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Original Research Article

Effects of Hatching Egg Weight and Length of Storage Period on Hatching Success in Pekin Ducks

Fazli Alpay* and Metin Petek
Department of Animal Science, Faculty of Veterinary Medicine, Uludag University, Bursa, TURKEY

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ABSTRACT

This study was carried out to investigate the effects of hatching egg weight and length of storage period on egg weight loss, hatchability performance and incubation length of Pekin ducks. Eggs were classified into 3 groups on the basis of egg weight such as small, medium, and large. Then, the eggs in each group were further divided into 3 storage period treatments (5, 10, or 15 days). At the end of the storage period eggs were weighted individually to determine egg weight loss. Hatching time, apparent fertility, hatchability of total and fertile eggs, and embryonic mortality were determined to measured hatching success. Egg weight loss during the storage period significantly affected by egg weight and length of storage period (P < 0.001, P < 0.05). Differences for the hatching time, apparent fertility, hatchability of total and of fertile eggs, embryonic mortality in the storage period groups were found significant (P < 0.001). The results of this study showed that effects of the hatching egg weight and length of storage on hatchability was similar to other kind of poultry. In general, hatchability was more affected by length of egg storage period.

Keywords: Hatching egg weight, Hatching success, Pekin duck, Storage period

INTRODUCTION

The duck meat industry growth in Asia averaged 3.5% per year which was just above the global figure of 3.2% between 2000 and 2013 (Anonymous, 2013). Although, the total duck population is less than the chicken and turkey populations in worldwide, duck meat is one of most commercially expensive types of meat (Huda *et al*., 2011). Especially the Pekin duck, which became the leading breed for duck meat production in the world (Pingel, 2004).

The incubation procedures are important for maintenance and improvement of duck egg production (Woodard *et al*., 1993). The quality of the chick all depends on the weight and quality of the egg. It is essential that care is taken in the storage, especially effects of storage time influence the hatching success of eggs. Previous studies have determined the effects of egg weight and storage time on embryo survival, incubation length and hatchability, but these studies generally focused on other poultry species like chicken, turkey and quail. The purpose of the present study to determine the effects of egg weight and storage time on egg weight loss, hatchability performance and incubation length of Pekin ducks.

MATERIALS AND METHODS

This research was conducted at the Research and Experimental Farm of the Faculty of Veterinary Medicine, in Bursa. A total of 675 eggs were collected from 110 female Pekin ducks at the hen age of 55 wk. Flock were housed in free-range housing system and a ratio of one male to five female.

On each day afternoon the laid eggs were collected, placed on egg flats with their small ends down, cleaned and fumigated. Eggs were weighed and classified into 3 groups on the basis of egg weight (small: 74 – 78 g; medium: 79 – 83 g; large: 84 – 88 g). Prior to egg storage, the eggs in each group were further divided into 3 storage period treatments as 5, 10, 15 d.

Eggs in storage groups were collected 5, 10 and 15 d before initial time of the incubation. Eggs were stored at 14 – 15 ºC and 75% RH and turned twice a day. All eggs were weighed after storage to determine egg weight loss, and the eggs from each group were incubated in a commercial setter and hatcher for 28 d. Trays representing all egg weight and storage period treatment groups were distributed in the setter and hatcher. The setter was operated at 37.5 ± 0.5 ºC dry bulb temperature and 29.0 ± 0.5 ºC wet bulb temperature. The hatcher

* Corresponding author: falpay@uludag.edu.tr

was operated at 37.0 ± 0.5 ºC dry bulb temperature and 31.0 ± 0.5 ºC wet bulb temperature. Eggs in the incubator were turned 15 times per day.

At the time of removing the chicks from the hatchers all unhatched eggs were opened and examined macroscopically to determine percentage hatchability of fertile and total eggs. the period of embriyonic develoment of dead embriyos was determined [early (0 to 6 d), middle (7 to 17 d), late (18 to 28 d plus pipped)] according to Hamburger and Hamilton (1951). Hatchability of fertile or total eggs was calculated as the number of chicks hatched per fertile or total eggs set and the fertility results were reported as “apparent fertility” (Taylor, 1998).

