



## RESEARCH ARTICLE

### Effects of egg laying week on some egg quality characteristics of Rock partridges (*A. graeca*)

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### Kaya keklüklerinde (*A. graeca*) yumurtlama yaşının bazı yumurta kalite özelliklerine etkisi

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#### Öz

**Amaç:** Bu çalışmada, yumurtlama yaşının kaya keklüğü yumurtasının bazı yumurta kalite özelliklerine olan etkilerinin belirlenmesi amaçlanmıştır.

**Gereç ve Yöntem:** Araştırma materyalini olarak 32 haftalık yaştaki toplam 144 Kaya keklüğü oluşturmuştur. 34-41 haftalık yaşlardan elde edilen 160 adet keklük yumurtasının kalite özellikleri araştırıldı

**Bulgular:** Yumurtlama yaşının yumurta ağırlığı, şekil indeksi, yumurta sarısı indeksi, albümin indeksi, yumurta kabuk ağırlığı, kabuk kalınlığı, Haugh birimi, membran ağırlığı ve albüm ağırlığı üzerine etkisinin istatistiksel olarak önemli olduğu saptanmıştır ( $P < 0.05$ ). Yumurtlama yaşının yumurta sarısı ağırlığı üzerindeki etkisi önemli bulunmamıştır ( $P > 0.05$ ). Yumurtlama yaşının artışı ile yumurta ağırlığı, şekil indeksi ve yumurta sarısı indeksi yumurtlama haftalarına göre artış göstermiş ( $P < 0.05$ ); albumen indeksi, kabuk membran ağırlığı ve kabuk membran kalınlığı azalmıştır ( $P < 0.05$ ). Yumurta yumurtlanma haftası ile albüm indeksi, kabuk membran ağırlığı, kabuk membran kalınlığı azalmıştır ( $P < 0.05$ ).

**Öneri:** Kaya keklüğü yumurtalarının bazı iç ve dış kalite özellikleri belirlenmiş ve bu özelliklerin yumurtlama yaşına göre farklılıkları araştırılmıştır. Keklik yumurtalarının kalite özelliklerini etkileyen diğer faktörler üzerinde daha fazla araştırma yapılarak ortaya konulması tavsiye edilmiştir.

**Anahtar kelimeler:** Keklik, yumurtlama yaşı, yumurta kalite özellikleri

#### Abstract

**Aim:** In this study, it was aimed to determine the effects of egg-laying week on some egg quality characteristics of rock partridges.

**Materials and Methods:** Quality characteristics of 160 partridge eggs obtained from 34-41 week ages were investigated. 144 rock partridges in 32 week of ages were used as research material

**Results:** It was determined that the effects of egg-laying week on egg weight, shape index, yolk index, albumen index, egg shell weight, shell thickness, Haugh Unite, membrane weight and albumen weight were found statistically important ( $P < 0.05$ ). The effects of egg-laying week on yolk weight was found not important ( $P > 0.05$ ). Egg weight, shape index and yolk index of partridge eggs has been increased according to egg-laying week ( $P < 0.05$ ). While albumen index, shell membrane weight, shell membrane thickness has been decreased with the egg-laying week ( $P < 0.05$ ).

**Conclusion:** Some internal and external quality characteristics of partridge eggs were determined and also the differences in these characteristics according to egg-laying week were investigated. it can be recommended further investigations should be carried out on the other factors effecting the quality characteristics of partridge eggs.

**Keywords:** Partridge, egg-laying week, egg quality characteristics



## Introduction

Partridge breeding is available in some countries such as Italy, Spain and the U.S.A. specializing in hunting tourism such as the hunting sector is widely material as the material. For example, it is reported that there are 669 partridge farms in Spain (Redondo, 2010). The fact that the meat is very tasty also increases the demand for this animal and ensures the partridge breeding is widespread. In Turkey, partridge breeding is rather done for hunting or consuming as food. Ministry of Agriculture and Forestry produced these animals in farms depending on the enrichment for deliberately wildlife.

