Effect of egg weight on chick weight, egg weight loss and hatchability in rock partridges (A. graeca)

Tamer Çağlayan, Mustafa Garip, Kemal Kırıkçı, Aytekin Günlü

Zootekni Anabilim Dalı. Selçuk Üniversitesi, Konya, Turkey

Corresponding author: Dr. Tamer Çağlayan. Zootekni Anabilim Dalı. Veteriner Fakültesi, Selçuk Üniversitesi. Alaaddin Keykubat Kampüsü, 42031 Konya, Turkey - Tel. + 90 332 2232701 - Fax: + 90 332 2410063 - Email: caglayan@selcuk.edu.tr

Received November 13, 2008; accepted March 14, 2009

ABSTRACT

This study was conducted to determine the effect of egg weight on chick weight, egg weight loss and hatchability in partridges. Eggs (847) obtained from rock partridges (44-46 weeks ages) were classified according to their weights as <18 g, 18.00-18.99 g, 19.00-19.99 g, 20.00-20.99 g, 21.00-21.99 g, 22.00-22.99 g and ≥23 g and incubated. A positive, powerful and important correlation (0.46 and 0.82 values) between egg weight and egg weight loss and chick weight in different groups was determined (P<0.001) in the study. The differences between hatchability and fertility in the egg groups were significant (P<0.05), but no differences were detected between hatchability of fertile eggs and embryonic mortalities.

In conclusion, smaller and bigger eggs of partridges had low fertility while hatchability was disproportionately reduced in eggs that had lost less mass during incubation.

Key words: Egg weight, Chick weight, Egg weight loss, Hatchability, Partridge.

RIASSUNTO

INFLUENZA DEL PESO DELLE UOVA SUL PESO DEL PULCINO, SULLA PERDITA DI PESO E SULLA SCHIUDIBILITÀ DELLE UOVA DI PERNICI (A. GRAECA)

Questo studio è stato condotto al fine di determinare gli effetti del peso delle uova sul peso del pulcino, nelle pernici, e su perdita di peso e schiudibilità delle uova stesse. Le uova ottenute (847) da pernici di 44 - 46 settimane di età sono state classificate in base al peso: <18 g, 18,00-18,99 g, 19,00-19,99 g, 20,00-20,99 g, 21,00-21,99 g, 22,00-22,99 g e ≥23 g, e incubate. Nei differenti gruppi è stata rilevata una forte e positiva correlazione (con valori di 0,46 e 0,82) sia tra il peso delle uova e la perdita di peso delle uova durante l’incubazione sia tra il peso delle uova e il peso alla nascita del pulcino(P<0,001). Sono emerse differenze significative tra i gruppi per quanto concerne la schiudibilità e la fertilità (P<0,05); mentre non sono state riscontrate differenze significative per quanto riguarda la schiudibilità delle uova fertili e la mortalità embrionale.

In conclusione, le uova più piccole e quelle più grandi hanno fatto registrare la più bassa fertilità, mentre la schiudibilità è calata in modo non proporzionale nelle uova dove la perdita di peso durante l’incubazione è stata minore.

Parole chiave: Peso delle uova, Peso del pulcino, Perdita di peso delle uova, Schiudibilità, Pernici.
Introduction

Partridges are mostly raised to be hunted and as a game bird. In recent years the number of partridges raised has increased continuously both in Turkey and around the world. Because partridge chicks are very valuable, it is desirable that all eggs be incubated. As in the breeding of all poultry species, the incubation process is one of the most important steps in economic partridge breeding. It is necessary to know all factors affecting the incubation success of partridges. One of the factors affecting the incubation results is weight of incubated eggs. In chickens (Witt and Schwalbach, 2004; Yıldırım, 2005), quail (Petek et al., 2005; Çağlayan and İnal, 2006), turkeys (Çopur, 2004) and ostriches (Gonzalez et al., 1999; Hassan et al., 2005) the effect of egg weights on hatching results were well studied. However, the studies made on partridges regarding this subject are quite limited.

