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Effect of Egg Storage Length on Hatchability and Weight Loss in Incubation of Egg and Meat Type Japanese Quails

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■ Keywords

Egg weight loss, incubation, Japanese quail, storage.

ABSTRACT

The quail raising in Brazil has increased through the last years and the incubation procedures are important to maintenance and improvement of quail egg production. To obtain a sufficient number of eggs to fill an incubator, eggs are usually accumulated in storage over a period from 1 day up to 3 weeks before incubation. The objective of this research was to verify the effect of egg storage on hatchability and egg weight loss for two lineages of Japanese quails. Sixty four Japanese quails were divided in two groups: G1 (n=32) for meat production and G2 (n=32) for egg production. They were used for serial egg collections that were performed every day, during 15 consecutively days, totaling 600 eggs. After collection they were placed in refrigerated room (20°C and 60% of relative humidity) and submitted to different periods of storage, from 0 day until 14 days, according to their collection day. The incubation occurred at 37.6°C and 60% RH. The weight measurements were done during storage, incubation and hatching. The results showed that for Meat type and Egg type quails, the egg hatchability was around 84% until 10 days of storage, and then this rate decreased significantly. Both types of quail eggs presented similar weight loss during storage and incubation. The research showed that quail eggs present great hatchability until 10 days of storage and that eggs submitted to storage present a reduced weight loss during incubation.

INTRODUCTION

Quail production in Brazil has increased during the last few years. In 2002, 9.25 millions dozen quail eggs were produced by 5,572,068 birds, which yielded a revenue of R$ 48 millions (IBGE, 2002). The incubation procedures are important for maintenance and improvement of quail egg production. In broiler production, in order to obtain a sufficient number of eggs to fill an incubator, eggs are usually accumulated under storage for 1 day to 3 weeks 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 20-25°C, whereas for those stored 4-7 days, temperature should be maintained between 16 and 17°C, and for eggs stored for more than 7 days, temperature should be lowered to 10-12°C (Meijerhof, 1992). Storage causes egg water loss by evaporation, which rate is influenced by temperature and relative humidity. Studies report that long storage periods are detrimental to table- and hatching-egg quality (Samli *et al.*, 2005; Scott *et al.*, 2000; Walsh *et al.*, 1995). Water loss is a normal process during incubation; 12 to 14% of water are usually lost by broiler and turkey eggs (Rahn *et al.*, 1981). However, if water loss is too low or too high, embryo

hatchability (Meir *et al.*, 1984). An increase in the number of storage days elevates embryo mortality rate during storage and incubation, and thereby increases the probability of failure to hatch (Whitehead *et al.*, 1985; Yoo & Wientjes, 1991; Scott & Mackenzie, 1993). Some researchers reported hatchability reductions of as much as 5% per day after 7 days of storage (Mayes & Takeballi, 1984). As compared to literature on *Gallus gallus* incubation, there are few studies on incubation techniques for Japanese quails strains. The objective of this study was to verify the effect of egg storage on hatchability and egg weight loss for two strains of Japanese quails.

MATERIAL AND METHODS

This experiment was performed at Laboratório de Estudos Ornitológicos da Universidade Estadual do Ceará. A total number of 64 Japanese quails were divided in two groups according to strain: 32 meat-type birds, and 32 layer birds. Birds were housed in experimental battery cages with three females and one male per cage. Initial age was 4 month age, and average egg production was 90%. All quails were supplied *ad libitum* with water and 17 hours/day of light were provided.

Eggs were daily collected at 05:00 pm. Eggs were submitted to selection according to industrial parameters for egg incubation, which included egg shape, extreme sizes, and eggshell intactness by candling. Twenty eggs from each quail strain were daily selected for 15 consecutive days, totaling 600 eggs. After daily collection, eggs were stored in a refrigerated room at 20°C and 60% of relative humidity. These eggs were divided into different experimental groups according to strain and storage length under refrigeration, which varied from 0 to 14 days, according to their collection day.