Partridge eggs are used mainly for reproduction, and the hatch results depend on their biological value. Incubation results are significantly affected by egg weight, shape index, shell thickness, porosity, egg yolk ratio, albumen ratio and shell ratio. Partridge eggs weight were ranged between 19.16 – 22.50 g according to some researcher (Woodard et al., 1982; Kırıkçı et al., 1999; Song et al., 2000). Yannakopoulos (1992) has reported egg weight as 20.84 g and expressed that partridge egg weight did not increase with age. Song et al. (2000) stated that the shape index of partridge eggs is 78.00 and the egg shell thickness is 0.232 mm. There are few literatures on egg quality characteristics. Kırıkçı et al. (2007) investigated the effect of live weight on egg production and egg quality characteristics in partridge eggs. These researchers reported that live weights of rock partridges had statistically significant effect on egg weight, specific gravity, albumen index, crustal weight, crustal thickness Haugh unit and albumen weight ( $P < 0.05$ ). Live weights were found not effective on shape index, membrane weight and yolk weight.

Egg shell weight of egg-laying weeks eggs did not affect different storage times (Günhan and Kırıkçı, 2017). Similarly, to this results Çağlayan et al (2009) noted that there was no difference between shell weights of partridge eggs stored for one to 14 days. In addition, Tilki and Saatci (2004) reported that egg storage was adversely affected by egg yolk weight ( $P < 0.05$ ). Egg shell thickness and egg yolk weight were measured with 14 days of storage (Çağlayan et al., 2009) or 35 without storage periods (Tilki and Saatçi, 2004). Günhan and Kırıkçı (2017) reported that the effect on the shell weight rate was significant ( $P < 0.05$ ).

The effects of hen weight (Kırıkçı et al., 2007) and storage period (Tilki and Saatçi, 2004; Çağlayan et al., 2009, Günhan and Kırıkçı, 2017) on the egg quality in partridges were investigated but egg quality characteristics were not determined according to the egg-laying week. In this study, the effect of the egg-laying week on some egg quality characteristics of partridge was investigated.

## Materials and Methods

### *Animals and husbandry*

Rock partridges used as research material were obtained from Research Farm of Veterinary Faculty of Selçuk University. In the study, eggs obtained from 144 female partridges aged 34-42 weeks were also used.

The partridges were placed randomly to cages having 4 floors with 4 division at each floor at numbers of 2 female partridges in each division. The group of each cage was numbered and 12 hours lighting was applied to the partridges daily. Lighting was increased 1 hour per week and was kept steady when reached to 16 hours daily. Among the laying period a ration composing 24 % crude protein was given to the partridge's ad libitum. Water was provided from the automatic water cups. The eggs obtained from the partridges were gathered daily and recorded. Egg gathering was continued for 8 weeks. In order to determine the egg quality characteristics of the partridges, 20 eggs of each week were investigated.

### *Egg quality analysis*

The partridges eggs were measured with short and long diameters with a digital caliper measuring 0.001 mm to determine the shape index. After the measurement, the eggs were individually broken on a flat sheet after a waiting time of 5 minutes. Albumen and egg yolk diameters were measured with long and short diameters, and egg yolk and albumen height were determined using a caliper. The albumen was weighed and the weights obtained were recorded. The crusts of the broken eggs were cleaned under slightly running tap water to separate from albumen residues and then air-dried. They were weighed again to determine their final weights. The egg shells were measured with equator point and the blunt ends were scarred and scarce. The measured values obtained were according to Yannakopoulos and Tserweni-Gousi, 1986; Poyraz, 1989 and Nesheim et al. 1979.

Shape index = (breadth/length) × 100;

Yolk index = (yolk height/yolk diameter) × 100;

Albumen index = [albumen height/(long diameter of albumen + short diameter of albumen/2)] × 100;

Shell thickness = (pointed end + equator + blunt end)/3

Haugh unit:  $100 \times \log(\text{albumen height} + 7.57 - 1.7 \times \text{egg weight}^{0.37})$  (Nesheim et al., 1979).

### *Statistical analysis*

Analysis of variance was used to determine differences between egg quality characteristics. Duncan's multiple range test were used to determine the differences between subgroups after analysis of variance (Petrie and Watson, 1997). Statistical analysis was performed using the IBM SPSS 22.0 package program.