It is known that the egg weight of partridges is between 19-23 g (Woodard et al., 1982; Yannakopoulos, 1992; Çetin et al., 1997; Kırıkçı et al., 2004; Kırıkçı et al., 2007). Yannakopoulos (1992) also stated that the egg weight of partridges did not change with age. On the contrary, Kırıkçı et al. (2007) determined that the weight of the female partridge is directly correlated to their egg weights (P<0.05) and heavier eggs were obtained from heavier females. Researchers reported the chick weight of partridges is between 13.40 -14.22 g (Çetin et al., 1997; Kırıkçı et al., 1999; Alkan et al., 2007). Kırıkçı et al. (2004) reported that partridge eggs, which are smaller / larger than the average, have very low fertility ratios. Thus the hatching of light eggs and heavy eggs would greatly contribute to a decrease in the hatching performance.

In this research the effect of the partridges’ incubating egg weight on chick weight, egg weight loss and hatching results were investigated.

Material and methods

Animals and husbandry

A totally of 847 eggs were obtained from 120 rock partridges 44-46 week-old raised in the Research and Application farm of the Faculty of Veterinary Medicine in Selçuk University where partridges have been reared since 1993 and no selection criteria was applied to this population. Partridges were mated in a 4 floored cage with 4 drawers in each floor and 1 male and 2 females in each drawer. During mating a ration including 24% CP and 2850 MJ/kg metabolisable energy was given ad libitum to partridges and water was provided from automatic drinkers.

Eggs were stored for 14 days in 75% humidity and at 14°C. After storage, the partridge eggs were divided into 7 treatment groups with egg weight <18 g, 18.00-18.99 g, 19.00-19.99 g, 20.00-20.99 g, 21.00-21.99 g, 22.00-22.99 g and ≥23 g. The egg groups are presented in Table 1.

Before incubation eggs were individually weighed (to 0.01 g) to determine initial egg weight and numbered and fumigated with formaldehyde before being set into an incubator set at 37.7°C with 60% relative humidity. Eggs were re-weighed at 21 days of incubation to determine % weight loss. Then, each egg was put in a linen bag before being transferred into hatcher baskets to allow for pedigree hatching in a hatcher set at 37.5°C and 70% relative humidity. After the 72-hour incubation process hatched chicks were removed from the bags and weighed. Unhatched eggs were opened to determine infertility and the number of dead embryos.

Statistical methods

In the analysis of values concerning egg weight, egg weight loss and chick weight
Egg weight and hatchability in partridge

Results and discussion

Weight loss during incubation among egg weight groups, chick weight and egg weight and correlations between examined characteristics are presented in Table 2.

In eggs of different weight groups, the differences between egg weight loss ratios and chick weights were significant (P<0.001). In general, as the egg weight increases, egg weight loss ratios and chick weights increase (P<0.001). Although the egg weights from different groups varied between 17.24-24.00 g, the average egg weight (20.62 g) was similar to the reported value for the partridge by Woodard et al. (1982), Yannakopoulos (1992), Tilki and Saatçı (2004), Kırıkçı et al. (2006).

Egg weight loss determined during incubation in different egg weight groups varied
between 9.84 and 26.53%. Average egg weight loss (15.48%) in the study is higher than the value of 12.94% reported by Soliman et al. (1994) for quail eggs. It also is lower than the values of 24.76% reported by Saylam (1999) and 20.90% reported by Saylam and Sarica (1999) in quail eggs, and higher than the values of 11.24% reported by Reis et al. (1997) in chicken eggs and 12.61% and 13.16% reported by Fasenko et al. (2001) in chicken eggs stored 4 days and 14 days and 9.94% reported by Nakage et al. (2003) in eggs of a different type of partridge (Rhynchotus rufescens). The differences in weight losses among different studies during incubation can be due to the difference in species. Mayes and Takeballi (1984) determined that 10-12% weight loss is necessary during incubation in order to get a good incubation result in stored and non-stored eggs.

