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Short Communication

The Effect of Egg Shell Thickness on Some Hatching Traits of Broiler Breeders

Umut Sami YAMAK [1] ✐ Musa SARICA [1] Mehmet Akif BOZ [2] Hasan ÖNDER [1]

[1] Ondokuz Mayis University, Agricultural Faculty, Department of Animal Science, TR-55139 Samsun - TURKEY
[2] Bozok University, Agriculture and Natural Science of Faculty, Department of Animal Science, TR-66100 Yozgat - TURKEY

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Abstract

This study examined the effect of egg shell thickness on hatching traits of broiler breeders. A total of 253 eggs from broiler breeders were classified into three groups according to shell thickness (thin, medium, thick). Eggs were weighed, and shell thicknesses were measured ultrasonically. Hatchability, chick weight and chick length were assessed at the end of the incubation period. The effect of egg shell thickness on hatchability was found to be insignificant for all groups. Moreover, shell thickness had no significant effect on chick weight or length.

Keywords: *Egg shell thickness, Hatchability, Incubation, Ultrasound*

Broiler Damızlıklarda Yumurta Kabuk Kalınlığının Bazı Kuluçka Özellikleri Üzerine Etkisi

Özet

Bu çalışma broiler damızlıklarda kabuk kalınlığının kuluçka sonuçları üzerine etkisini araştırmıştır. Broiler damızlık sürüden elde edilen toplam 253 yumurta kabuk kalınlıklarına göre gruplandırılmıştır (kalın, orta ve ince). Yumurtalar tartılmış ve kabuk kalınlıkları ultrasonik olarak ölçülmüştür. Çıkış gücü, civciv ağırlığı ve civciv uzunluğu kuluçka sonunda belirlenmiştir. Tüm gruplarda kabuk kalınlığının çıkış gücüne etkisi önemsiz bulunmuştur. Ayrıca, kabuk kalınlığının civciv ağırlığı ve civciv uzunluğu üzerine önemli bir etkisi de olmamıştır.

Anahtar sözcükler: *Yumurta kabuk kalınlığı, Çıkış gücü, Kuluçka, Ultrasonik*

INTRODUCTION

Incubation is one of the most important factors affecting profitability in poultry production. Egg physical characteristics play an important role in the processes of embryo development and successful hatching. Any abnormalities in these characteristics can lead to a collapse in embryo development [1]. While the shell must be thick enough to protect the embryo from external factors during incubation, it must also be thin and fragile enough not to act as a strong barrier to hatching [1]. Eggshell thickness is usually measured with or without membranes using a thickness measurer [2]. However, this method does not sufficiently reflect the effect of shell thickness on hatchability. Hence, some researchers have assessed egg shell thickness according to egg specific gravity [3], which is closely related to shell thickness [4]. Eggs with specific gravities of 1.080 or 1.075 have been classified as thin shelled, whereas those with specific gravities of 1.085 or higher have been classified as thick shelled [3]. Ar et al.[5] calculated eggshell thickness with a logarithm that used egg weight, and this logarithm was adopted by other researchers as well [6]. In yet another method, shell thickness determined after hatching [7]. However, all these methods assess egg shell thickness indirectly. Furthermore, whereas most studies investigate egg physical characteristics (egg weight, shape, length, etc.) in relation to chick measurements (chick weight and chick length), there is little information available about the relationship between egg shell thickness and hatchability. Therefore, this study evaluated the relationship between egg shell thickness and hatchability, chick weight and chick length.

MATERIAL and METHODS

This study was conducted at the Experimental Farm of the Ondokuz Mayis University Agricultural Faculty using a total of 253 eggs from two broiler breeder genotypes