Table 1. Egg weight and shape index of partridge eggs according to egg-laying week (mean  $\pm$  SE)

Week of laying	Egg weight	Shape index
1	21.43 $\pm$ 0.41 <sup>c</sup>	73.97 $\pm$ 0.74 <sup>d</sup>
2	21.89 $\pm$ 0.40 <sup>bc</sup>	74.04 $\pm$ 0.70 <sup>d</sup>
3	22.25 $\pm$ 0.38 <sup>abc</sup>	74.54 $\pm$ 0.64 <sup>d</sup>
4	22.32 $\pm$ 0.47 <sup>abc</sup>	74.66 $\pm$ 0.67 <sup>d</sup>
5	22.45 $\pm$ 0.43 <sup>abc</sup>	77.24 $\pm$ 1.00 <sup>c</sup>
6	22.86 $\pm$ 0.31 <sup>ab</sup>	79.37 $\pm$ 0.86 <sup>b</sup>
7	22.70 $\pm$ 0.37 <sup>ab</sup>	80.42 $\pm$ 0.60 <sup>db</sup>
8	23.36 $\pm$ 0.30 <sup>a</sup>	81.53 $\pm$ 0.57 <sup>a</sup>

a, b, c, d: Mean values of traits in the same column with different letters differ significantly ( $P < 0.05$ ).

## Results

Egg weight and shape index of partridge eggs according to egg-laying week were presented in Table 1.

It was determined that partridge egg weight and shape index have been increased according to egg-laying week ( $P < 0.05$ ). Statistically significant differences were detected only between 1, 2 week and 8 week of laying.

Table 2 shows internal egg quality characteristics of partridge egg according to egg-laying week.

When Table 2 is examined, it will be seen that yolk index, shell thickness and membrane thickness are decreased ( $P < 0.05$ ). The decline in the yolk index is very obvious. On the other hand, there is an increase in the index of albumin ( $P < 0.05$ ), but there is no visible increase or decrease in Haugh unit value according to egg-laying week.

Shell weight, shell membrane weight, yolk weight and albumen weight of partridge eggs according to egg-laying week were given in Table 3.

In the partridge egg, shell weight and shell membrane weight are declining according to egg-laying week ( $P < 0.05$ ), but the albumen weight increased ( $P < 0.05$ ). In the yolk weight, no significant differences was found.

## Discussion

In this study, it was determined that partridge egg weight has been increased according to egg-laying week ( $P < 0.05$ ). Nearly 2 g increasing was determined in partridge egg weights during the 8 weeks of the research period. Çağlayan et al. (2009) and Günhan and Kırıkçı (2017) have been reported that partridge egg weights were not increased during the long storage period. Egg weight correlated significantly with membrane weight ( $P < 0.05$ ), shell weight, Haugh Unit, yolk weight, and albumen weight ( $P < 0.001$ ) (Günlü et al. 2003).

Shape index of the partridge egg was determined as 73.97 for the first week and detected as 81.53 at the end of the research period. Increasing of the shape index could be arisen from increasing of the egg weight. Shape index value for the partridge egg has been reported as 78.00 by Song (2000), reported for partridge has in different body weight as 77.00 by Kırıkçı et al. (2007) and also reported for partridge eggs have in different storage period as 76.00 by Günhan and Kırıkçı (2017). The effect of the body weight and storage period on shape index was not important but the egg-laying week was important ( $P < 0.05$ ).

As it could be seen in Table 2, the egg-laying week of partridge has an important factor on the yolk index. While, yolk index of the eggs obtained in the first week was 51.17, the last week this value decreased to the 41.73 ( $P < 0.05$ ). It could be seen from according the Table 3 yolk weight of the partridge eggs has been decreased by the egg-laying week. It decreasing yolk weight of the partridge eggs could be thought as a reason for decreasing in yolk index. Çağlayan et al. (2009) and Günhan and Kırıkçı (2017) reported that dramatic changes occurred in the yolk index of partridge eggs when the storage period was increased. Yolk index value determined in this study was similar to the re-

Table 2. Internal egg quality characteristics of partridge eggs according to egg-laying week (mean  $\pm$  SE)

