Effect of storage duration on the quality of hatching turkey eggs

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SUMMARY

The experiment was performed in 2011 in the breeder farm of the Hybrid Poultry Centre at the Institute of agriculture – Stara Zagora in order to determine the effect of the different preincubation storage periods on hatchability traits of turkey eggs and the changes in egg components. Eggs from light layer (LL) line of turkeys at the age of 38 weeks used as maternal side for turkey-broilers production were used. They were divided into the following groups: eggs stored for 14, 10, and 4 days as well as fresh eggs (without storage). The storage of eggs took place in an egg storehouse with constant air temperature and humidity (17°C and 72%). The loss of weight during the storage increased as the storage duration prolonged ($p<0.001$). During incubation, the highest weight loss percentage was exhibited by eggs stored for 10 days (14.29%) that was statistically significantly ($p<0.001$) different from weight loss of fresh eggs. which lost weight. The highest fertility (92.42%) was noted in fresh eggs. A very high early embryonic death rate was observed in eggs stored for 14 days (13.63%). The hatchability of fertile eggs was the highest in fresh eggs (90.77%) and the lowest in eggs stored for 14 days (71.45%) ($p<0.001$). The albumen percentage of total egg weight was the highest in fresh eggs (59.09%). The albumen pH increased with the storage duration and was the highest in eggs stored for 14 days (9.25). Albumen's height decreased as storage duration became longer. For incubation to be use turkeys eggs from LL line stored at least time at 72% humidity and 17°C, because hatchability decreases with increasing duration of storage.

Keywords*:* turkey, egg quality, storage period, hatchability, embryonic mortality, pH

INTRODUCTION

Hatching eggs are not incubated immediately due to logistics reasons. The duration of storage of breeder eggs in the hatchery depends on the demand

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for 1-day-old chicks, the availability of incubators for eggs, the capacity of incubators, the productivity and the size of selected flocks. The research during the last 50 year has shown that the long-term storage of eggs before the incubation has a negative effect on egg morphology, embryo and hatchability (Walsh et al., 1995, Brake et al., 1997, Scott and Silversides. 2000, Heiber and Jarp, 2001). Petek and Dikmen (2006) established that the hatchability of fertile broiler eggs decreased from 97.8% for eggs stored for 5 days to 61.8% for eggs stored for 15 days. The embryonic death rate was also markedly increased from 9.52 to 38.19%. Van de Ven, 2004 reported increased embryonic death rates in eggs stored for more than one week.

Lourens (2006**)** observed a positive effect of specific durations and conditions of egg storage on incubation traits. Mishra et al., (2007) reported that the storage of eggs during the summer months at room temperature for more than 4 days results in reduction of hatchability by 3.3% with every day of storage. Fasenko (1996), having investigated the duration of storage of turkey eggs on incubation traits, observed differences in the embryonic metabolism. In another study, Fasenko et al. (2001) concluded that the hatchability decreased from 70.4% in eggs stored for 4 days to 65.2% for eggs stored for more than 14 days.

The quality of eggs, and thus embryo depends on the term and conditions of storage. Having studied the effect of temperature and storage duration on egg morphology, Samli et al. (2005**)** reported major changes in the Haugh units, the air cell, the weight of eggs and albumen height. Albumen quality is among the most important parameters of eggs' freshness (Lapao et al.,1999)**.** In fresh eggs, albumen pH ranges between 7.0 and 9.0 (Benton and Brake, 1996**)**, whereas in eggs stored for up to 4 days, albumen pH sharply increases (Scott and Silversides. 2000, Lapao et al.1999).

This study aimed to investigate the effect of different preincubation storage periods on hatchability traits and the changes in the different parts of turkey eggs from 38-week-old turkeys from LL line, used as maternal side for production of turkey-broilers.

Material and Methods

The experiment was carried out in 2011 in the turkey breeder farm of the Institute of Agriculture – Stara Zagora. Eggs (n = 637) from 38-week-old LL line turkeys, as maternal side for production of turkey-broilers, were used. Turkeys were reared in boxes on deep permanent litter, were inseminated twice weekly in the afternoon hours. All eggs from the daily production of this line were used, only eggs that were deformed, cracked and very dirty were

removed. Before incubation, eggs were submitted to fumigation with formalin vapours.

They were divided into the following groups: eggs stored for 14, 10, 4, and 0 days. The specific duration of storage was suggested by the practice, as incubation eggs needed to be collected for different time periods depending on the demand for one-day-old turkey-broilers.

