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**Original Contribution** 

# INCUBATION AND VITAL MORPHOLOGICAL TRAITS IN EGGS FROM AGE-RELATED TURKEYS

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#### SUMMARY

The experiment was performed in the selection farm of the Agricultural Institute, Stara Zagora, "Poultry breeding and production technologies" section in 2008. Eggs produced by turkeys of the Heavy Meat (HM) strain at the age of 32 and 44 weeks were used. The incubation traits were studied on all newly-laid eggs with hatching potential. The early embryonic death rate (EED) was determined at first week of incubation at following defined periods: I – formation of embryonic disk (incubation days 0-3) and II – after formation of the embryonic disk (incubation days 4-7). The embryonic death was determined by examinations by Day 25 and by the time of placing eggs in the hatching chamber. The eggs of the Heavy Meat hybrid turkeys, aged 32 weeks, showed a higher fertilization rate – 91.92%, higher early embryonic death rates: 1.35% up to the 3<sup>rd</sup> day of incubation and 2.02% up to the 7<sup>th</sup> day, vs. 0.88% (up to day 3) and 0.88% (up to day 7) in eggs laid by turkeys aged 44 weeks. The hatchability of placed and fertilized eggs was higher for eggs from younger layers (age of 32 weeks) compared to those laid by turkeys at the age of 44 weeks.

Key words: turkey, age, eggs, hatch, morphologic qualities of the eggs.

#### INTRODUCTION

The efficacy of turkey meat production is largely dependent on the reproduction traits of turkeys, i.e. the amount of produced eggs and their incubation traits The studies of numerous authors show that different factors have an impact on the hatchability of eggs. Mater et al. (1) and (2) reported the effect of the storage term of eggs with regard to layer feeding mode (3). French (4) established a different hatchability and fertilization rate of eggs depending on their size. Sharlanov (5), having studied four hens lines, concluded that the percentage of dead embryos increased in parallel to increasing the intensity of egg laying.

The studies of others (6,7,8,9,10) showed the existence of a relationship between the incubation properties of eggs and the age of layers.

Tona K. et al. (11) reported the highest hatchability and the lowest embryonic death rate in eggs of broiler parents at the age of 42 weeks. Shevchenko et al. (12) did not observe any differences in the fertilization rate and the

moblakova@abv.bg, Stara Zagora tel 042607012 hatchability of turkey eggs, produced by turkeys with various live body weights and at a various age.

The embryonic death rate also influences hatchability rates. Brah et al. (13) classified embryonic death rates in chickens as early (0-11 days), late (12-22 days) and pips and observed strong positive genetic correlations between them (0.498-0.931). The overall embryonic death rate in this experiment was between 6.8 and 15.3% over four generations of two White Leghorn strains.

In a study on the effect of layer age upon the quality of their eggs, Silversides et al. (14) and (15) observed that egg weight increased together with layer age, as well as the relative egg yolk content. Christesen et al. (16) and (17), found out that in turkeys, the weight of eggs laid at the age of 33-36 weeks was significantly smaller compared to those laid by birds at the age of 54-55 weeks. According to (18), the optimal egg albumen and eggshell quality was observed by the time of peak egg production- age of 35 weeks. The purpose of the study was to determine the effect of age of turkey layers upon the incubation and some morphological traits of produced eggs.

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## MATERIAL AND METHODS

The experiment was performed in the selection farm of the Agricultural Institute, "Poultry Stara Zagora, breeding and production technologies" section in 2008. Eggs produced by turkeys of the Heavy Meat (HM) strain at the age of 32 and 44 weeks were used. The turkeys were reared according to a routine technology used in the selection farm - on a deep litter in selection nests, 12 turkeys in each, i.e. at an area of  $1 \text{ m}^2$  per 3 birds. They were fed a standard commercial diet for turkey layers with metabolisable energy of 2987.174 and average daily consumption of 300 g.

Artificial insemination with 0.025 ml undiluted fresh semen was performed, initially twice weekly, and then once up to the end of the period.

The incubation traits were studied on all eggs with potential for hatching, collected over 3 days. The early embryonic death rate (EED) was determined during the first week of incubation. Two periods were defined: I – formation of embryonic disk (incubation days 0-3) and II – after formation of the embryonic disk (incubation days 4-7). The embryonic death was determined by examinations by the Day 25 and by the time of placing eggs in the hatching chamber.

