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Araştırma Makalesi

Yumurta şekil indeksinin kuluçka performansı ve cinsiyet üzerine etkisi

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ÖZ

Bu çalışmada kuluçkalık yumurtalarında şekil indeksinin, civciv uzunluğu, cinsiyet, döllülük oranı, kuluçka randımanı, çıkış gücü üzerine etkileri incelenmiştir. Çalışmanın verilerini 1008 adet kuluçkalık broyler yumurtası oluşturmuştur. Veriler SPSS paket programında ki-kare kullanılarak analiz edilmiştir. Çalışma sonucunda çıkış gücü, embriyonik ölümler, döllülük oranında en iyi sonuçlar şekil indeksinin %72-76 arasında olduğu gruptan elde edilmiştir. Dolayısıyla kuluçkalık yumurtalarda şekil indeksinin %72-76 arasında (normal şekilli) olması başarılı bir kuluçka için önemli olduğu sonucuna varılmıştır. Çalışmada şekil indeksinin civciv cinsiyeti üzerinde bir etkisi olmadığı tespit edilmiştir.

Anahtar kelimeler: Civciv uzunluğu, çıkış gücü, döllülük oranı, kuluçka randımanı, şekil indeksi.

Effect of egg shape index on hatching performance and gender

ABSTRACT

In this study, the effects of shape index on chick length, gender, fertility rate, hatchability and hatching power in hatching eggs were investigated. The data of the study consisted of 1008 broiler hatching eggs. The data were analyzed using chi-square in the SPSS package program. As a result of the study, the best results in hatchability, embryonic deaths and fertility rates were obtained from the group where the shape index was between 72-76%. Therefore, it was concluded that the shape index in hatching eggs should be between 72-76% (normal shape) for successful incubation. In the study, it was determined that the shape index had no effect on the chick gender.

Key words: Chick length, hatching power, fertility rate, hatchability, shape index.

INTRODUCTION

The livestock sector has an important and continuous role in the nutrition of societies, and poultry breeding and feeding models strive to produce the healthiest solution for human nutrition in the shortest time (Karakaya & İnci, 2014).

Shape index is one of the external quality traits used to determine egg quality in poultry (Çelik et al. 2017; Durmuş, 2014). Egg shape index is the ratio of egg width to length (Türkoğlu & Sarıca 2014; İnci et al. 2015), and the "normal" chicken egg has an elliptical shape (Jacqueline et al. 2000). It is the egg shape that remains unchanged throughout all stages of incubation. In order to ensure a high rate of chick hatching, in addition to optimum incubation conditions, hatching eggs must also have appropriate characteristics. Any abnormality in the physical properties of the egg leads to the deterioration of basic functions that will provide the best conditions for embryo development (Durmuş, 2014). Better hatching is achieved from eggs with a normal shape than from eggs with an abnormal shape. Therefore, better hatching results are obtained from eggs with a shape index between 72-76% (Durmuş, 2014).

Worldwide, early gender determination in eggs used in incubation of laying hens is a critical issue related to the welfare of poultry animals. Gender determination is important in poultry farms depending on the production objectives (Alaşahan & Akpinar, 2014). Due to differences in nutritional requirements, growth rate, marketing age, management and nutrition of male and female animals, raising males and females separately requires sex determination (Kaleta & Redmann, 2008; Tran et al., 2010; Saatci et al., 2011; Sari et al., 2013; Shafey et al., 2013; Alaşahan & Akpinar 2014). Pastrana et al. (2019) reported that sex determination in chicks can be used in planning conservation and breeding programs of endangered local breeds. This study was conducted to investigate the effects of shape index on chick length, gender, fertility rate, hatchability and hatching power in hatching eggs.

MATERIAL and METHOD

In the study, a total of 1008 hatching eggs obtained from a 53-week-old flock (ROSS 308) were divided into 3 groups according to their shape index as 1) Shape index 72% and lower (SI≤72), 2) Shape index 72-76% range (72≤SI≤76), 3) Shape index 76% and above (SI≥76) and egg weights were determined. On the 18th day of incubation, fertility control was performed on the eggs and they were transferred to the hatcher. Eggs that did not hatch as a result of incubation were broken and early (<6 days), middle (7-15 days) and late (16 days+ bursting through the shell and dying) embryonic deaths were determined. Each chick was weighed with a scale with a sensitivity of 0.01 g and the chick weight and chick length were determined with the help of a ruler (Table 1). At the same time, the gender of the chicks was determined according to their wing feathers. In the evaluation of hatching results (fertility rate, hatchability, hatching power), the formulas in Table 1 were used. Data were analyzed using chi-square in the SPSS package program.