Although chick weights determined in the groups in this study varied between 11.47-15.94 g, chick weight average was 13.81 g. This value shows similarity with 14.22 g that Kırıkçı et al. (1999) reported in rock partridges and 13.74 g and 13.40 g chick weights that Çetin et al. (1997) and Alkan et al. (2007) reported in chukar partridges (Alectoris chukar).

The relationships between egg weight and chick weight are presented in Figure 1, and between egg weight and egg weight loss ratios are presented in Figure 2.

The regression equation between chick weight and egg weight was determined as $Y=-0.779+0.714X$, $R^2=66.6\%$ and was significant ($P<0.001$). The regression equation between egg weight loss ratios and egg weight was determined as $Y=-41.0+2.73X$, $R^2=21.0\%$ and was significant ($P<0.001$).

In this study, a positive, powerful and important correlation (0.46 and 0.82 values) between egg weight and egg weight loss and chick weight in different groups was determined ($P<0.001$). However, there was no correlation between egg weight and chick/egg weight ratio ($P>0.05$). Abiola et al. (2008) similarly determined that there was a positive correlation between egg weight and chick weight in chickens. Çağlayan and İnal

Figure 1. The relationship between egg weight and chick weight.
Ital. J. Anim. Sci. vol. 8, 567-574, 2009

Egg weight and hatchability in partridge

(2006) also determined that in quails chick weight increased depending on the increase in egg weight as well. The correlation coefficient of 0.993 that Küçükyılmaz et al. (2001) reported between egg weight and hatching weight in quails is similar to the findings of this study. Wilson (1991) determined that egg weight loss affects chick weight, chick weight composes 62-78% of egg weight and the correlation between egg weight and chick weight decreases as the parents’ age increases. The regression equation obtained from the study (Y=-0.779+0.714X, R2=66.6%) between chick weight and egg weight was quite important (P<0.001). This result is similar to the findings of Tserveni-Gousi and Yannakopoulos (1990) that every 1 g increase in pheasant eggs will result in a 0.7262 g increase in chick weight.

Hatchability results for egg weight groups are presented in Table 3.

According to Table 3, while an important difference was determined between hatching performance and fertility of eggs in different weight groups (P<0.05), there was no significant (P>0.05) difference between hatchability of fertile eggs and embryonic mortality of the groups. It was determined that hatching performance and fertility in 21.00-21.99 and 22.00-22.99 g groups were better than the other groups and the highest hatchability and the lowest embryonic mortality were also in 22.00-22.99 g group. The lowest hatchability results were determined <18 g group.

While the fertility varied between 53.85-89.89% among groups, the average fertility ratio was 81.11%. The highest fertility ratios were determined in egg groups of 21.00-21.99 and 22.00-22.99 g. While this value is similar to the 81.53% and 82.67% values (Kırıkçı et al., 2006) in rock partridges as mated young male-old female and old male-old female groups, it is lower than the 91.73% and 92.22% values in young male-young female and old male-young female

Figure 2. The relationship between egg weight and egg weight loss ratio.
groups (Kırıkçı et al. 2006) and the 89.06% that was reported by Çetin et al. (1997) in chukar partridges.

The differences between hatchability of the groups were significant (P<0.05). The highest hatchability was observed in eggs between 21.00-21.99 and 22.00-22.99 g. On the contrary, hatchability values of eggs that were much higher (≥23 g) and much lighter (<18 g) than normal are quite low compared to other groups (P<0.05). Average hatchability determined is higher than the results of Woodard and Morzenti (1975) and Woodard et al. (1982) for rock partridges but lower than the results of Woodard et al. (1981) and Yannakopoulos (1992). However, it is higher than the 60.2, 62.8, 62.1 and 56.3% values of Woodard and Morzenti (1975) from partridge eggs stored for 1, 2, 3 and 4 weeks.

Hatchability of fertile eggs varied between 71.43-88.75% in the groups in this research. Average value (85.44%) determined is higher than the 76.70-78.78% values of Kırıkçı et al. (2006) for rock partridges but lower than the 91.11% and 93.75% of values Çetin et al. (1997) on chukar partridges raised in flocks and cages.

