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Effects of Storage Duration at Low Temperature on Hatchability and Post-hatch Performances of Japanese Quails (*Coturnix japonica*)

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Abstract

This study aimed to determine the effect of duration storage of Japanese quail eggs at low temperature on hatchability and post-hatch performance. A total of 800 eggs was subjected to four storage periods, (0, 3, 5 and 7 d) at 4ºC and 60 to 70% relative humidity. Hatchability, survival rate, birth weight, post-hatch average daily gain, feed intake and feed conversion ratio were investigated in this study. The results showed that storage duration significantly affected hatchabilities and survival rates ($P<0.05$). Egg hatchability decreased when they were stored for a long time (84.5, 79.5, 74.0, and 69.0% for 0, 3, 5 and 7 d of storage duration, respectively). Survival rates of eggs stored for 3 d was not significantly different from the control group. Survival rates of 5- and 7-d storage were lower than 0-and 3-d groups ($P<0.05$). Storage egg at 4ºC did not affect birth weight, post-hatch average daily gain, feed intake and feed conversion ratio of the Japanese quails. The results of this study suggested that keeping egg of Japanese quails for 0 d before incubation was the best for hatchability. For incubation, Japanese quail eggs should not be stored at 4ºC longer than 3 d.

Keywords : *Japanese quails, hatchability, incubation, low temperature storage*

1. Introduction

The Japanese quail (Coturnix japonica) has been found in many parts of Thailand and becomes widely used for meat and egg production (1). It has an important role because of high egg and meat production capacity (2). Fertility is affected by different factors, i.e. egg quality (3), diet (4), climatic and environmental condition (5), and especially egg storage and incubation procedures (6). In hatchery process, to utilize maximum capacity of the incubator, eggs are usually accumulated and stored over a period of time before incubation. Several studied has been reported the effect of storage duration of eggs on hatchability and post-hatch growth performance (7,8), including embryonic

viability (9). In general, the recommended optimum storage temperature for keeping fertile egg is between 12-26 ºC which is stored for 7 d (10, 11). Storing quail eggs at 16ºC and 75% RH for more than 4 d reduced hatchability (12). Interestingly, some farmer usually keeps their egg in a normal refrigerator before setting. Whether, temperature of the refrigerators is lower than the storage temperature recommended, egg kept in the refrigerator still hatch after incubation. However, to our knowledge, no information has been published concerning the effect of storage duration of egg at low temperature (4 ºC) on hatchability and post-hatch performances of Japanese quails. Therefore, the objective of this study was to determine the effect of duration storage of egg at low temperature on hatchability and post-hatch performances of Japanese quails.

2. Materials and Methods

2.1 Birds, egg collection and incubation

Breeding stocks of the Japanese quails were maintained at the University of Phayao experimental farm and were given ad libitum feed and water. Birds were mated at a ratio of one male to three females in each cage. One hundred and fifty female Japanese quails were used for egg collection. In total, the present study was conducted on 800 eggs, which separated into 2 batches (400 eggs in each batch) to investigate the overall hatching performance. A randomized complete block design was used with four treatments assigned randomly with four storage durations (0, 3, 5 and 7 d). The storage temperature was maintained at 4ºC and 60 to 70% RH for all treatments and eggs were warmed up at room temperature for 24 hour periods for setting and were fumigated in the incubator on the day of setting. The single-stage incubators with electronic controlled were used in this study. The eggs were incubated according to conventional temperature and humidity conditions, which were automatically monitored and turned.

The experiment was carried out from December 2014 till March 2015 at the experimental station belonged to the Division of Animal Science, School of Agriculture and Natural Resources, University of Phayao, Phayao, Thailand. The average temperature varies from 18 to 35ºC and the relative humidity varies from 60 to 85% throughout the experimental periods. All animals in the present study were cared for in accordance with the guideline of the Department of Livestock Development, Ministry of Agriculture and Cooperative, Thailand.