The most important morphological parameters of eggs – weight of eggs and egg shape index; albumen weight, yolk weight, and the albumen and yolk indexes; thickness and weight of the eggshell with the inner membrane; Roche egg yolk colour scores were determined in 60 eggs for each of two studied ages. The measurements of egg weight, eggshell weight with the inner membrane, yolk and albumen weights was done with a precision of 0.01 g on a balance. The length and width of eggs were measured with caliper gauge with a precision of 0.05 mm and calculated by routine formulas (19).

The results were presented in percentage of the total number of studied eggs.

Data was statistically processed using the one and two descriptive factor analysis-ANOVA 2000.

#### **RESULTS AND DISCUSSION**

The fertilization rate and the hatchability are the main parameters that determine the reproductive performance of economically important birds. In general, they determined the production of one-day-old poults. **Table 1** shows the results from the incubation of eggs, produced by Heavy meat turkeys at the age of 32 and 44 weeks.

Age (weeks)	Eggs for hatching, pcs.	Non- fertilized eggs, pcs.	Fertilization, (%)	Dead embryos 3 day - pcs. (%)	Dead embryos- 7 day, pcs. (%)	Dead embryos 25 day, pcs. (%)	Hatched poults, pcs.	Hatchability, from being hatched (%)	Hatchability, from fertilized (%)
32	445	36	91.92	6 (1.35)	9 (2.02)	16 (3.60)	319	71.69	77.99
44	340	40	88.24	3 (0.88)	3 (0.88)	19 (5.50)	226	66.47	75.33

Table 1: Incubation traits of eggs from Heavy Meat turkeys at the age of 32 and 44 weeks

•Hatchability from being hatched (%)

•Hatchability from fertilized (%)

The data showed a higher fertilization rate of eggs laid by HM turkeys at the age of 32 weeks -91.92%. In other studies (9), fertilization of eggs from the first cycle of egg laying was lower compared to those obtained during the second one.

The early embryonic death rate was determined throughout the I and II examination periods– at formation of embryonic disk (0-3 days of incubation) and after formation of embryonic disk (4-7 days of incubation). It was higher in eggs produced by younger turkeys – 1.35% and 2.02% (32-week-old) vs. 0.88% and 0.88% (44-week-old), respectively. The hatchability of incubated eggs and the hatchability of fertilized eggs were

71.69% and 77.99% vs. 66.47% and 75.33 % in eggs from 44-week-old turkeys. These data confirm earlier studies which also established better albumen quality and higher hatchability of eggs from younger layers (8). The eggs of older layers were with lower hatchability, but the poults possessed better growth potential.

The investigation of the main morphological traits of eggs from Heavy meat turkey hybrids are presented on **Table 2**. The weight of eggs laid by 32-week-old turkeys was significantly lower than that of the eggs laid by 44-week-old birds. The difference between the average egg weights for both studied ages was 4.3 g at p<0.001. The data for the egg shape index showed that this parameter was good for both ages, as it is considered that values under 71% and over 74% results in higher number of cracked and broken eggs (20), (5). The shape index was higher at 32 weeks of age, when the eggs were more rounded (p < 0.05).

**Table 2:** Most important morphological traits of eggs from Heavy Meat turkeys at the age of 32 and 44 weeks, n=60

Age of turkeys (weeks)	32	44		
Parameters				
	$X \pm Sx$ % of the parameter	$X \pm Sx$ % of the parameter		
	from egg's weight	from egg's weight		
Egg weight, g	84.67 ±0.71***	88.97±0.70		
Egg shape index, %	$73.32 \pm 0.36*$	72.33±0.34		
Albumen weight, g	$49.20 \pm 0.56^*$ 58.11	50.89±0.55 57.20		
Albumen index, %	$7.73 \pm 0.22 **$	6.81±0.21		
Yolk weight, g	$26.02 \pm 0.21^{***}$ 30.73	28.86±0.26 32.44		
Yolk index, %	$37.84 \pm 0.39$ ***	34.90±0.21		
Eggshell weight (with the inner	9.43 ± 0.11 11.14	9.37±0.09 10.53		
membrane), g				
Shell thickness, mm	$0.44 \pm 0.009$	0.43±0.004		
Roche egg yolk colour score	$4.53 \pm 0.06$	4.53±0.06		

*at p< 0.001, p< 0.01, p< 0.05* 

The eggs from older turkeys contained 1.69 g (3.43 %) more albumen than those of younger turkeys (p<0.05). Albumen index was different at both studied ages. At 32 weeks, the difference was significant (p<0.01), 7.73 vs. 6.81, respectively. In an earlier study (22) and (23), it was found that the albumen height decreased with layer's age, thus the albumen index.

