | NS |
| Chick weight (g/chick) | $34.56^{b}$ | $37.55^{c}$ | $5.18^{a}$ | 0.853 | ** |
| Chick weight as % egg weight | $58.40^{b}$ | $62.07^{c}$ | $54.24^{a}$ | 1.790 | ** |

+NS, P>0.05; **P>0.01; abc, values having dissimilar superscripts are significantly different; all SED'S are 6 against error degrees of freedom.

***Weight of chicks at hatching***

Chick weight at hatchings was highest ($p<0.01$) in duck (37.55g), intermediate in chicken (34.56g) and lowest in quail (5.61g) (Table 3). These results suggest that the day old body weight at hatching is positively correlated with egg weight. This finding is supported by Costantini and Panella (1982), who observed that chick weight at hatching increased from 35.2 to 45.3g with increasing egg weight ($P< 0.01$). Egg weight had a significant effect on chick weight at hatching.

***Chick weight as per cent of egg weight***

Chick weight as per cent of egg weight was found highest ($p<0.01$) in duck (62.07%), intermediate in chicken (58.40%) and lowest in quail (54.24%) (Table 3). This result revealed that chick weight as per cent of egg weight was higher in heaviest eggs, intermediate in intermediate eggs and lowest in lightest eggs, rather species had an important role. This is might because of moisture loss is less in larger eggs than that of smaller eggs. Relative chick weight (chick weight as percentage of egg weight) was in favour of heavier species along with the egg weight. This result agrees with Raju *et al.* (1997), who found positive correlation between egg weight and chick weight. They also reported that the day old chick weight incresed significantly ($P<0.01$) with the increase of egg weight.

## Conclusions

It is concluded that under similar environment,

hatchability on fertile eggs were similar and higher in quail and chicken and lower in duck.

***Conflict of interest statement***

The authors declare that they have no conflict of interest.

**References**

Ar, A. and Rahn, H. 1980. Water in the avian egg overall budget of incubation; *American Zoologist*, 20: 373-384.

Byerly, T. C. and Godfrey, A. B. 1937. Fertilizing capacity of the male chickens in natural coatings. National Poultry Improvement Plan Con. Ret., pp. 57.

Chaudhary, M. R. and Alvi, M. S. 1967. Comparative study of fertility and hatchability of New Hampshire and Rhode Island Red breeds of chicken. Animal Breeding Abstracts, 39: 383.

Costantini, F. and Paneila, F. 1992. Correlations between egg weight, chick weight and broiler performance. Istituto di Zoocolture Perugia, Italy, 5: 35-40.

Demmining, D. C. and Van Middelkoop, J. H. 1999. Effect of strain and flock age on fertility and embryonic mortality of broiler breeder eggs. *British Poultry Science*, 40: 522-526.

Kuurman, W. W.; Bailey, B. A.; Koops, W. J. and Grossman, M. 2002. Influence of storage days on the distribution for time of embryonic mortality during incubation. *Poultry Science*, 81: 1-8.

Lundy, H. 1969. A review of the effects of temperature, humidity, turning and gaseous environment in the incubator on hatchability of hen's eggs. In: T. C. Carter and B. M. Freeman, editors. Oliver and Boyd, (Edinburgh, UK). The Fertility and Hatchability of the Hen's Egg. pp. 143-176.

Luykx, R. 1994. Effect of genotype, age and storage on characteristics and hatchability in broiler breeders. In: Proceedings, 9th European Poultry Conference, Glassgow, 1: 405-406.

Meijerhof, R. 1992. Pre incubation holding of hatching eggs. *World's Poultry Science Journal*, 48: 57-68.

Meir, M. and Ar, A. 2008. Changes in eggshell conductance, water loss and hatchability of layer hens with flock age and moulting. *British Poultry Science*, pp. 677 – 684.

Orszagh, V. and Micek, J. 1961. The effect of temperature variation during incubation on hatchability. Animal Breeding Abstracts, 33: 492.

Parker, J. E. and Spadden. B. J. 1949. Fertility in chicken and turkeys. Fertility and hatchability of chicken and turkeys eggs. Lewis, W. Taylor, Editor, John Wiley and Sons. Inc. New York, pp. 423.

Pedroso, A. A.; Cafe, M. B.; Leandro, N. S. M.; Stringhini, J. H. and Chaves, L. S. 2006. Desenvolvimento embriondrio e eclodibilidade de ovos de codomas armazenados por diferentes periodos e incubados em umidades e temperatures distintas; In: Revista. Brasileira de Zootecnia, 35: 2344-2349.

Raju, M. V. L. N.; Chawak, M. M.; Praharaj, N. K.; Rao, S. V. R. and Mishra, S. K. 1997. Interrelationship among egg weight, hatchability, chick weight, post hatch performance and rearing method in broiler breeders. *Indian Journal of Animal Sciences*, 67: 48-50.

Roman, J. M.; Moraes, T. G. V.; Teixeira, R. S. C.; Buxade, C. and Cardoso, W. M. 2009. Effect of relative humidity on incubation of Japanese quail eggs. Livestock Research for Rural Development, 21: 321-324.

Sergeeva, A. 1984. The incubation of eggs at different weight classes of poultry. Poultry Abstracts, 10: 71.

Swan, S. E. J. 1977. Fertility and hatchability of meat and egg strains of poultry in Fiji. Poultry Abstract, 3: 425.

Tullett, S. G. 1990. Science and art of incubation. *Poultry Science*, 69: 1-15.

Wilson, H. R. 1991. Interrelationship of egg size, chick size, post hatching growth, and hatchability. *World's Poultry Science Journal*, 47: 5-20.

Yoo, B. H. and Wientjes, E. 1991. Rate of decline in hatchability with pre incubation storage of chicken eggs depends on genetic strain. *British Poultry Science*, 32: 733-740.

Yoshizaki, N. and Saito, H. 2002. Changes in shell membranes during the development of quail embryos. *Poultry Science*, 81: 246-251.