2.2 Data collection and statistical analysis

Hatchability, fertility, survival rate, birth weight, body weight, average daily gain, feed intake and feed conversion ratio were recorded. Hatchability was calculated using the following formula:

Hatchability = (Number of hatching eggs / number of egg set) × 100

The survival rate was evaluated after hatching to 4 weeks of age using the following formula:

Survival rate = (Number of dead birds / number of hatching birds) × 100

After hatching, birds were weighted and immediately transferred to the brooding cages. Birds were fed with commercial diet for Japanese quail containing 24% crude protein and 3200 Kcal per kg diet. Body weight, feed intake and average daily gain were recorded weekly. One-way analysis of variance (ANOVA) was used to determine the effects of storage time on hatchability

of eggs. The differences of means among treatments were considered using Duncan's multiple range test ($p<0.05$).

3. Results and Discussion

3.1 Egg weight, hatchability and survival rate

The results of the egg weight, hatchability and survival rate are shown in Table 1. In this study, egg weight of the quails did not significantly differ among storage periods. However, some studies indicated that the weight loss increased with time of storage (12, 13). Variation in storage temperature and RH might explain these differences. Storage duration at low temperature had a significant effect ($P<0.05$) on hatchability of Japanese quails. Hatchability of eggs kept for 3 d at 4ºC and 60 to 70% relative humidity was 5% lower than the control groups (79.5 and 84.5%, respectively) ($P<0.05$). The effect of storage time on the decline in hatchability found in this study coincides with other studies. Karabayir (2010) reported that hatchability of 10-d egg storage at 15 ºC and 70 to 80% RH were significantly decreased compared to eggs stored for 1 to 7 d (11). Aygun et al (2013) reported that hatchability of Japanese quails eggs stored for 14 d was significantly lower than eggs stored for 7 d (14). The influence of storage time on hatchability might be due to the increasing in albumen degradation that influences the viability of the embryo (8) and total hatchability (15). However, the percent hatchability on the basis of a total egg set reported in our study was slightly higher than values previously reported (16, 17). The reason of higher in hatchability of the present study could be due to various factors such as the high fertility of the birds, level of nutrition, mating and time of mating. The survival rate of bird hatched from eggs kept for 3 d at 4ºC and 60 to 70% relative humidity was not statistically different with bird hatched from eggs kept for 0 d ($P>0.05$). In addition, the results of this study showed that the incubation period of egg storage at low temperature was not different from the control group (17 d after incubation). There has been, to our knowledge, no experiment carried out in storage of Japanese eggs at low temperature (4ºC) on hatchability and on post-hatch performance. However, Wentworth et al. (2009) (18) reported that the embryos of Japanese quail have a delay in hatching equal to the hours in a hypothermic state. While, previously research (19) found that storage egg at high temperature (30 ºC) shortened the incubation period and reduced the hatching success. The results regarding hatchability of egg stored at 4ºC in this study suggested that Japanese quail embryos can survive in low temperature. However, it is well known that egg storage longer than 7 d negatively influenced hatchability (20). Our study suggested that storage egg for a long time not only affected hatchability but also the survival rate of post hatch chicks. The survival rate of bird hatched from eggs kept for 5 and 7 d at 4ºC and 60 to 70% relative humidity was significantly lower than bird hatched from eggs without keeping and eggs kept for 3 d ($P<0.05$). It has been suggested that longer period of storage will increase the spread of time over which hatching takes place and this may influence the overall quality of chicks (15). Thus, this result indicated that keeping Japanese quail egg before setting in the incubator at low temperature (4ºC, 60 to 70% RH) should not be longer than 3 d because the survival rate will be decreased.