With regard to yolk parameters (yolk weight and index) the differences were highly significant (p<0.001). The yolk weight of eggs produced by older turkeys at the age of 44 weeks was higher by 2.84 g (10.91%) compared to those of 32-week-old birds. The yolk index was higher in eggs of younger turkeys - 37.84% vs. 34.90% respectively (p<0.001).

The data about eggshell weight and thickness showed that the weight had similar values for eggs laid by turkeys from both studied ages: 9.43 g (32-week-old) and 9.37 g (44-week-old) and were insignificant.

The thickness of eggshell with the inner membrane is an indirect parameter of egg hardness. The average eggshell thickness was 0.44 mm (layer age 32 weeks) and 0.43 mm (layer age 44 weeks).

The intensity of yolk colour determined on the Roche scale was equal for both studied ages -4.53. It is known that yolk colour is determined by the presence of xanthophyll, a vitamin A precursor. Therefore, this parameter is mostly influenced by the feeding mode.

The results about the relative proportions of egg parts vs. the whole egg weights are shown on Table 2. The albumen percentage was similar in eggs laid by birds from both studied ages: 32 and 44 weeks -58.11% and 57.20%, respectively. The yolk proportion however was higher in eggs laid by 44-week-old turkeys (32.44% of egg's weight) vs. 30.73% from 32-week-old layers. Silversides F. G et al. (14) observed that the proportion of albumen and eggshell vs. the whole egg's weight decreased with advancing of layer's age together with increased share of the yolk. It was also shown (24) that embryos from young turkey layers developed more slowly than those of older layers during the last week of the incubation. The studies have shown that these differences were due to the proportional increase of yolk weight in eggs of older layers, hence the higher lipid content of the yolk of the embryo during the final incubation week.

The relative proportions of the eggshells for both studied ages were similar and ranged between 10.53% (44-week-old turkeys) and 11.14% (32-week-old turkeys). The investigation of the relationship between the morphological parameters and the incubation traits of eggs (21) has shown that the highest hatchability was that of eggs with relative proportion of the eggshell over 10%, that allowed us to conclude that the eggshell parameters observed in the present study, were optimal from a biological point of view for both studied layers' ages.

## CONCLUSIONS

This investigation has shown that:

- 1. The eggs of the Heavy Meat hybrid turkeys at the age of 32 weeks showed a higher fertilization rate 91.92%, higher early embryonic death rates: 1.35% up to the 3<sup>rd</sup> day of incubation and 2.02% up to the 7<sup>th</sup> day, vs. 0.88% (up to day 3) and 0.88% (up to day 7) in eggs laid by turkeys aged 44 weeks.
- 2. The hatchability of placed and fertilized eggs was higher for eggs from younger layers (age of 32 weeks) compared to those laid by turkeys at the age of 44 weeks.
- 3. The weight of eggs from older turkeys was significantly higher than that of younger Heavy meat turkey layers.
- 4. The proportion of yolk increased with layer age, whereas the amount of albumen vs. the whole egg weight was reduced.
- 5. The weight of thickness of eggshells with the inner membrane changed insignificantly within an optimal biological range for both studied ages.

