# The effects of prestorage incubation and length of storage of broiler breeder eggs on hatchability and subsequent growth performance of progeny

M. Petek, S. Dikmen

Department of Zootechnics, Faculty of Veterinary Medicine, University of Uludag, Bursa, Turkey

**ABSTRACT**: A total of 1 200 broiler breeder eggs were collected from a commercial flock at the hen age of 37 weeks and divided into storage treatments of 5 and 15 days. Prior to storage, the eggs were further divided into pre-storage incubation (PRESI) 0 (control), 4 and 8 h treatments. Eggs in the 4 and 8 h PRESI treatment were incubated at a standard dry-bulb temperature of 38.0°C. All eggs were weighed prior to and after storage, then incubated in a commercial setter and hatcher for 21 days. After the incubation, all unhatched eggs were opened to determine fertility, hatchability and embryonic death. The 4 and 8 h PRESI treatment significantly decreased hatchability results of long-term stored eggs compared to non-heated eggs. Hatchability results of eggs stored for 5 days were significantly better compared to eggs stored for 15 days. Subsequent growth performance of progeny was not significantly affected except for the main effect of egg storage on feed conversion. There were significant PRESI × egg storage interactions for apparent fertility, hatchability of total and fertile eggs and embryonic mortality. It was concluded that the PRESI treatment did not have a detrimental effect on the hatchability of broiler breeder eggs stored for 5 days and it might even increase hatchability while it had a detrimental effect on the hatchability of broiler breeder eggs stored for 15 days.

**Keywords**: broiler; prestorage; performance

Hatching eggs are often stored on broiler breeder farms as well as at hatcheries to minimize transportation costs or to provide for enough eggs available to fill large incubators. But the storage of eggs for more than a week is known to increase embryonic abnormalities and mortality due to the degradation of viscosity of egg albumen (Van de Ven, 2004). The eggs stored longer than a week also show reduced hatchability and an increase in the amount of incubation time required to hatch. Post-hatch growth and quality of chicks and poults from eggs stored for long periods are also deteriorated. A number of methods have been investigated to improve the hatchability of eggs stored for more than seven days. One of them is to heat eggs prior to storage (Fasenko, 1997; Anonymous, 2000). Compared with eggs that were not heated, the pre-heating of poultry eggs before storage was reported to result in more live chicks and in a lower level of embryonic mortality (Fasenko et al., 2001a,b; Petek and Dikmen, 2004, 2005). The first objective of this study was to determine if PRESI would improve the hatchability of eggs of modern, high meat yielding broiler breeders. The second objective was to determine the interactive effect of different length of storage period with PRESI treatments on hatchability and subsequent growth performance of progeny.

## MATERIAL AND METHODS

The experimental procedures conducted in this study were in accordance with the principles and guidelines set out by the Committee on Veterinary Medicine. Freshly laid broiler breeder eggs (modern, high meat yielding breeder strain) were collected from a commercial flock at the hen age of 37 weeks. At the time of collection, 1 200 eggs selected at random were weighed and randomly distributed into two groups of 600 eggs each, and they were exposed to egg storage lasting 5 or 15 days. Eggs in either group of egg storage treatment were randomly allocated to three groups by 200 eggs exposed to the PRESI treatment for 4 and 8 hours or not (control, 0 h). Eggs for the 15-day storage group were collected 10 days prior to the eggs collected for the 5-day storage group so that all the eggs from all groups could be set in the incubator at the same time. A total of 6 interactive groups constituted this study (3 levels of PRESI × 2 levels of egg storage period). Fifty eggs constituted a replication in each treatment group.