✐ İletişim (Correspondence)
☏ +90 362 3121919
✉ usyamak@omu.edu.tr

obtained from the farm's parent stock. Hens of the parent stocks were two-way crosses of ROSS x Rhode Island Red (RIR) and ROSS x Barred Plymouth Rock (BAR), and they were mated with ROSS males to obtain the eggs used in the study. Eggs were collected when the flock age was 43 wks, with 117 eggs collected from the ROSSx(ROSSxBAR) flock ('Genotype 1') and 136 from the ROSSx(ROSSxRIR) flock ('Genotype 2'). All eggs were collected on the same day. Eggs were numbered and weighed, and shell thicknesses were measured with an Egg Shell Thickness Gauge (ORKA Tech. Ltd., Israel) that uses precision ultrasound to gauge thickness without breaking the egg and is accurate to within 0.01 mm. The shell thicknesses were measured on blunted edge of eggs. Three measurements were performed for each egg and the mean of these measurements was assessed as egg shell thickness. The thinnest and thickest egg shell thickness values of the eggs were determined. The difference between thickest and thinnest eggs was divided to three (X_{max}-X_{min} /3). This value was added to mean egg shell thickness to determine the range of thick shell group; and deducted from mean egg shell thickness to determine the range of thin shell group. The eggs were classified to three egg shell thickness groups (thin, medium and thick) with this method *(Fig. 1).*

Eggs were placed in a 2400-egg-capacity incubator (Cimuka Incubator Company, Turkey) and transferred to individual pedigree hatch baskets at 18 d of incubation to allow for chick measurement according to egg number. The eggs were randomly distributed to trays. But each genotype and shell thickness group was rationally represented on trays. Also, trays were replaced to each levels of incubation to eliminate the different conditions of incubation machine. Hatching was completed at 21.5 days. All chicks were weighed and chick length measured at hatch. Chick weight was assessed using a bascule with a sensitivity of up to 0.01 g. Length was determined by measuring each chick from the tip of the beak to the end of the middle toe, with the chick's dorsal surface extended over a ruler [8].

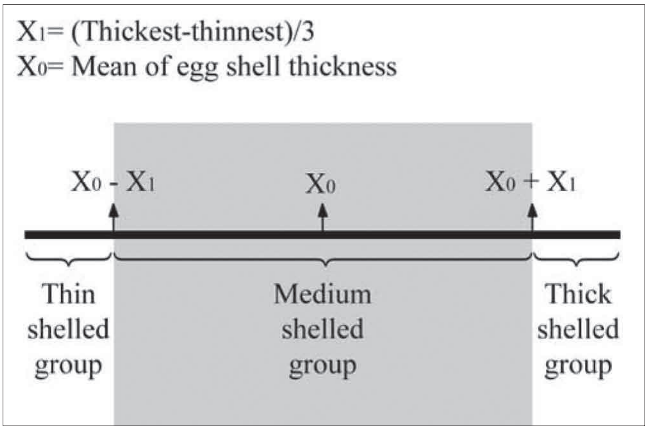

Fig 1. Classification method of egg shell thickness groups
Şekil 1. Yumurta kabuk kalınlığı gruplarını sınıflandırma metodu

Factorial analysis was conducted on a completely randomized design, with genotype and shell thickness as factors. Pearson correlation analysis was used to assess relationships between egg shell thicknesses and hatching traits, with differences in means evaluated for significance using Duncan's Multiple comparison test. R statistical software was used to analyze the data. A difference of $P<0.05$ was considered statistically significant.

RESULTS

Analysis results showed that Genotype x Egg Shell Thickness interaction was insignificant ($P>0.05$) on all traits, so only main effects were interpreted. Mean egg weight, shell thickness, chick weight and chick length at hatch are given in *Table 1*. Differences between all hatching traits were significant among genotypes ($P<0.05$). Chick weights at hatch for Genotypes 1 and 2 were 41.42 g and 43.18 g, respectively, and chick weight/egg weight ratios were 68.54 and 69.67, respectively.

Egg shell thicknesses ranged between 0.28-0.45 mm and included thin (≤0.34 mm), medium (0.35-0.38 mm) and thick (≥0.39) -shelled eggs, which were classified using the equation X_{max}-X_{min} /3. Infertile eggs (Genotype 1: 6/117; Genotype 2: 20/136) were not evaluated. Hatching rates, egg weights, chick weights and chick lengths of each genotype according to eggshell thickness classifications are given in *Table 2*.

Table 3 shows the relationships between shell thickness, egg weight, chick weight and chick length.