The hatchability and embryonic development data were analyzed by ANOVA. When an interaction was significant, the Duncan multiple mean comparison test was used to compare treatment means (Snedecor and Cochran, 1989). All tests were performed using SPSS® computer software 13.00 (2004). Results for the hatching time, apparent fertility, hatchability of total and fertile eggs, and embryonic mortality are expressed as mean values ± SEM.

RESULTS

The main effects of egg weight and length of egg storage on egg weight loss, apparent fertility, hatchability of total and fertile eggs are presented in Table 1. There were significant differences in egg weight losses during storage due to the main effects of egg weight and egg storage treatment ($P < 0.05$, $P < 0.001$). 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 egg storage treatment ($P < 0.001$). The interactions between the two main effects on egg weight loss, apparent fertility, hatchability of total and fertile eggs were not significant.

Embryonic mortalities and hatching time in the main and interactive groups are presented in Table 2. The middle period of embryonic mortalities and total embryonic mortalities significantly affected by the main effects of egg storage treatment ($P < 0.001$).

Table 1. The effects of egg weight and length of egg storage on egg weight loss, apparent fertility, hatchability of total and fertile eggs*.

Factors	Egg weight before storage (gr)	Egg weight loss (%)	Apparent fertility (%)	Hatchability of total eggs (%)	Hatchability of fertile eggs (%)
Storage Period (d)					
5	81.13 ± 0.14	0.630 ± 0.39 ^{c}	92.07 ± 2.83 ^{a}	69.58 ± 3.61 ^{a}	75.68 ± 4.03 ^{a}
10	81.38 ± 0.11	1.096 ± 0.37 ^{b}	81.10 ± 2.81 ^{b}	50.66 ± 3.59 ^{b}	59.99 ± 4.03 ^{b}
15	81.14 ± 0.17	1.554 ± 0.32 ^{a}	69.10 ± 2.84 ^{c}	33.33 ± 3.59 ^{c}	40.88 ± 4.00 ^{c}
Egg Weight[1]					
Small	76.64 ± 0.15 ^{c}	1.028 ± 0.36 ^{b}	79.99 ± 2.88	53.77 ± 3.59	61.33 ± 4.00
Medium	81.08 ± 0.14 ^{b}	1.085 ± 0.33 ^{ab}	79.77 ± 2.81	46.88 ± 3.58	55.99 ± 4.04
Large	85.93 ± 0.11 ^{a}	1.166 ± 0.37 ^{a}	82.51 ± 2.83	52.92 ± 3.61	59.23 ± 4.03
Storage Period x Egg Weight					
5 x Small	76.53 ± 0.25	0.560 ± 0.64	93.33 ± 4.87	73.33 ± 6.22	79.33 ± 6.93
5 x Medium	81.08 ± 0.26	0.669 ± 0.63	93.99 ± 4.86	65.99 ± 6.23	71.33 ± 6.95
5 x Large	85.78 ± 0.21	0.659 ± 0.65	88.88 ± 4.97	69.44 ± 6.35	76.38 ± 7.07
10 x Small	76.78 ± 0.23	1.031 ± 0.68	75.99 ± 4.81	47.99 ± 6.31	57.33 ± 6.99
10 x Medium	81.15 ± 0.25	1.023 ± 0.68	81.33 ± 4.82	50.66 ± 6.27	64.66 ± 6.91
10 x Large	86.21 ± 0.28	1.233 ± 0.66	85.99 ± 4.92	53.33 ± 6.24	57.99 ± 6.89
15 x Small	76.61 ± 0.26	1.493 ± 0.63	70.66 ± 4.97	39.99 ± 6.23	47.33 ± 6.99
15 x Medium	81.02 ± 0.24	1.563 ± 0.62	63.99 ± 4.82	23.99 ± 6.21	31.99 ± 6.93
15 x Large	85.80 ± 0.21	1.606 ± 0.64	72.66 ± 4.86	35.99 ± 6.27	43.33 ± 6.97
ANOVA					
Storage Period	0.399	0.001	0.001	0.001	0.001
Egg Weight	0.001	0.028	0.748	0.338	0.638
Storage Period x Egg Weight	0.966	0.514	0.426	0.653	0.543