Eggs were weighed individually on the day of laying in order to determine the weight loss during storage. The storage of eggs took place in an egg storehouse with constant air temperature and humidity (17°C and 72%). On the day of incubation, all eggs were weighed once again.

Changes in egg components were determined on 30 eggs from each group. The egg weight, the weights of the eggshell, albumen and yolk were determined on a balance with a precision of 0.01 g. Albumen height (mm) was measured with a micrometer Ames s-6428. The percentage of egg parts from the total egg weight was calculated. The albumen pH was measured with pH meter (AMARELL ELEKTRONIC, Kreuzwertheim, Germany) with a precision of ±0.2.

The incubation took place in an egg incubator Optima59.

The first exam was done on the 7^{th} day to determine the number of infertile eggs and dead embryos, the second exam was done on the 13^{th} day and dead embryos were removed. Throughout the isolation on the 25^{th} day, the water loss of eggs for the entire incubation was detected.

On the day of hatching, turkey poults were weighed and the percentage of their weight vs the egg weight was calculated. The percentage of dead turkey poults until the 14^{th} post hatching day, the percentage of fertility and hatchability of fertile eggs were determined.

Data were statistically processed by EXCEL – ANOVA 2000, and for the significance of differences testing it was used simple Student t-test.

In this study we used Descriptive statistics for Mean and Standard Error of Mean, for difference between means we used the Student t-test.

RESULTS AND DISCUSSION

The initial weight of eggs set for storage was higher in the group of eggs stored for 4 days compared to those stored for 10 and 14 days ($p<0.01$ and $p<0.05$, Table 1).

The weight loss during storage increased with storage duration ($p<0.001$). For 4 days of storage, the egg mass loss was 0.51%, for 10 days – 1.02%, for 14 days – 1.55%, which makes losses of about 0.43 g, 0.85 g and 1.3 g for 4, 10 and 14 days of storage at 17^{o} C and humidity 72%, respectively. Walsh et al. (1995) reported for weight loss of chicken eggs of up to 0.56 g for 14 days.

Table 1 Effect of storage duration on the weight loss

Storage duration	Egg weight before storage x±SE	Egg weight at incubation (g) x±SE	Weight loss during storage (%) x±SE	Weight loss during incubation from days 1 to 25, (%), x±SE	Absolute weight of hatchlings (g) x±SE	Relative weight of hatchlings (%) x±SE
0 days	---	86.01±0.50$^{c\,d}$	---	12.85±0.19^{fg}	54.86±0.48^{i}	64.77±0.53^{k}
4 days	85.34±0.53^{ab}	84.90±0.53	0.51±0.10^{e}	13.87±0.25^{fgj}	52.67±0.58$^{i\,j}$	62.19±0.36^{k}
10 days	83.48±0.51^{a}	82.44±0.47^{c}	1.02±0.10^{e}	14.29±0.27^{fh}	53.78±0.52	63.57±0.90
14 days	83.90±0.48^{b}	82.11±0.59^{d}	1.55±0.10^{e}	13.04±0.25^{jh}	52.82±0.66^{i}	63.94±0.43

* Means with a common superscripts differ: a-a- p<0.01; b-b- p<0.01; c-c-p<0.001; d-d p<0.001; e-e-p<0.001; f-f- p<0.001; g-g p<0.001; j-j-p<0.05; h-h- p<0.01; i-i- p<0.01;k-k- p<0.001

During incubation, the highest weight loss was exhibited by eggs stored for 10 days – 14.29%, that was statistically significant different from fresh eggs (p<0.001) more with 1.44 points or 10.08%. In eggs that were not stored prior to incubation, the weight loss was lower (12.85%) than in eggs stored for 4 days –13.87% (p<0.001). This was not consistent with the studies of Reijrink et al. (2009) on chicken eggs which showed that the preincubation storage duration did not influence the weight loss during incubation, but only weight loss during storage.

In general, the absolute weight of turkey poults that hatched from fresh eggs was the highest 54.86 g, and statistically significantly different from birds which hatched from eggs stored for 4 days – 52.67 g and 14 days – 52.82g. The same trend was present with regard to the relative weight –highest values in turkeys hatching from fresh eggs (64.77%). There was a significant difference (p<0.001) between the relative weight of turkey poults hatching from eggs stored for 4 d (62.19%) and those from fresh eggs. The respective percentages of hatchlings from eggs stored for 10 and 14 days were 63.57% and 63.94%. Having investigated the effect of storage of eggs from heavy turkeys on the body weight of hatchlings, Mróz, E. et al.,(2006**)** did not observe any relationship.