DISCUSSION

Mean egg weights for Genotype 1 and Genotype 2 were, respectively, 60.43 g and 61.98 g, which Abiola et al.[9] described as 'medium-sized' eggs. Their study found

Table 1. *Some hatching characteristics of genotypes (Mean ± SEM)*
Tablo 1. *Genotiplerin bazı kuluçka özellikleri (Ortalama ± Standart Hata)*

Genotype	Egg Weight (g)	Shell Thickness (mm)	Chick Weight (g)	Chick Length (cm)
1	60.4±0.44b	0.380±0.003b	41.4±0.4b	18.7±0.050a
2	62.0±0.48a	0.390±0.003a	43.2±0.41a	18.4±0.060b
Sig (P)	0.019	0.020	0.002	0.007

a, b: *Differences in superscript letters within columns represent significant differences between groups (P<0.05),* ***SEM:*** *Standard Error of Means*

***Table 2.** Hatching rates, egg weights, chick weights and chick lengths of genotypes 1 and 2, according to egg shell thickness classification (Mean ± SEM)*

***Tablo 2.** Kabuk kalınlığı gruplandırmasına göre 1. ve 2. genotiplerin çıkış gücü, yumurta ağırlığı ve civciv ağırlığı ve civciv uzunlukları (Ortalama ± Standart Hata)*

Genotype	Egg Shell Thickness Classification	Hatching Rate (%)	Egg Weight (g)	Chick Weight (g)	Chick Length (cm)
1	Thin	91.6	58.6±1.39	40.3±1.2	18.4±0.160
	Medium	84.6	60.5±0.630	41.8±0.51	18.7±0.090
	Thick	91.3	60.8±0.700	41.3±0.69	18.7±0.070
Sig. (P)		0.852	0.492	0.119	0.479
2	Thin	77.8	63.3±1.22	45.6±1.10	18.6±0.200
	Medium	95.0	61.5±0.840	42.4±0.640	18.5±0.100
	Thick	87.9	62.2±0.620	43.6±0.550	18.4±0.09
Sig. (P)		0.432	0.492	0.119	0.479

***SEM:** Standard Error of Means*

***Table 3.** Coefficient of correlations between egg shell thickness, chick weight and chick length*

***Tablo 3.** Yumurta kabuk kalınlığı, civciv ağırlığı ve civciv uzunluğu korelasyon katsayıları*

Egg and Chick Traits	Egg Shell Thickness	Chick Weight	Chick Length
Egg weight	0.108	0.862**	0.365**
Egg shell thickness		0.082	0.020
Chick weight			0.302**

*** P<0.01*

'medium-sized' eggs had the greatest hatchability. Shell thicknesses of Genotypes 1 and 2 were 0.38 and 0.39 mm, respectively. These figures are lower than those reported by Wolanski et al.[10], who reported shell thicknesses of eggs from 10 broiler breeder genotypes ranging from 0.325 to 0.370 mm. Chick weight/ egg weight ratios were similar to those obtained in previous studies [8,10]. Msoffe et al.[11] has shown that chick lengths at hatch are positively correlated with adult body weight (r = 0.96).

No significant differences were observed between groups for hatching rates, egg weights, chick weights and chick lengths; in other words, egg shell thickness had no effect on egg weight, chick weight, or chick length.

The highest correlation was found between egg weight and chick weight. The correlation between chick weight and chick length was also found to be significant. This result is similar to the result reported by Wolanski et al.[8], who found a correlation of 0.303 between chick weight and length. In line with the correlation found between chick weight and chick length, the correlation between egg weight and chick length was also found to be significant.

Bennet [3] found that eggs with thin shells had hatchability rates between 3%-9% lower than eggs with thick shells, whereas Tsarenko [12] reported a 30% difference in hatchability rates between thin- and thick-shelled eggs. A number of studies [13] examining hatchability in different poultry species including turkey and geese found hatchability of thick-shelled eggs to be 20%-40% higher than that of thin-shelled eggs, although a study by Andrews [14] found the hatchability of turkey eggs to be higher for eggs with thinner shells. Despite their differences in findings, all of these studies reported egg shell thickness to have an effect on egg hatchability. In contrast to this, however, our study found egg shell thickness had no effect on hatchability. Also, most of previous studies classified the eggs as thin or thick regardless measuring the average shell thickness of eggs. In our study, the mean shell thickness of the eggs was determined, and the differences between the thickest/thinnest shelled eggs and mean shell thickness were used to identify the limits of each thickness group. This method had more accurate classification than general classifying.