Table 1: Measurements used to determine the features

Features	Formula
Shape index (SI) (%)	Egg width / Egg length x 100 (Türkoğlu & Sarıca, 2014; İnci et al. 2015)
Egg weight (EW) (g)	Measured with a scale with a sensitivity of 0.01 g.
Fertility rate (FR) (%)	(Number of fertile eggs / Number of eggs placed in the machine) x 100 (Aksoy,1999)
Embryonic deaths (early, middle and late stages)	(Number of died embryos /Number of fertile eggs) x100 Early period (EED): Deaths occurring between days 0-6 of incubation. Mid-term (MED): Deaths occurring between days 7-18 of incubation. Late term (LED): Deaths occurring between days 19-21 of incubation.
Hatchability (H) (%)	(Number of hatched chicks / Number of eggs placed in the machine) x 100 (Aksoy, 1999)
Hatching power (HP) (%)	(Number of hatched chicks / Number of fertile eggs placed in the machine) x 100 (Aksoy, 1999)
Chick weight (CW) (g)	Measured with a scale with a sensitivity of 0.01 g.
Chick length (CL) (cm)	The length from the tip of the beak to the tip of the finger was taken. (Aksoy, 1999; Wolanski et al. 2005).
Gender (G)	It was determined according to the wing feathers.

RESULT and DISCUSSION

In the study, shape index did not have a significant (p<0.05) effect on chick weight, chick length, fertility rate, hatchability, hatching power, embryonic mortality and gender.

Table 2: Effect of shape index on hatchability and chick gender

Feature	Number of Egg	EW (g)	FR (%)	H (%)	HP (%)	CW (g)	CL (cm)	EED (%)	MED (%)	LED (%)	G (%)
SI (%)		-	-	-	-	-	-	-	-	-	-
<72	336	67,06	88,98	81,50	91,63	46,57	20,00	3,30	0,70	1,70	M:49,6 F: 50,4
72-76	336	66,42	91,07	87,70	94,10	45,60	20,00	2,60	0,00	1,60	M: 52,4 F:47,6
>77	336	65,40	90,77	85,40	94,10	45,32	19,52	3,60	0,00	1,00	M:53,7

											F:46,3
Mean	**1008**	**66,29**	**90,30**	**84,20**	**93,30**	**45,83**	**19,84**	**3,20**	**0,20**	**1,40**	**M: 51,9 F:48,1**
p-value		**0,199**	**0,615**	**0,255**	**0,376**	**0,199**	**0,199**	**0,770**	**0,129**	**0,724**	**0,633**

-: No significant (P>0.05)   M:Male   F: Female

As a result of the statistical analyzes, chick weight was found as 46.57, 45.60, 45.32 g in SI=<72, SI=72-76, SI=>77 groups. Chick length was found as 20.00, 20.00, 19.52 cm, respectively. Gender was found as M: 49.6%, F: 50.4 in SI=<72 group, M: 52.4%, F: 47.6% in SI=72-76 group, M.53.7%, F: 46.3% in SI=>77 group. As can be seen in Table 2, the best results in terms of fertility rate and hatchability were obtained from the group with shape index 72-76. The highest hatching power was obtained from the group with shape index 72-76 and >77. The lowest early embryonic death was obtained from the group with shape index 72-76, mid-term embryonic death was obtained from the group with shape index 72-76 and >77, and late embryonic death was obtained from the group with shape index >77.