* $\bar{X} \pm S\bar{X}$, [1]Small: 74-78 gr; Medium: 79-83 gr; Large: 84-88 gr, $^{a\text{-}c}$within columns, values with different superscript differ significantly (P < 0.05)

Table 2. The effects of egg weight and length of egg storage on embryonic mortalities and hatching time*.

Factors	Embryonic mortalities (%)				Hatching time (h)
	Early	Middle	Late	Total	
Storage Period (d)					
5	2.44 ± 1.86	12.00 ± 3.28 ^{c}	9.11 ± 2.71	23.55 ± 3.96 ^{c}	651.36 ± 1.60 ^{c}
10	2.66 ± 1.84	20.66 ± 3.27 ^{b}	14.00 ± 2.77	37.33 ± 3.90 ^{b}	661.15 ± 1.87 ^{b}
15	7.11 ± 1.89	29.55 ± 3.22 ^{a}	15.77 ± 2.76	52.44 ± 3.95 ^{a}	674.04 ± 2.37 ^{a}
Egg Weight[1]					
Small	5.33 ± 1.89	14.66 ± 3.22	12.00 ± 2.75	32.00 ± 3.91	663.38 ± 1.88
Medium	4.00 ± 1.85	24.88 ± 3.23	14.66 ± 2.81	43.55 ± 3.92	662.33 ± 2.13
Large	2.88 ± 1.81	22.66 ± 3.29	12.22 ± 2.70	37.77 ± 3.96	660.84 ± 1.90
Storage Period x Egg Weight					
5 x Small	1.33 ± 3.22	10.00 ± 5.68	9.33 ± 4.81	20.66 ± 6.85	649.85 ± 2.69
5 x Medium	2.66 ± 3.18	16.00 ± 5.60	8.66 ± 4.79	27.33 ± 6.80	652.53 ± 2.85
5 x Large	3.33 ± 3.27	10.00 ± 5.61	9.33 ± 4.88	22.66 ± 6.81	651.72 ± 2.82
10 x Small	6.66 ± 3.19	14.66 ± 5.59	13.33 ± 4.87	34.66 ± 6.87	664.16 ± 3.32
10 x Medium	-	17.33 ± 5.58	18.00 ± 4.86	35.33 ± 6.92	660.48 ± 3.27
10 x Large	1.33 ± 3.20	30.00 ± 5.66	10.66 ± 4.83	42.00 ± 6.90	658.80 ± 3.15
15 x Small	8.00 ± 3.22	19.33 ± 5.68	13.33 ± 4.81	40.66 ± 6.87	676.13 ± 3.70
15 x Medium	9.33 ± 3.31	41.33 ± 5.69	17.33 ± 4.88	68.00 ± 6.81	674.00 ± 4.70
15 x Large	4.00 ± 3.18	28.00 ± 5.67	16.66 ± 4.82	48.66 ± 6.83	672.00 ± 3.83
ANOVA					
Storage Period	0.138	0.001	0.215	0.001	0.001
Egg Weight	0.649	0.070	0.753	0.121	0.635
Storage Period x Egg Weight	0.524	0.133	0.904	0.258	0.742

* $\bar{X} \pm S\bar{X}$, [1] Small: 74-78 gr; Medium: 79-83 gr; Large: 84-88 gr, $^{a\text{-}c}$within columns, values with different superscript differ significantly (P < 0.05)

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-d storage were by higher than in 5 and 10-d storage. It was expected because long-time storage would increase the opportunity for water vapor to escape from the egg old (Wilson, 1991; North and Bell, 1990). These results are in contrast to the findings of Tilki and Saatci (2004) and Petek and Dikmen (2006). Differences in egg weight losses may be explained by the deterioration of the egg external shell quality (unseen cracks), especially in large weight group.