#### REFERENCES

- Mater, C.M. and K.F. Laughlin. 1976. Storage of hatching eggs: The effect on total incubation period. *Br.Poultry Science* 17:471-479.
- 2. Fasenko,G.M., 2007. Egg storage and the embryo. *Poultry science*. 86: 1020-4.
- 3. Wilson, H.R.1997 Effects of Maternal Nutrition on Hatchability. *Poultry Science* 76:134–143.
- French. N., 1997.Modeling Incubation Temperature: The Effects of Incubator Design, Embryonic Development, and Egg Size. *Poultry science* 76: 124-133.
- 5. Sharlanov D., 1988. Effect of the intensity of laying of hens upon the incubation traits of eggs. *Animal Sciences (Sofia)*, 5: 45-50.
- Tretyakov N., B. Bessarabov, G. Krok, 1990. Incubation with elementary embryology, Moskow, Rossagropromizdat: 98.
- Fairchild B. D., V. L. Christensen, J. L. Grimes, M. J. Wineland, and L. G. Bagley. 2002 Hen Age Relationship with Embryonic Mortality and Fertility in Commercial Turkeys. J. Appl. Poult. Res. 2002 11: 260-265.
- 8. Tona K., O. Onagbesan, B. De Ketelaere, E. Decuypere, and V. Bruggeman.2004.

Effects of Age of Broiler Breeders and Egg Storage on Egg Quality, Hatchability, Chick Quality, Chick Weight, and Chick Posthatch Growth to Forty-Two Days. *J. Appl. Poult. Res.* 13:10–18.

- 9. Lerner S.P., French N., McIntyre D., Baxster Jones-C., 1993. Age-related changes in egg production, fertility, embryonic, mortality and hatchability in commercial turkey flocks. *Poultry Science* 72, 6:1025-1039.
- 10. Fasenko,G.M.,R.T. Hardin, and F.E. Robinson. 1992. Relationship of hen age and egg sequence position with fertility, hatchability, viability, and preincubacion embryonic development in broiler breeders. *Poultry science* 71:1374-1383
- 11. Tona K., F. Bamelis, W. Coucke, V. Bruggeman, and E. Decuypere. 2001. Relationship between broiler breeder's age and egg weight loss and embryonic mortality during incubation in large-scale conditions. J. Appl. Poult. Res. 10:221–227
- 12. Sevcenko, A., T. Scliarova, 1992. Ties with the turkey live weight and reproductive quality, *Poultry*, 6: 8-10.
- Brah G.S, Sanddhu J.S., Chaudhary M.L., 1999. Variance and covariance component analysis of incubational mortality in chickens, Arhiv-fur-Tierzuht.42:3,295-302.
- Silversides F. G., and T. A. Scott, 2001. Effect of Storage and Layer Age on Quality of Eggs From Two Lines of Hens. *Poultry Science* 80:1240–1245
- 15. Rizzi Ch., G. M. Chiericato. 2005. Organic farming production. Effect of age on the productive yield and egg quality of hens of two commercial hybrid lines and two local breeds. *ITAL.J.ANIM.SCI*. 4 (SUPPL. 3), 139-141.
- Christensen V. L, J. L. Grimes, and M. J. Wineland, 2001. Effects of turkey breeder hen age, strain, and length of the incubation period on survival of embryos and hatchlings. J. Appl. Poultry Res. 10:5–15.
- 17. Applegate, T. J., and M. S. Lilburn, 1996. Independent effects of hen age and egg size on incubation and poult characteristics in commercial turkeys. *Poultry Sci.* 75:1210–1216.
- Bains, B.S., 1994. Internal egg quality influence on fertility and hatchability. World Poult. Sci. J. 10(11):35–37.
- 19. Doncev, R., G.Kaitazov, M. Kabakciev, D.Aleksieva, 1981. Manual for exersises of poultry, c. 24-26.

- 20. Kosenko, N., A. Kovalenko, A. Sapronova, 1985. *Poulrtry*, 10: 31-36
- Sharlanov D., N.Bacev, M. Lalev, 1988. Study of the dependence between some morphological indexes and incubation quality of turkey eggs, *Animal Sciences* (Sofia), Animal Sciences (SofiAnimal Sciences (SofiXXV, N 7, 13- 17.
- 22. Hill, A. T., and J. W. Hall, 1980. Effects of various combinations of oil spraying, washing, sanitizing, storage time, strain, and age upon albumen quality changes in storage and minimum sample sizes

required for their measurement. *Poultry Sci.* 59:2237–2242

- 23. Silversides, F. G., 1994. The Haugh unit correction for egg weight is not adequate for comparing eggs from chickens of different lines and ages. J. Appl. Poult. Res. 3:120–126.
- 24. Applegate, T. J., 2002. Reproductive maturity of turkey hens: egg composition, embryonic growth and hatchling transition. *Avian and Poultry Biology Reviews*. Vol. 13, N 1: 31-41(11).