Chick Weight

In the study, chick weights in the groups SI=<72, SI=72-76, SI=>77 were found to be 46.57, 45.60, 45.32 g, respectively. These values are not statistically significant (p>0.05). Iqbal et al. (2016) stated that chick weight and chick length increased with increasing egg size, Abiola et al. (2008) stated that there was a positive correlation between egg size and chick weight in broiler chickens, Alabi et al. (2012), Sabah & Şahan, (2018) stated that heavier chicks were obtained from heavy eggs, and Vieira et al. (2005) stated that heavier chicks were obtained from large eggs (72.7 ± 2.5 g) compared to small eggs (57.7 ± 1.8 g) in the 40-week-old Ross-38 flock. In several studies, slaughter weight results confirmed the importance of hatched egg size (Wyatt et al. 1985). Williams (1994) explained this situation by the fact that heavier eggs contain more nutrients than smaller eggs and therefore embryos developing from heavier eggs tend to contain more nutrients for their growth requirements. In a study conducted (Patbandha et al. 2017), initially heavier chicks gained significantly more weight up to day 15 compared to lighter chicks. In Ross chickens, Suk (2014) did not observe any effect of chick weight on post-hatch growth (between weeks 1 and 5) except on day 1. The presence of residual yolk sac (0.8–10.6 g, 2–2–8 g) in the abdominal region of chicks may mislead their actual weight and this may be the reason for the insignificant effect of chick weight on growth after two weeks of age. In addition, breeds of chickens used in the studies may cause differences in results between studies. The gender of chicks used in different studies may be another reason for the variability of the results (Molenaar et al. 2008). Broiler performance depends on chick weight, ration and environmental conditions such as ambient temperature and hygiene. Chick weight, which helps determine the ultimate performance of the broiler, depends on parent age, nutritional level and egg weight (Tona et al., 2004; Alabi et al., 2012; Coskun et al. 2017).

Gender

In the study, the highest male chick hatching was in the SI=>77 group (round-ended eggs), and the lowest male chick hatching was in the SI=<72 group (pointed eggs). The highest female chick hatching was in the SI=<72 group (pointed eggs), and the lowest female chick hatching was in the SI=>77 group (round-ended eggs). When all groups were considered, the average number of male chicks was 51.9 and the number of female chicks was 48.1. No significant difference was found between the groups in terms of gender (p>0.05). Yılmaz-Dikmen & Dikmen (2013) reported that the gender of the chick can be determined by morphological measurements (shape index) of the egg before incubation in white layer hens. Various studies have reported that pointed eggs are more likely to produce male chicks, while round eggs are more likely to produce female chicks (Mulder & Wollan, 1974; Yılmaz-Dikmen & Dikmen, 2013; Maltsev et al., 2018; Indarsih et al. 2021). Contrary to these studies, Górecki et al. (2020), Aşçı & Durmuş (2015), Idahor et al. (2015), Rutkowska et al. (2014) reported that there is no relationship between egg size and chick gender. Alaşahan & Akpinar (2014) stated that egg weight and egg width have a positive effect on chick gender in quails. Although chick gender can be determined before, during and after incubation (Kayadan & Uzun 2023), gender determinations made before hatching are more advantageous, but the prediction rate is relatively low (Kayadan & Uzun 2023). Early gender determination in hatching eggs has scientific and practical value in differentiating rearing technology and reducing feed and costs per production unit and increasing the economic efficiency of poultry production, determining the ration (Maltsev et al. 2018), and may be beneficial in increasing management, nutrition and protection practices in endangered poultry breeds (Salgado Pardo et al. 2022).

Chick Length

In the study, chick length was found to be the highest in the SI=<72 and SI=72-76 groups and the lowest in the SI=>76 group. However, there was no significant difference in chick length between the groups (p< 0.05). Since chick length is a fast, repeatable and harmless method for the animal, it is recommended to use chick length to determine chick quality and predict performance. Chick length is an indicator of the yolk absorption rate and may vary depending on the age of the breeders, chick weight or incubation conditions (temperature, humidity, etc.). According to research, a positive correlation has been found between chick length and chick weight for up to 7 days. A study on this subject has shown that the heart, liver and spleen weights of tall chicks are higher than those of short chicks and that the digestive system is better developed in tall chicks. Therefore, it can be said that the organs of tall chicks are better developed (Petek et al., 2008; Willemsen et al., 2008; Meijerhof, 2009; Şeremet, 2012; Sözcü & İpek, 2013; Kamanlı & Durmuş, 2014; Pesmen, 2023). King'ori (2011), who reported that hatchability and chick weight may be closely related to egg weight, suggested that it is not healthy to use chick weight as an indicator of growth performance due to the residual egg yolk that is not absorbed in the abdomen, while Patbandha et al. (2017) suggested that chick length is more important in predicting the growth performance of chickens. Chick length reflects the development of the embryo at hatching. It was also found that there is a positive correlation between chick length and performance at older ages. Again, chicks with high body length gained higher live weight until slaughter age compared to chicks with low and medium body length. When all these are considered together, it can be concluded that day-old chick length significantly affects growth performance in broilers. However, although chick length significantly affects body weight at older ages, this effect gradually decreases towards marketing age (Patbandha et al. 2017).