According to these results, it could be said that, after the embryo completed its development, it could crack the egg regardless to the thickness of shell. The insignificant correlation between egg shell thickness and chick weight supported this result.

In conclusion, after measuring shell thicknesses with an ultrasound gauge and classifying eggs into three groups accordingly, this study found no significant differences between egg weights, hatching rates, chick weights and chick lengths among egg shell groups.

It should be noted that although most studies determine egg shell thickness by using specific gravity, Sarica et al.[15] have shown that this parameter may not yield accurate results, as the correlation between specific gravity and egg shell thickness varies by age. Thus, future studies comparing measurement methods would be beneficial.

REFERENCES

1. Narushin VG, Romanov MN: Egg physical characteristics and hatchability. *Worlds Poult Sci J,* 69, 297-303, 2002. DOI: 10.1079/WPS20020023

2. Peebles ED, Mcdaniel CD: A practical manual for understanding the shell structure of broiler hatching eggs and measurements of their quality. Missippi Agric. & Forestry Experiment Station. Bulletin 1139. 16 p., Missippi, 2004.

3. Bennet CD: The influence of shell thickness on hatchability in commercial broiler breeder flocks. *J Appl Poult Res,* 1, 61-65, 1992. DOI: 10.1093/japr/1.1.61

4. Voisey PW, Hamilton RMG: Notes on the measurement of egg specific gravity to estimate shell quality. Engineering Research Service. Agriculture Canada. Report 7322-598, 1976.

5. Ar A, Paganelli CV, Reeves RB, Grene DG, Rahn H: The avian egg: Water vapor conductance shell thickness and functional pore area. *Condor,* 76, 153-158, 1974.

6. Shafey TM: Effects of Egg size and eggshell conductance on hatchability traits of meat and layer breeder flocks. *Asian-Aust J Anim Sci*, 15 (1): 1-6, 2002. DOI: 10.5713/ajas.2002.1

7. Saylam K, Sarica M: Effects of shell thickness, shell pores and egg weight loss on hatchability on Japanese quail eggs. *Turk J Vet Anim Sci,* 23 (Suppl. 1): 41-46, 1999.

8. Wolanski NJ, Renema RA, Robinson FE, Carney FE, Fancher BI: Relationship between chick conformation and quality measures with early growth traits in males of eight selected pure or commercial broiler breeder strains. *Poult Sci,* 85, 1490-1497, 2006.

9. Abiola SS, Meshioye OO, Oyerinde BO, Bamgbose MA: Effect of egg size on hatchability of broiler chicks. *Arch Zootec,* 57, 83-86, 2008.

10. Wolanski NJ, Renema RA, Robinson FE, Carney FE, Fancher BI: Relationships among egg charasteristics. chick measurements and early growth traits in ten broiler breeder strains. *Poult Sci*, 86, 1784-1792, 2007. DOI: 10.1093/ps/86.8.1784

11. Msoffe PLM, Minga UM, Olsen JE, Yongolo MGS, Juul-Madsen HR, Gwakisa PS, Mtambo MMA: Phenotypes including immunocompetence in scavenging local chicken ecotypes in Tanzania. *Trop Anim Health Prod,* 33, 341-354, 2001.

12. Tsarenko PP: Increasing the Quality of Poultry Products: Table and Hatching Eggs. Agropromizdat. Leningrad. Russia, 1988.

13. Koneva A: Relationship of morphological traits of turkey eggs with hatching of chicks. *Ptitsevodstvo,* 11, 32-33, 1968.

14. Andrews LD: Phenotypic correlation of certain turkey egg parameters. *Poult Sci,* 51, 2010- 2014, 1972. DOI: 10.3382/ps.0512010

15. Sarica M, Yamak US, Boz MA: Changes in egg quality parameters due to age in laying hens from two commercial and three local layer genotypes. *Tavukçuluk Araşt Derg,* 9, 11-17, 2010.