### Management

Eggs in 4 and 8 h PRESI groups were incubated at a standard dry-bulb incubation temperature of 38.0°C. After the PRESI treatments were completed, all eggs including control and PRESI groups were stored at an average temperature of 14°C and relative humidity of 65% for 5 or 15 days, and they were turned twice a day. All eggs were weighed after storage, and eggs from each group were incubated in a commercial setter and hatcher for 21 days. The setter was operated at 38.0 ± 1.0°C dry bulb temperature and 29.0 ± 0.5°C wet bulb temperature. The hatcher was operated at 37.0 ± 1.0°C dry bulb temperature and 31.0 ± 0.5°C wet bulb temperature. Eggs in the setter were turned 15 times per day. Trays representing all treatment groups were distributed in all positions in the setter and hatcher. Newly hatched chicks in all groups were reared under the standard growing conditions in a deep-litter house with mechanical ventilation. Chicks belonging to the same group were randomized into four replications at hatch. All chicks were brooded and reared at 30°C for the $1^{st}$ week, 28°C for the $2^{nd}$ week, 26°C for the $3^{rd}$ week, and 21–24°C from day 28 to day 42 of age. Standard commercial broiler feed was used during the treatment (220 g/kg protein and 3 000 kcal/kg metabolizable energy from 1 to 14 days of age, 200 g/kg protein and 3 050 kcal/kg metabolizable energy from 15 to 35 days of age, 180 g/kg protein and 3 100 kcal/kg metabolizable energy from 36 to 42 days of age). All birds had an *ad libitum* access to feed and water. Twenty-four hour lighting was used throughout the growth period.

### Data and statistical analysis

After the eggs were divided into the treatment groups, the fresh egg weights were compared to determine that the weights were not different between the treatment groups. Three days after removing the chicks from the hatcher all unhatched eggs were opened to determine the fertility. The fertility results are reported as apparent fertility. Hatchability of fertile or total eggs was calculated as the number of chicks hatched per fertile or total eggs (Taylor, 1998; Akcapinar and Ozbeyaz, 1999). Individual body weights of chicks were measured at the end of the growth period (42 days of age), and cumulative feed conversion (grams of feed intake per grams of body weight gain) was calculated for this period. Mortality was recorded as per group. European Efficiency Factor (EEF) was calculated according to the methods described by Nilipour (1998).

The hatchability and growth period data were analyzed by ANOVA with three levels of PRESI (0, 4 and 8 h) and two levels of egg storage (5 and 15 days). When an interaction was significant, Duncan's multiple mean comparison test was used to compare treatment means. All data in percentages were transformed using arc sine square root transformations prior to the analysis (Snedecor and Cochran, 1989). The statistical analyses for measured traits were calculated on the basis of the replications. All tests were performed using SPSS® computer software 10.00 (SPSS®, 1999). The PRESI treatment and the length of storage were the main effects.

## RESULTS

The main effects of PRESI treatments and egg storage on apparent fertility, hatchability of total and fertile eggs, and embryonic mortality are presented in Table 1. Fresh egg weights were not different between the different PRESI treatments and storage periods. The interactions between the two main effects were not significant. There was a significant difference in egg weight losses during storage due to the main effect of egg storage treatment. Differences in apparent fertility and hatch of total and fertile eggs and embryonic mortality were found to be significant due to the main effect of PRESI and egg storage treatment ($P < 0.001$, $P < 0.001$). There were significant PRESI × egg storage

Table 1. The effects of PRESI treatment and egg storage on hatching success of broiler breeder eggs