Week of laying	Yolk index	Albumen index	Shell thickness (mm)	Membrane thickness (mm)	Haugh Unit
1	51.17 $\pm$ 1.15 <sup>a</sup>	1.39 $\pm$ 0.08 <sup>c</sup>	0.25 $\pm$ 0.00 <sup>a</sup>	0.004 $\pm$ 0.00 <sup>a</sup>	85.25 $\pm$ 0.74 <sup>a</sup>
2	50.53 $\pm$ 0.65 <sup>ab</sup>	1.43 $\pm$ 0.05 <sup>c</sup>	0.22 $\pm$ 0.00 <sup>b</sup>	0.004 $\pm$ 0.00 <sup>a</sup>	85.77 $\pm$ 0.87 <sup>a</sup>
3	50.41 $\pm$ 0.47 <sup>ab</sup>	1.50 $\pm$ 0.05 <sup>bc</sup>	0.22 $\pm$ 0.00 <sup>bc</sup>	0.004 $\pm$ 0.00 <sup>a</sup>	84.77 $\pm$ 0.86 <sup>a</sup>
4	48.04 $\pm$ 0.86 <sup>bc</sup>	1.50 $\pm$ 0.06 <sup>bc</sup>	0.21 $\pm$ 0.00 <sup>bc</sup>	0.003 $\pm$ 0.00 <sup>b</sup>	83.88 $\pm$ 0.94 <sup>ab</sup>
5	45.73 $\pm$ 0.79 <sup>c</sup>	1.58 $\pm$ 0.07 <sup>bc</sup>	0.20 $\pm$ 0.00 <sup>bc</sup>	0.003 $\pm$ 0.00 <sup>b</sup>	86.01 $\pm$ 1.18 <sup>a</sup>
6	45.79 $\pm$ 0.97 <sup>c</sup>	1.61 $\pm$ 0.06 <sup>bc</sup>	0.20 $\pm$ 0.00 <sup>c</sup>	0.003 $\pm$ 0.00 <sup>b</sup>	81.31 $\pm$ 1.38 <sup>b</sup>
7	45.56 $\pm$ 0.56 <sup>c</sup>	1.65 $\pm$ 0.05 <sup>a</sup>	0.20 $\pm$ 0.00 <sup>c</sup>	0.003 $\pm$ 0.00 <sup>b</sup>	86.60 $\pm$ 0.71 <sup>a</sup>
8	41.73 $\pm$ 1.33 <sup>d</sup>	1.66 $\pm$ 0.08 <sup>a</sup>	0.20 $\pm$ 0.00 <sup>c</sup>	0.003 $\pm$ 0.00 <sup>b</sup>	85.43 $\pm$ 1.13 <sup>a</sup>

a, b, c: Mean values of traits in the same column with different letters differ significantly ( $P < 0.05$ ).



Table 3. Shell weight, shell membrane weight, yolk weight and albumen weight of partridge eggs according to egg-laying week (mean  $\pm$ SE)

Week of laying	Shell weight (g)	Shell membrane weight (g)	Yolk weight (g)	Albumen weight (g)
1	2.46 $\pm$ 0.06 <sup>a</sup>	0.50 $\pm$ 0.02 <sup>a</sup>	8.50 $\pm$ 0.29	10.92 $\pm$ 0.32 <sup>b</sup>
2	2.43 $\pm$ 0.06 <sup>ab</sup>	0.50 $\pm$ 0.03 <sup>a</sup>	8.77 $\pm$ 0.20	11.21 $\pm$ 0.32 <sup>b</sup>
3	2.43 $\pm$ 0.06 <sup>ab</sup>	0.50 $\pm$ 0.02 <sup>a</sup>	8.34 $\pm$ 0.16	11.49 $\pm$ 0.24 <sup>ab</sup>
4	2.34 $\pm$ 0.07 <sup>abc</sup>	0.48 $\pm$ 0.02 <sup>ab</sup>	8.18 $\pm$ 0.21	11.81 $\pm$ 0.42 <sup>ab</sup>
5	2.28 $\pm$ 0.04 <sup>abcd</sup>	0.46 $\pm$ 0.03 <sup>ab</sup>	8.24 $\pm$ 0.19	11.85 $\pm$ 0.28 <sup>ab</sup>
6	2.25 $\pm$ 0.06 <sup>bcd</sup>	0.45 $\pm$ 0.03 <sup>ab</sup>	8.10 $\pm$ 0.25	12.18 $\pm$ 0.25 <sup>a</sup>
7	2.20 $\pm$ 0.07 <sup>cd</sup>	0.43 $\pm$ 0.03 <sup>ab</sup>	8.55 $\pm$ 0.18	12.26 $\pm$ 0.33 <sup>a</sup>
8	2.12 $\pm$ 0.08 <sup>d</sup>	0.42 $\pm$ 0.01 <sup>b</sup>	8.26 $\pm$ 0.19	12.38 $\pm$ 0.28 <sup>a</sup>

a, b, c, d: Mean values of traits in the same column with different letters differ significantly ( $P < 0.05$ ).

ported value by Kırıkçı et al. (2007) for the control, heavy, middle and light group as 47.97, 48.38, 46.12 and 47.02, respectively.