While embryonic mortality from the groups varied between 11.25-28.57%, average embryonic mortality was determined as 14.56%. This value is lower than the 21.07% and 21.23% of values Kırıkçı et al. (2006) reported in rock partridges as mated young male-young female and old male-young female groups.

**Conclusions**

In conclusion, in partridge breeding the selection of eggs weighing between 21.00-22.99 g in hatching would be more suitable. In very light (<18 g) and very heavy (≥23 g) eggs, hatching performance, fertility and hatchability of fertile eggs decrease and the embryonic mortality ratio increases. It was concluded that these eggs are not the suitable eggs for incubation in partridge breeding. In the meantime, the number of studies of this type on partridges is limited and more advanced studies would be useful in terms of their widespread use in the breeding of partridges as a game bird.

---

**Table 3. Hatchability results of the egg weight groups (%).**

| Groups | Chicks hatched (n) | Hatchability | Fertility | Hatchability of fertile eggs | Embryonic mortality |
|--------|-------------------|--------------|-----------|------------------------------|---------------------|
| <18    | 10                | 38.46c       | 53.85d    | 71.43                        | 28.57               |
| 18.00-18.99 | 49         | 62.03b       | 72.15cd   | 85.96                        | 14.04               |
| 19.00-19.99 | 114        | 67.06b       | 80.59bc   | 83.21                        | 16.79               |
| 20.00-20.99 | 152        | 67.86b       | 80.36bc   | 84.44                        | 15.56               |
| 21.00-21.99 | 172        | 76.44a       | 86.67ab   | 88.21                        | 11.79               |
| 22.00-22.99 | 71         | 79.78a       | 89.89a    | 88.75                        | 11.25               |
| ≥23    | 19                | 55.88bc      | 70.59cd   | 79.17                        | 20.83               |
| Average| 587               | 69.30        | 81.11     | 85.44                        | 14.56               |

* * * *

a, b, c, d: the differences between the values carrying different letter in the same column are significant.

*: P< 0.05  -: P> 0.05
REFERENCES

Abiola, S.S., Mesiwoye, O.O., Oyerinde, B.O., Bamgbose, M.A., 2008. Effect of egg size on hatchability of broiler chicks. Arch. Zootec. 57:83-86.

Alkan, S., Karabağ, K., Balçoğlu, M.S., Galiç, A., 2007. Determination of some egg traits and body weights in chukar partridge (Alectoris chukar). Akd. Üniv. Ziraat Fak. Magazine 20:225-228.

Çağlayan, T., Inal, Ş., 2006. Effect of egg weight on hatchability, growth and survival rate in Japanese quail. Vet. Bil. Derg. 22 (1-2):11-19.

Çetin, O., Kırıkçı, K., Gülşen, N., 1997. Some productivity characteristics of Chukar partridges (A. chukar) in different management conditions. Vet. Bil. Derg. 13 (2):5-10.

Çopur, G., 2004. The effects of egg weight and its lost on hatching characteristics in broiler parent stocks. J. Anim. Vet. Adv. 3:580-583.

Fasenko, G.M., Robinson, F.E., Whelan, A.I., Kremeniuik, K.M., Walker, J.A., 2001. Prestorage incubation of long-term stored broiler breeder eggs: 1. Effects on hatchability. Poultry Sci. 80:1406-1411.

Gonzalez, A., Satterlee, D.G., Moharer, F., Cadd, G.G., 1999. Factors affecting ostrich egg hatchability. Poultry Sci. 78:1257-1262.

Hassan, S.M., Siam, A.A., Mady, M.E., Cartwright, A.L., 2005. Egg storage period and weight effects on hatchability of Ostrich (Struthio camelus) eggs. Poultry Sci. 84:1908-1912.

Kırıkçı, K., Deeming, D.C., Günlü, A., 2004. Effects of egg mass and percentage mass loss during incubation on hatchability of eggs of the Rock partridge (Alectoris graeca). Brit. Poultry Sci. 45:380-384.