The incubation traits of experimental eggs are presented in Table 2. The number of eggs set for incubation was as followed: 132 non-stored; 133 stored for 4 days, 113 stored for 10 days and 139 stored for 14 days.

During the first examination, the highest fertilization was that of fresh eggs and eggs stored for 4 days: 92.42% and 93.98%, respectively. Although the duration of storage should not have any impact on egg fertilization, a very low fertilized egg percentage was observed for eggs stored for longer periods of time (p<0.001).

Table 2 Effect of storage duration on fertilized egg percentage, embryonic death rate and hatchability

Storage duration	Number of eggs set	Number of fertile eggs	Fertility, %, x±SE	Embryonic death rate (%) (0-7 days), x±SE	Embryonic death rate (%), (8-14 days) x±SE	Embryonic death rate (%), (from the 15th day to hatching) x±SE	Hatchability of fertile eggs, (%) x±SE	Number of hatchlings
0 days	132	125	92.42±2.54^{a}	0	2.72±1.22	6.52±1.07^{e}	90.77±2.36^{f}	116
4 days	133	126	93.98±1.59^{b}	1.42±0.67	2.64±1.04	7.37±1.73	88.17±2.61	113
10 days	113	100	86±5.22^{abc}	3.20±1.6^{d}	4.35±0.59	7.25±1.79	86.88±3.12	90
14 days	139	112	80.11±1.18^{abc}	13.63±3.2^{d}	3.76±0.68	11.15±2.04^{e}	71.45±5.24^{f}	77

* Means with common superscripts differ: a-a -p<0.001; b-b- p<0.001; c-c p<0.001; d-d -p<0.001; e– e- p<0.05; f -f- p<0.001

During the storage, depending on the conditions, the development of the embryo stops or is delayed and in the first days of incubation, it could not be reinstated. These results are similar to what was reported by other researchers (Petek et al. 2003, Petek and Dikmen 2004).

The early embryonic death was the highest (13.63%) in eggs stored for 14 days before the incubation while in fresh eggs, embryonic death was not observed until the 7t day of incubation. Eggs stored for 10 days showed embryonic death rate of 3.20%, that was significantly lower than culled embryos from eggs stored for 14 days (p<0.001).

Fasenko et al. (2001) observed a higher embryonic death date until the 7th day of incubation in turkey eggs stored for 14 days, than in eggs stored for 4 days. This was however, in contradiction to data confirming no difference between the embryonic development of eggs stored for 3, 7 or 14 days at 15^{o}C (Bakst and Gupta, 1997**).**

From the 8th to the 14th day of incubation, embryonic death rate varied from 2.64% in eggs stored for 14 days, 2.72% in fresh eggs, 3.76% in those stored for 14 days and attained 4.35% in eggs stored for 10 days; the differences were insignificant.

From the 15th incubation day to hatching, the highest embryonic death rate was observed in eggs with the longest storage period – 11.15%, which was statistically significantly higher than respective percentage in fresh eggs – 6.52% at p<0.05. In eggs stored for 4 and 10 days, late embryonic death varied from 7.37% and 7.25% respectively, with inconsistent differences.

The high embryonic death rate during the incubation of eggs stored for a long time, is also confirmed by Fasenko et al., 1992and Fasenko et al.,2001.

The highest hatchability from fertile eggs was that of fresh eggs – 90.77%, i.e. by 2.6 points or 2.87% higher than that of eggs stored for 4 days and by 3.89 points or 4.29% higher than that of eggs stored for 10 days. The percentage of hatchlings from fertile fresh eggs was statistically significantly higher than that from eggs stored for 14 days – 71.45% at p<0.001

Table 3 presents data for egg components and some albumen traits depending on the storage duration.

The highest egg weight was that of fresh eggs. Eggs stored for 10 and 14 days at 17^{o} C had considerably lower values due to the egg mass loss. Eggshell weight varied from 7.06 g to 8.06 g or 8.66% to 9.71% of egg weight. The highest values were those of eggs stored for 14 days. The difference could be attributed rather to the physiological and productive status of turkey layers than to the storage duration of eggs (Siopes and Neely, 1997).