Fertility Rate

In the study, the fertility rate was found to be 88.98%, 91.07%, 90.77% in the SI=<72, SI=72-76, SI=>77 groups, respectively. No statistically significant difference was found between the groups (p>0.05). These results are compatible with the results of the studies conducted by Elibol, (2009), Sarı et al. (2010), Aşçı & Durmuş (2015). The infundibulum section of the oviduct is the section where fertilization occurs, and the magnum is the section where the egg shape is formed (Elibol, 2009). Due to this situation, Aşcı & Durmuş (2015) reported that the shape index will not affect fertility. Fertility and hatchability may be affected by age and egg size (Kruenti et al. 2022). Iqbal et al. (2016) reported that in order to obtain high fertility and hatchability in broiler breeder flocks (45 weeks of age), medium weight eggs (60-69 g) should be selected for hatching. Kirk et al. (1980) observed that hatchability in eggs obtained from 60-week-old breeders decreased by 9% in eggs weighing more than 70 g. This effect was partly explained by the relationship between breeder age and egg weight (Iqbal et al. 2016). Wilson (1991) suggested that the heritability of hatchability is low, that it may take a long time to improve this trait by selection, and therefore, improving hatching egg weight and hatchery management may be the most appropriate way to improve hatchability. (Abiola et al., 2008) reported that medium-sized eggs should be selected to obtain better hatching results, Taşkın et al. (2015) reported that an increase in fertility and hatchability was observed in Japanese quails with egg weights over 11 g, and Kruenti et al. (2022) reported that fertility was significantly affected by egg size.

Hatchability

In the study, hatchability was found to be 81.50%, 87.70%, 85.40% in the SI=<72, SI=72-76, SI=>77 groups, respectively. These values are not statistically significant (p<0.05). However, the highest hatchability rate was obtained from the SI=72-76 group. King'ori (2011) reported that hatchability may be closely related to egg weight, while Kruenti et al. (2022) reported that it may be affected by egg size. Khurshid et al. (2004) reported in their study on quail eggs that the increase in shape index negatively affected hatchability performance. Average values of internal and external egg quality characteristics have a more positive effect on hatchability than extreme values (Durmuş, 2014).

Hatching Power

In the study, the highest hatching power was seen in the SI=72-76 and SI=>77 groups. Aşçı & Durmuş (2015) reported that it is important for the shape index to be between 72-76% for optimum hatching power in hatching eggs. Maltsev et al. (2018) reported in their study that chick hatchability increased with the increase in the egg shape index value. The low hatching power in deformed eggs is probably due to the embryo changing its axial direction. However, it is estimated that the rotation of the embryo in the egg may be difficult in eggs with narrow and very distinct oval structures (Durmuş, 2014).

Embryonic Deaths

In the study, the lowest embryonic death (early, middle, late period) occurred in the SI=72-76 group, and the highest in the SI=<72 group. In a study conducted on the Cobb breed, small eggs were associated with higher embryonic death rates, which resulted in lower hatchability (Tona et al. 2001). Mcloughlin & Gous (1999) attributed this to insufficient nutrients and pores in small eggs, which could affect embryo development and the hatching process. Durmuş (2014) reported that this was due to the embryo changing its axial direction in deformed eggs (Durmuş, 2014).

CONCLUSION

In the study, when hatchability, embryonic deaths, fertility rate, hatchability were taken into consideration, the best results were obtained from the group where the shape index was between 72-76%. Therefore, it is important for the shape index to be between 72-76% in hatching and breeding eggs. With the rapid increase in demand for methods of determining the sex of embryos during the incubation period and research in this direction, more definite results will be obtained in studies on this subject.

Conflict of Interest: The Authors declares that there are no conflicts of interest.

Author Contributions: The author has made a contribution to the entire study.

Ethical approval: The study does not require ethics committee approval.

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