| Main treatment effects | | Fresh egg weight (g) | Egg weight loss during storage (%) | Apparent fertility (%) | Hatchability of eggs (%) | | Embryonic mortality during incubation (%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | total | fertile | I | II | III | total |
| **Main effects** | | | | | | | | | | |
| PRESI (hours) | 0 | 66.05 | 0.56 | 77.50[a] | 67.50[a] | 85.43[a] | 10.75 | 2.00 | 6.79 | 19.55[c] |
| | 4 | 66.86 | 0.64 | 72.00[b] | 58.00[b] | 74.81[c] | 8.10 | 4.21 | 16.87 | 29.19[a] |
| | 8 | 65.67 | 0.76 | 68.50[c] | 59.00[b] | 79.17[b] | 7.20 | 6.97 | 8.65 | 22.83[b] |
| Egg storage (days) | 5 | 66.10 | 0.29 | 90.66 | 88.66 | 97.78 | 5.10 | 0.68 | 3.74 | 9.52 |
| | 15 | 66.30 | 1.01 | 54.66 | 34.33 | 61.82 | 12.27 | 8.11 | 17.60 | 38.19 |
| **Interactive effects** | | | | | | | | | | |
| 0 h–5 days | | 65.68 | 0.29 | 88.00[b] | 86.00[b] | 97.72[a] | 5.10 | 1.02 | 6.12 | 12.24[d] |
| 0 h–15 days | | 66.45 | 0.83 | 67.00[c] | 49.00[c] | 73.13[b] | 16.41 | 2.98 | 7.47 | 26.86[c] |
| 4 h–5 days | | 67.14 | 0.15 | 90.00[b] | 88.00[b] | 97.77[a] | 5.10 | 1.02 | 4.08 | 10.20[d] |
| 4 h–15 days | | 66.58 | 1.13 | 54.00[d] | 28.00[d] | 51.85[d] | 11.11 | 7.40 | 29.67 | 48.18[a] |
| 8 h–5 days | | 65.47 | 0.44 | 94.00[a] | 92.00[a] | 97.87[a] | 5.10 | 0.00 | 1.02 | 6.12[e] |
| 8 h–15 days | | 65.86 | 1.08 | 43.00[e] | 26.00[d] | 60.46[c] | 9.30 | 13.95 | 16.28 | 39.53[b] |
| **ANOVA** | | | | | | | | | | |
| PRESI | | n.s. | n.s. | 0.001 | 0.001 | 0.001 | n.s. | n.s. | 0.001 | 0.001 |
| Egg storage | | n.s. | 0.01 | 0.001 | 0.001 | 0.001 | 0.01 | 0.001 | 0.001 | 0.001 |
| PRESI × egg storage | | n.s. | n.s. | 0.001 | 0.001 | 0.001 | n.s. | 0.01 | 0.001 | 0.001 |
| SEM | | 0.46 | 0.13 | 1.20 | 1.02 | 1.30 | 0.023 | 0.022 | 0.019 | 0.058 |

[a–e]within columns, values with different superscripts differ significantly (** $P < 0.01$, *** $P < 0.001$), n.s. = not significant
I, II, and III = 1[st], 2[nd], and 3[rd] period of incubation

interactions ($P < 0.001$) for the apparent fertility and hatch of total and fertile eggs and embryonic mortality.

The subsequent growth performances of progeny in the main and interactive groups are presented in Table 2. The body weight and survival rates of broilers belonging to the three PRESI treatments and two egg storage groups were found not to be statistically different while the differences in the feed conversion ratio (FCR) due to the main effect of egg storage were significant at the end of the growth period. There was no significant PRESI × egg storage interaction for growth performance data.

## DISCUSSION

In this study, egg weight losses during storage were significantly affected by the main effect of the length of egg storage. Egg weight losses in 15-day storage were by 72% higher than in 5-day storage. Differences in egg weight losses prior to incubation were numerical due to the PRESI treatment. These results were expected because an exposure to long-time storage and heat treatment would increase the opportunity for water vapour to escape from the egg. Although the long storage time did not affect true fertility, the present study and the works of Petek et al. (2003), Petek and Dikmen (2004) demonstrated that the long period of egg storage prior to incubation decreased apparent fertility significantly. The fact that the collection of eggs for the 5- and 15-day storage groups was separated by 10 days might have accounted for the differences in fertility. In this study, the PRESI treatment of eggs prior to storage significantly affected the hatchability of total and fertile eggs. But the effects of PRESI treatment on hatchability in