Apparent fertility was significantly decreased ($P < 0.001$) due to the length of egg storage period. This is concurrent with the finding of Saylam (1999), Erensayin (2001) and Fasenko and Robinson (1999). There was no main effect on egg weight at apparent fertility, but it was found that higher fertility observed in larger egg weight groups. This is concurrent with the finding of Karaman and Testik (1995), Narahari *et al*. (1991), Saylam (1999), Seker *et al.* (2004a), Aysan (1997) and Erisir (1999). Results indicated that, fertility of 10-d storage x large egg weight group and 5-d storage in all weight groups are similar to pekin duck at the same age (El-Hanoun *et al.*, 2012).

In this study, hatchability of total eggs significantly affected by the main effect of the length of egg storage. This result was expected in accordance with previous reports on broilers (Fasenko and Robinson, 1999; Elibol *et al*., 2002; Demircioglu, 1994) and quails (Saylam, 1999; Petek *et al*., 2003; Petek *et al*., 2005) related to egg storage. There was no main effect on egg weight at hatchability of total eggs, this result was not agreement with previous reports on Pekin ducks (Karaman and Testik, 1995), quails (Petek *et al*., 2003; Petek *et al*., 2005) and broiler (Aysan, 1997). Like other hatchability characteristics, there were significant differences for the hatchability of fertile eggs from different storage time. This result was expected to be consistent with previous reports on ducks (Onbasilar *et al*., 2007) and other species (Saylam, 1999; Fasenko and Robinson, 1999; Elibol *et al*., 2002; Christensen *et al.*, 2003; Fasenko *et al.*, 1992; Fasenko *et al.*, 2001a; Fasenko *et al.*, 2001b; Whitehead *et al.*, 1985).

Hatchability of fertile egg was not affected by the egg weight, this result was not corroborated by previous observations in findings of Karaman and Testik (1995) and Narahari *et al.* (1991) on ducks. Hatchability of fertile and total eggs of 5-d storage in all weight groups results support El-Hanoun *et al.* (2012) . Total embryonic mortality of eggs and incubation time in this study was significantly affected by the main effect of the length of egg storage. It has been established that embryonic mortality even before incubation can be measured and that mortality increases as storage time lengthens (Fasenko, 1992). Total embryonic mortality results are in contrast to the findings of Narahari *et al.* (1991), Onbasilar *et al.* (2007) on ducks, Kurman *et al.* (2002), Whitehead *et al.* (1985), Lapao *et al.* (1999), Reis *et al.* (1997) on broiler, Seker *et al.* (2004b) on quails, Christensen *et al.* (2003) on turkeys. Embryonic mortality in 15-day storage were by higher than other storage treatments, especially in middle period. The comparison of storage treatments indicates that eggs submitted to 5-day storage hatched about 1 day earlier (22.68 h) than 15-day storage. This result is concurrent with the finding of Bagliacca *et al*. (2005) on ducks and other species (Tona *et al*., 2004; Christensen *et al*., 2003; Fasenko *et al*., 2001a; Ates *et al*. 2004; Altan *et al*. 2002; Fasenko *et al*. 1997). These effects of storage may be explained by the deterioration of the egg internal quality, especially albumen height decreases and the albumen pH increases during storage (Tona *et al*., 2003).

There were no main effect of egg weight at total embryonic mortality of eggs and incubation time, but it was found that higher mortality observed in middle and large egg weight treatments.

As conclusion, the results of this study clearly proved that hatching egg weight and length of egg storage affected hatchability traits of the Pekin ducks. All egg weight groups were found to be suitable for the hatchability. The effects of long term egg storage prior to incubation have a detrimental effect on the hatchability. Therefore, 5-day storage treatment may be a feasible method for Pekin ducks.

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