Table 1 shows egg mean weight and storage length according to group.

All eggs were weighed on their collection day and daily during the storage period to check egg weight loss with a precision scale (0.01g precision). Eggs were also weighed during incubation period at the 2nd, 4th, 6th, 8th, 10th, 12th, and 14th day of incubation. All quail chicks and eggshells were weighed after hatching.

Incubation was carried out in automatic Premium Ecológica® incubators and hatchers, with a capacity for 300 quail eggs each capacity. The models of the incubators and hatchers were IP-130 and NP-130, respectively. Eggs were incubated at a temperature of 37.6ºC, relative humidity of 60%, and egg turning in every 30 minutes. At day 14 of incubation (336h), egg turning was stopped, and eggs were transferred to the hatchers, which maintained the same temperature and relative humidity until hatch.

Eggs were divided into 30 experimental groups, according to quail strain and pre-incubation storage length. There were four replications of five eggs per treatment. Hatchability and egg weight loss means were submitted to regression analysis. Regression equation and coefficient of determination (R^2) were obtained for each dependent variable.

RESULTS AND DISCUSSION

The trend lines for hatchability of egg- and meat-type quail eggs submitted to different storage periods (0-14 days) are shown in Figure 1.

Both types of Japanese quail eggs presented a reduction of hatching rates as storage length increased. Egg-type quail eggs presented higher hatchability along egg storage as compared to meat-type quail eggs.

Table 1 - Experimental groups of egg- and meat-type quails.

Egg type quails			Meat type quails		
Groups	Storage length (days)	Egg weight mean (g)	Groups	Storage length (days)	Egg weight mean (g)
E-0	0	10.20	M-0	0	13.10
E-1	1	10.30	M-1	1	13.15
E-2	2	10.60	M-2	2	13.05
E-3	3	11.05	M-3	3	12.80
E-4	4	11.05	M-4	4	12.80
E-5	5	10.95	M-5	5	12.95
E-6	6	11.15	M-6	6	12.65
E-7	7	11.05	M-7	7	12.80
E-8	8	10.95	M-8	8	12.80
E-9	9	10.85	M-9	9	12.95
E-10	10	10.80	M-10	10	12.80
E-11	11	11.10	M-11	11	12.85
E-12	12	10.70	M-12	12	13.10
E-13	13	10.85	M-13	13	13.10

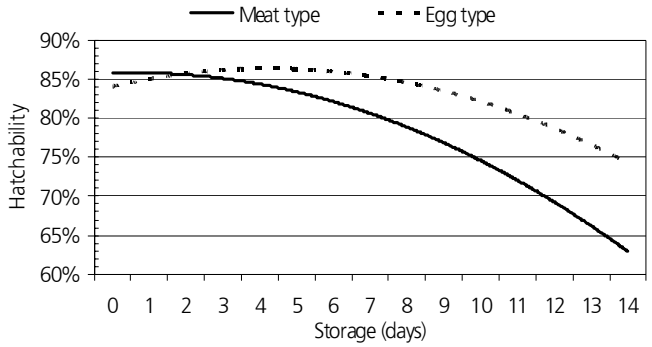

Figure 1 - Percentage of hatchability to Meat type and Egg type quail eggs at different periods of storage.

Egg-type quail eggs presented 85% average hatchability up to 10 days of storage, whereas meat-type quail eggs had an average of 83%. Total hatchability was 83% for egg-type quails and 78% for meat-type quails at 14 days of storage. Regression analysis of hatchability as a function of storage length gave the following regression equation ($y = -0.0013x^2 + 0.0042x + 0.8545$) and R^2 (0.4559) for meat-type quails and the regression equation ($y= -0.0013x^2 + 0.0134x + 0.8282$), R^2 (0.1848) for egg-type quails. Meat-type quails had a better coefficient of regression as compared to egg-type quails. However, both coefficients of regression were low, and therefore the predicting models for hatchability of eggs submitted to storage are not very precise.