Table 1. Egg weight, hatchability and survival rate of Japanese quail egg keep at low temperature

	Egg weight (g)	Hatchability (%)	Survival rate (%)			
			Wk 1	Wk 2	Wk 3	Wk 4
Storage period (d)						
0	11.31	84.50[a]	95.85[a]	95.26[a]	95.26[a]	95.26[a]
3	10.93	79.50[b]	94.92[a]	93.64[a]	93.64[a]	93.64[a]
5	10.69	74.00[c]	85.12[b]	82.39[b]	81.06[b]	81.06[b]
7	10.66	69.00[d]	78.52[c]	72.70[c]	72.70[c]	72.70[c]
SEM	0.11	2.23	2.79	3.68	3.70	3.70

[a-c]Values within the same row with different superscripts are different (P<0.05)

3.2 Growth performance

The growth performance of the Japanese quails is presented in Table 2. The mean of hatching chick weight for all groups was 7.69±0.26 g which was slightly higher than the previous reported (6.47 g) (16) but smaller (8.06 g) than the other report (21). The average body weights of the quails were not statistically significant, similar to egg weight, but tended to decline when the storage period increased. This result supported by previous studies which reported that the egg weight had a strong positive relationship with hatching weight (13, 22) which indicated that the selection for high hatching weight resulted in high egg weight, vice versa. However, it was shown that the weight loss in the eggs was only 2.99% after stored at room temperature for 14 d (13). Fourth week body weight of birds were in the ranges of 44.87 to 46.12 g, the live weight results in this study demonstrate similarities with the study of Karabayir (2010) (11). An average daily gain of birds at first week was 0.95±0.10 g/d. Average daily gain for all treatments in the second, third and fourth week were 1.6±0.07, 1.38±0.05 and 1.47±0.11 g/d/b, respectively. Average feed intake for all periods of the experiment was 181.94±8.75 g/birds. The feed conversion ratio for week 1, 2, 3 and 4 were 2.65±0.04, 3.97±0.34, 5.55±0.42 and 6.66±0.810, respectively. The increase in FCR at 14, 21 and 28 d could be attributed to changes in physical characteristics of birds. The FCR of birds in this study tended to increase at 21 and 28 d as found by the previously reported (23). However, these all performance data were not significantly between the control and experimental group. The results of this study suggested that keeping eggs at low temperature (4ºC, 60 to 70% RH) for 7 d had no effect on the performance of Japanese quails.

Table 2. Growth performance of post-hatch Japanese quails in different storage period

	Body weight (g/b)				
Age (weeks)	0	1	2	3	4
Storage period (days)					
0	8.04	13.90	25.62	35.46	46.12
3	7.72	14.94	26.14	36.15	45.30
5	7.50	14.72	25.29	34.86	45.42
7	7.48	13.64	24.92	34.16	44.87
SEM	0.09	0.38	0.28	0.38	0.27
	Average daily gain (g/b/d)				
Age period (weeks)		0-1	1-2	2-3	3-4
Storage period (days)					
0		0.84	1.68	1.40	1.52
3		1.04	1.60	1.43	1.30
5		1.03	1.51	1.36	1.51
7		0.88	1.61	1.32	1.53
SEM		0.05	0.03	0.04	0.06
	Feed intake (g/b/d)				
Age period (weeks)	0-1	1-2	2-3	3-4	All
Storage period (days)					
0	15.26	40.52	50.30	62.86	168.95
3	16.30	46.80	53.26	69.20	185.55
5	17.05	44.28	53.44	70.50	185.26
7	19.00	45.50	56.50	67.00	188.00
SEM	0.71	0.15	0.91	1.57	3.22
	Feed conversion ratio				
Age period (weeks)		0-1	1-2	2-3	3-4
Storage period (days)					
0		2.88	3.48	5.15	5.92
3		2.26	4.18	5.34	7.78
5		2.36	4.19	5.61	6.68
7		3.10	4.04	6.11	6.26
SEM		0.24	0.13	0.19	0.37

4. Conclusions

In conclusion, the results of the present study indicated that the storage duration for keeping Japanese quail eggs at 4ºC and 60 to 70% RH before incubation should be less than 3 d. Long storage period at 4ºC will decrease hatchability and survival rates.

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