Table 2. Main and interactive effects on subsequent growth performance of chicks (0–42 days)

| | | Body weight (g) | FCR | Survival rate (%) | EEF |
|---|---|---|---|---|---|
| **Main effects** | | | | | |
| PRESI (hours) | 0 | 2 545.78 | 1.81 | 99.28 | 332.45 |
| | 4 | 2 480.15 | 1.84 | 99.44 | 319.12 |
| | 8 | 2 495.09 | 1.79 | 97.55 | 323.71 |
| Egg storage (days) | 5 | 2 502.55 | 1.75 | 98.78 | 336.24 |
| | 15 | 2 511.45 | 1.88 | 98.71 | 313.92 |
| **Interactive effects** | | | | | |
| 0 × 5 | | 2 556.42 | 1.79 | 98.55 | 335.06 |
| 0 × 15 | | 2 535.13 | 1.83 | 100.00 | 329.83 |
| 4 × 5 | | 2 453.92 | 1.76 | 98.87 | 328.18 |
| 4 × 15 | | 2 506.38 | 1.92 | 100.00 | 310.41 |
| 8 × 5 | | 2 497.32 | 1.69 | 98.94 | 348.10 |
| 8 × 15 | | 2 492.85 | 1.88 | 96.15 | 303.53 |
| **ANOVA** | | | | | |
| PRESI | | n.s. | n.s. | n.s. | |
| Egg storage | | n.s. | 0.01 | n.s. | |
| PRESI × egg storage | | n.s. | n.s. | n.s. | |
| SEM | | 19.42 | 0.03 | 0.90 | |

EEF (European Efficiency Factor) = g gained/day × % survival rate/conversion = 10

eggs stored 5 and 15 days were different. There was a numerical increase in eggs stored for 5 days due to PRESI treatment while PRESI treatment had a depressive effect on the hatchability of eggs stored for 15 days. The results in this study related to PRESI in eggs stored for 15 days were not agreement with previous reports on broilers and other species (Uddin et al., 1994; Fasenko, 1997; Anonymous, 2000; Fasenko et al., 2001a,b; Petek and Dikmen, 2004, 2005). In this study, the 5-day egg storage significantly improved the hatch of total and fertile eggs compared to the 15-day egg storage. This result was expected in accordance with previous reports on broilers and other species related to egg storage and PRESI (Uddin et al., 1994; Fasenko, 1997; Anonymous, 2000; Fasenko et al., 2001a,b). Some embryos of eggs stored for a long period could not start developing immediately after normal incubation temperatures were provided. Another possibility is that the development of embryos from eggs stored for a long time proceeds at a slower rate in the first period of incubation. Total embryonic mortality rates during incubation in this study were significantly affected by the main and interactive effects. Embryonic mortality of eggs in the 4 and 8 h PRESI treatment was significantly increased compared to the non-heated group. Most of the deaths were in eggs stored for 15 days. The embryos of eggs stored for 15 days showed noticeably lower hatchability and higher mortality during incubation (Table 1). The significant PRESI × egg storage interaction for hatchability and embryonic mortality revealed that PRESI treatment decreased hatchability and increased embryonic mortality in eggs stored for 15 days but not in eggs stored for 5 days.

In this study, neither the time of PRESI treatment nor the egg storage between the main groups significantly affected the subsequent body weight of progeny. These results are in contrast to the findings of Sachdev et al. (1988) and Reis et al. (1997), who reported that the body weight of quail hatched from eggs stored over a short period was enhanced. The feed conversion ratio of progeny hatched from eggs stored for 15 days was significantly higher than in progeny hatched from eggs stored for 5 days. Broilers in the group of 5 days consumed less feed per body weight gain. The findings about the FCR related to the storage period were not corroborated by previous observations in which FCR was not affected by the length of egg storage (Petek et al., 2003). The survival rate of progeny was not affected by main effects significantly in the present study. There were no significant PRESI × egg storage interactions for body weight gain, FCR and survival rate of progeny. According to the European Efficiency Factor, which is the best indicator of bird performance, the performance of broilers hatched from eggs stored for 5 days or non-heated eggs was found to be superior.