On contrary to the yolk index value, there was an increase in the albumen index together with the egg of the partridge. Albumen index value was determined as 1.39 for the first week. This value was determined as 1.66 for the last week. Increased albumen weight could be thought as a reason for the increasing in albumen index. Because average albumen weight of the eggs obtained in the first week of the research was 10.92 and this value was 12.38 for the last week. Kırıkçı et al. (2007) has been reported the albumen index value for the partridge eggs having different body weight (control, heavy, middle and light group) as 1.43, 1.51, 1.58 and 1.63 respectively.

Shell thickness and shell membrane thickness of partridge eggs were affected from the egg-laying week negatively ( $P < 0.05$ ). Shell thickness value, obtained the first-week egg was measured as 0.25 mm and in the last week, this value was measured as 0.20 mm. This result could be related to the decreasing calcium storage of the body. Shell thickness value was reported as average 0.22 mm by Kırıkçı et al. (2007). This result is similar the determined value in this study. Günhan and Kırıkçı (2017) determined shell thickness to be 0.28 mm together with shell membrane.

Except for 6<sup>th</sup>-week eggs, Haugh unit values among the egg-laying weeks are similar. Kırıkçı et al. (2007) have reported that the highest Haugh Unites value for partridge eggs have taken from the partridges of heavy body weight. As reported by Tilki and Saatçi (2004), Çağlayan et al. (2009) and Günhan and Kırıkçı (2017) there is a decrease in the Haugh Unit values as the storage period is increased.

Shell weight of the partridge eggs was decreased by the egg-laying week. The values shell weight of the partridge eggs obtained in the first week and last week were 2.46 g and 2.12 g ( $P < 0.05$ ). Similar to this, Kırıkçı et al. (2007) has been reported that different body weight partridge eggs shell weights were fo-

und between 2.23 g and 2.45 g. Günhan and Kırıkçı (2017) determined shell weight to be 2.40 g together with shell membrane. Garip et al. (2010) have reported that the proportion of shell weight with the membrane, yolk weight and albumen weight to the egg weight were calculated as 10.75, 33.05, and 56.20%, respectively.

Similar decreasing to the egg shell weight, membrane weight of the partridge eggs was also decreased by the egg-laying week. Nearly 0.90 g decreasing is determined in the 8 weeks of research period in the study ( $p < 0.05$ ).

Yolk weight average was reported by Kırıkçı et al. (2007) as 8.19-8.57 g and researchers indicated that body weights of partridge had no effect on egg yolk weight. In this study, egg-laying week was not effective on yolk weight. Çağlayan et al. (2009) reported that the weight of egg yolk stored for 14 days is not adversely affected by the storage period, as it was mentioned here; Tilki and Saatçi (2004) show that egg yolk weight is not changed in stored eggs for 35 days. In addition, Kırıkçı et al. (2007) found that there was no change in egg yolk weight, which corresponds to the increase in the age of partridge. In contrast, albumen weight increased according to egg-laying week ( $P < 0.05$ ). Initially, average albumen weight was determined as 10.92 g, and it was detected as 12.38 g in last egg-laying week.

Similarly, Kırıkçı et al. (2007) reported that maximum albumen weight was detected in eggs from higher body weight and minimum albumen weight was detected in eggs from lower body weight partridges. Increasing in egg weight according to age was probably arisen from increasing in albumen weight. Çağlayan et al. (2009), a significant change occurred between 10.83-12.51 g in the eggs stored between 1-14 d of the albumen weight; Reported a reduction in albumen weight after 14 days. Tilki and Saatçi (2004) reported that there was a corresponding decrease in the storage time for eggs stored for up to 35 days in albumen weights in eggs between 10.16 g and 8.76 g in partridge eggs.





## Conclusion

In this study, some internal and external quality characteristics of partridge eggs were determined and also the differences in these characteristics according to egg-laying week were investigated. As a result, it can be recommended further investigations should be carried out on the other factors effecting the quality characteristics of partridge eggs.

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