Table 3 Effect of storage duration of turkey eggs on the proportions of their components

Storage duration	Egg weight (g) x±SE	Eggshell weight, (g) x±SE	Yolk weight (g) x±SE	Albumen weight, (g) x±SE	Egg-shell (%) x±SE	Yolk, (%) x±SE	Albumen (%) x±SE	Albumen pH x±SE	Albumen height, (mm) x±SE
0 days	86.73±1.92^{ab}	7.73±0.25	26.20±0.84	51.20±1.10^{fg}	8.93±0.26^{d}	30.21±0.66	59.09±0.62^{h}	8.45±0.06	8.42±0.38^{kl}
4 days	85.00±1.47	7.86±0.26	25.73±0.76	50.13±1.24	9.26±0.26	30.28±0.79	58.98±1.07	8.60±0.05	7.30±0.40
10 days	81.68±1.76^{B}	7.06±0.37^{c}	25.31±0.59	45.68±1.34^{g}	8.66±0.44^{e}	31.06±0.66	55.81±0.65^{i}	9.06±0.04^{j}	6.59±0.28^{l}
14 days	82.43±0.86^{a}	8.06±0.14^{c}	27.00±0.68	45.93±0.57^{f}	9.71±0.11^{de}	32.59±0.83	56.04±0.86^{h}	9.25±0.02^{j}	6.25±0.19^{k}

* Means with a common superscripts differ: a-a p<0.01; b-b p<0.001; c-c p<0.01; d-d p<0.01; e-e p<0.01; f-f p<0.001; g-g p<0.001; h-h p<0.01; i-i p<0.001; j-j p<0.001; k-k p<0.001; l-l p<0.001

Yolk weight and yolk percentage did not exhibit significant differences, therefore this component of eggs was not markedly influenced by the duration of storage, as also assumed by other authors with chicken eggs (Ahn et al. 1999, Scott and Silversides 2000).

The highest albumen weight was established in fresh eggs that were significantly superior to eggs stored 10 and 14 days. Heavier eggs are known to have more albumen (Suk and Park, 2001) and in our study too, fresh eggs had more albumen as compared to eggs stored for 10 and 14 days.

The albumen percentage of egg weight was the highest in fresh eggs – 59.09%, and decreased in eggs stored for 14 days (56.04%) and 10 days (55.81%).

Albumen pH of eggs was the highest – 9.25 in eggs stored for 14 days and gradually decreased to attain 8.45 in fresh eggs. After 4 days of storage, albumen pH slightly increased to 8.60, and on the 10th day of storage – increased to 9.06, and thereafter to 9.25. Albumen pH was found to increase parallel to storage duration whereas albumen's height decreased, Brake (1995) reported that albumen pH during storage slowly increased to 9.0 on the 4th day, and then pH values did not almost change.

Albumen height relates to the freshness of the egg. It was 8.42 mm in fresh eggs and decreased to 6.25 mm in eggs stored for 14 days. There were no statistically significant differences between albumen heights of eggs stored for 4 days and fresh eggs. After 10 and 14 days of storage, the albumen height

sharply decreased as also reported by Li-Chan and Nakai (1989), Silversides and Villeneuve (1994), Benton and Brake (1996), Lapao et al.,(1999).

Jones and M. T. Musgrove (2005) communicated that during the first week of storage albumen height was 7.05 mm and during the second week, it decreased to 5.84 mm.

CONCLUSIONS

The loss of weight during the storage increased parallel with storage duration ($p<0.001$).

During incubation, the highest weight loss percentage was exhibited by eggs stored for 10 days (14.29%) that was statistically significantly different from weight loss of fresh eggs by more than 1.44 points or 10.08% ($p<0.001$).

The highest fertility (92.42%) was that of eggs that were not stored before the incubation. A very high early embryonic death rate was observed in eggs stored for 14 days (13.63%). The hatchability of fertile eggs was the highest in fresh eggs: 90.77 % and the lowest in eggs stored for 14 days: 71.45% ($p<0.001$).

The albumen percentage of total egg weight was the highest in fresh eggs – 59.09%, decreased with increasing storage time.

The albumen pH increased parallel to storage duration and was the highest in eggs stored for 14 days –9.25.

Albumen's height decreased as storage duration became longer.

For incubation to be use turkeys eggs from LL line stored at least time at 72% humidity and 17°C, because hatchability decreases with increasing duration of storage.

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