It was reported that egg storage prior to incubation can have both detrimental and beneficial effects (Brake *et al.*, 1993). Excessively long storage before incubation reduces hatchability (Becker, 1964). On the other hand, other studies reported that eggs stored for a few days presented higher hatchability than those set in an incubator immediately after lay (Asmudndson & MacLlriath, 1948). Sittmann *et al.* (1971) studied the hatchability quail eggs stored from 4 up to 38 days (13.3ºC) and found 78.6% hatchability for 4 days, 76.9% for 8 days, and 72.4% for 13 days of storage. According to Meijerhof (1992), eggs stored for more than 7 days should be held at 10-12ºC, as well as Sittmann *et al.* (1971). However, we verified better hatchability after two weeks of storage at a higher temperature (20ºC). Petek *et al.* (2005) observed hatchabilities of 85.8%, 88.3%, 83.8, and 82.3% for 1, 3, 5 and 7 days of storage at 18ºC with turning twice a day in Pharaoh quails, which are members of the *Coturnix* family (Shanaway, 1998). The hatchability of chicken eggs (70.5%) (Fasenko *et al*, 2001a) and higher than turkey eggs (65.6%) stored for the same period (Fasenko *et al*, 2001b). However, the storage temperatures used by Fasenko *et al*. (2001ab) for chicken and turkey eggs (11.5°C and 17.4°C, respectively) were lower than those used in the present study.

Excessive storage duration can negatively affect hatchability. Evidence of necrosis and regressive changes in the blastoderm have been reported even at storage temperatures of 13°C (Arora & Kosin, 1966; Mather & Laughlin, 1979), as well as shrinking of the blastoderm at 10°C (Funk & Bieller, 1944; Mather & Laughlin, 1979).

Figures 2 and 3 show the trend lines for percentage of egg weight loss during storage period and incubation up transference the hatcher for eggs stored from 0 to 14 days.

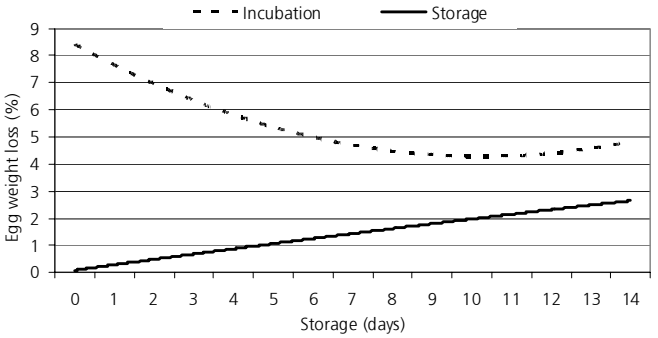

Figure 2 - Percentage of egg weight loss during storage and incubation of Meat type quail eggs.

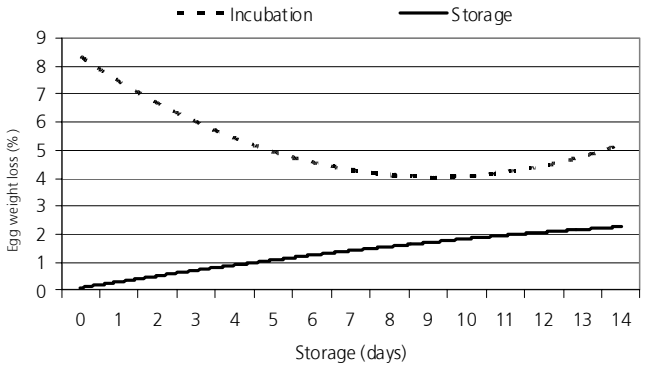

Figure 3 - Percentage of egg weight loss during storage and incubation of Egg type quail eggs.