The results of this study proved that eggs should not be stored for a long time. The PRESI treatment does not have a detrimental effect on the hatchability of broiler breeder eggs stored for 5 days and it may even increase hatchability. On the other hand, the PRESI treatment has a detrimental effect on the hatchability of broiler breeder eggs stored for 15 days. Further research must determine more precisely the length of egg storage and exact PRESI time and the length of egg storage interactions required to obtain maximum hatchability.

## REFERENCES


Akcapinar H., Ozbeyaz C. (1999): Hayvan Yetistiriciligi Temel Bilgileri (in Turkish). Kariyer Matb. Ltd. Şti publishing house, Ankara, Turkey. 83 pp.

Anonymous (2000): Preheating of ostrich eggs. Int. Hatch. Pract., *14* (Abstract), 32.

Fasenko G. (1997): How are embryo and poult viability, hatchability, and growth affected by storing turkey eggs for long periods. Alberta Poultry Research Centre News, *6*, 1.

Fasenko G.M., Christensen V.L., Wineland M.J., Petitte J.N. (2001a): Examining the effects of prestorage incubation of turkey breeder eggs on embryonic development and hatchability of stored for four or fourteen days. Poult. Sci., *80,* 132–138.

Fasenko G.M., Robinson F.E., Whelan A.I., Kremeniuk K.M., Walker J.A. (2001b): Prestorage incubation of long–term stored broiler eggs; 1. Effects on hatchability. Poult. Sci., *80*, 1406–1411.

Laurens S. (2002): Heating of hatching eggs before storage improves hatchability. World Poult., *18*, 24–25.

Nilipour A.H. (1998): Numbers for successful poultry production. World Poult., *14,* 26–8.

Petek M., Dikmen S. (2004): The effects of prestorage incubation of quail breeder eggs on hatchability and subsequent growth performance of progeny. Anim. Res., *53*, 527–534.

Petek M., Dikmen S. (2005): The effects of pre-storage incubation on hatching success of poultry and game bird eggs. Incubation and Fertility Research Group. In: WPSA Working group 6 (Reproduction), Meeting 6th–7th September 2004, University of Lincoln, Lincoln, UK. Avian Poult. Biol. Rev., *16* (Abstracts), 63–64.

Petek M., Baspinar H., Ogan M. (2003): Effects of egg weight and length of storage period on hatchability and subsequent growth performance of quail. S. Afric. J. Anim. Sci., *4*, 242–247.

Reis L.H., Gama L.T., Sacres M.C. (1997): Effects of short storage conditions and broiler age on hatchability, hatching time and chick weight. Poult. Sci., *76,* 1459–66.

Sachdev A.K., Ahuj P.S.D., Thomas P.C., Agrawal S.K. (1988): Effect of egg weight and storage periods of hatching eggs on growth of chicks in Japanese quail. Indian J. Poult. Sci., *23*, 14–17.

Snedecor G.W., Cochran W.G. (1989): Statistical Methods. 8th ed. Iowa State University Press, Ames, IA, USA.

SPSS® (1999): Computer Software 10.00, SPSS Inc., Headquarters. Wacker Drive, Chicago, Illinois 60606, USA. 233 pp.

Uddin M.S., Paul D.C., Huque Q.M.E. (1994): Effect of egg weight and pre-incubation holding periods on hatchability of Japanese quail eggs in different seasons. Asian-Australas. J. Anim. Sci., *7,* 499–503.

Taylor G. (1998): Egg Handling Techniques. 2nd ed. Medina, Ohio, USA. 4–10.

Van de Ven L. (2004): Storage of hatching eggs in the production process. Int. Hatch. Pract., *18*, 27–31.


Received: 05–03–30
Accepted after corrections: 05–09–19

*Corresponding Author*

Dr. Metin Petek, Department of Zootechnics, Faculty of Veterinary Medicine, University of Uludag, 160 59 Bursa, Turkey
Tel. +90 224 4429200 (dial-131), fax +90 224 4428025, e-mail: petek@uludag.edu.tr