Meat-type quail eggs presented continuous egg weight loss with storage length, reaching 2.72% at 14 days of storage at 20°C. During the incubation period, eggs tended to decrease the rate of egg weight loss

presented 8.27% of weight loss, whereas those stored for 14 days showed 4.40% of loss.

Regression analysis of egg weight loss gave the following regression equation: ($y = -0.0014x^2 + 0.2058x - 0.1161$) and R^2 (0.9947) for storage period and regression equation ($y = 0.0394x^2 - 0.8864x + 9.261$) and R^2 (0.9183) for incubation period of meat-type quail eggs. Meat-type quail eggs presented high coefficients of regression for egg weight loss during storage and incubation, indicating that these are suitable models for predicting weight loss of meat-type quail eggs stored at 20°C for up to 14 days and then incubated at 37.6°C with 60% RH.

Egg-type quail eggs lost 2.39% of their weight during two weeks of storage. Eggs stored for 0 days lost 9.31% during incubation, and those stored for 14 days lost 4.80%.

The regression analysis for egg weight loss gave the following regression equation: ($y = -0.0047x^2 + 0.2317x - 0.1336$) and R^2 (0.9909) for storage period and the regression equation ($y = 0.0505x^2 - 1.0316x + 9.3189$) and R^2 (0.7554) for incubation period of egg-type quail eggs. These eggs presented a high and a moderate coefficient of regression for egg weight loss during storage and incubation, respectively. Therefore, the regression equation found for storage is an adequate model for predicting egg weight loss of egg-type quail eggs stored at 20°C and 60% RH. The regression equation for weight loss during incubation can also be a useful prediction tool, despite its lower R^2.

Meat-type quail eggs lost 8.27% with no storage, and 7.12% for 14 days of storage. Egg-type quail eggs lost 9.31% for 0 and 7.20% for 14 days of storage. Soliman *et al.* (1994) observed 11.3% egg weight loss until 15 days of incubation of hatched quail eggs. Egg weight loss can be highly influenced by relative humidity during storage and storage length. Although relative humidity during storage is not extremely critical (Funk & Forward, 1960), it appears that only eggs from older flocks with poorer albumen quality are sensitive to lower humidity (Walsh, 1993), which may explain why Kaufman (1939) concluded that moisture loss was not the reason for high mortality after long-term storage.

As compared to Samli *et al.* (2005), who studied weight loss of chicken eggs stored for 2, 5, and 10 days (21°C and 55-60% of RH), weight loss of quail eggs of the present experiment increased, despite being stored at lower temperature (20°C). Chicken eggs (Samli *et al.*, 2005) stored for 2, 5, and 10 days respectively. Meat-type quail eggs, for the same storage days, lost 0.50%, 1.16%, and 1.94%. Egg-type quail eggs lost 0.57%, 1.14%, and 1.80%.

Egg weight loss is an important parameter for incubation. It has been used to estimate vital gas exchange (Paganelli *et al.*, 1978; Rahn *et al.*, 1979), and has been correlated with embryo metabolism and development rates (Rahn & Ar, 1980; Burton & Tullet, 1983).

In the present study, total egg weight loss was measured up to egg transference. Weight loss during incubation was directly influenced by weight loss during the storage. Eggs stored for longer periods presented lower levels of weight loss during incubation as compared to fresh incubated eggs or those that were submitted to a few days of storage. This relation was easier to observe in meat-type quail eggs than in egg-type quail eggs.

All hatched chicks were weighed. However, no correlation was found between storage length and chick body weight, which is consistent with the findings of Petek *et al.*(2005), and opposed to Sachdev *et al.* (1988), who reported higher body weight of quails hatched from eggs stored during a short period.

CONCLUSION

The present study showed that eggs of meat- and egg-type quails presented high hatchability up to 10 days of storage in a refrigerated room (20°C), and that storage length from 1 to 14 days influenced weight loss of Japanese quail eggs during incubation.

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