Kırıkçı, K., Günlü, A., Çağlayan, T., Garip, M., 2006. Effects of parental age on laying performance and hatchability of Rock partridges (A. graeca). Atatürk University J. of Veterinary and Science 1(3-4):51-54.

Kırıkçı, K., Günlü, A., Çetin, O., Garip, M., 2007. Effect of hen weight on egg production and some egg quality characteristics in the Partridge (Alectoris graeca). Poultry Sci. 86:1380-1383.

Kırıkçı, K., Tepeli, C., Çetin, O., Günlü, A., Yılmaz, A., 1999. Some production characteristics of Rock partridges (A. graeca) in different management and lighting conditions. Vet. Bil. Derg. 15 (1):15-22.

Küçükylmaz, K., Başer, E., Erensayın, C., Orhan, H., Arat, E., 2001. Effect of egg weight on the hatchability, fattening performance and egg yield traits of Japanese quail. J. Anim. Res. 11:6-12.

Mayes, F.J., Takeballi, M.A., 1984. Storage of the eggs of the fowl (Gallus domesticus) before incubation. World Poultry Sci. J. 4:131-140.

Nakage, E.S., Cardozo, J.P., Pereira, G.T., Queiroz, S.A., Boleli, I.C., 2003. Effect of temperature on incubation period, embryonic mortality, hatch rate, egg water loss and Partridge chick weight (Rhynchosotus rufescens). Rev. Bras. Ciência Avícola. 5(2):1-5.

Petek, M., Başpinar, H., Oğan, M., Balcı, F., 2005. Effects of egg weight and length of storage period on hatchability and subsequent laying performance of Quail. Turk. J. Vet. Anim. Sci. 29:537-542.

Petrie, A., Watson, P., 1999. Statistics for veterinary and animal science. Blackwell Science Ltd., Malden, USA.

Reis, L.H., Gama, L.T., Chaveiro Soares, M., 1997. Effects of short storage conditions and broiler breeder age on hatchability, hatching time, and chick weights. Poultry Sci. 76:1459-1466.

Saylam, S.K., 1999. The effects of egg weight and storage time on egg weight loss and hatchability traits in Japanese quail. Turk. J. Vet. Anim. Sci. 23:367-372.

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

Soliman, F.N.K., Ruzk, R.E., Brake, J., 1994. Relationship between shell porosity, shell thickness, egg weight loss, and embryonic development in Japanese Quail eggs. Poultry Sci. 73:1607-1611.

SPSS, 2006. Statistics 15.0. SPSS Inc, Chicago, IL, USA.

Tilki, M., Saatci, M., 2004. Effects of storage time on external and internal characteristics in Par-
ÇAĞLAYAN et al.

tridge (*Alectoris graeca*) eggs. Rev. Med. Vet.-Toulouse 155:561-564.
Tserveni-Gousi, A.S., Yannakopoulos, A.L., 1990. Quality characteristics of Pheasant eggs and effect of egg weight and shell quality on chick weight. Arch. Geflügelkd. 54:54-56.
Wilson, H.R., 1991. Interrelationships of egg size, chick size, posthatching growth and hatchability. World Poultry Sci. J. 47:5-20.
Witt, F., Schwalbach, L.M.J., 2004. The effect of egg weight on the hatchability and growth performance of New Hampshire and Rhode Island Red chicks. S. Afr. J. Anim. Sci. 34:62-64.
Woodard, A.E., Abplanalp, H., Snyder, L., 1982. Inbreeding depression in the Red-Legged Partridge. Poultry Sci. 61:1579-1584.
Woodard, A.E., Morzenti, A., 1975. Effect of turning and age of egg on hatchability in the Pheasant, Chukar and Japanese Quail. Poultry Sci. 54:1708-1711.
Woodard, A.E., Snyder, R.L., Abplanalp, H., 1981. Reproductive performance in aged Partridge. Poultry Sci. 60:2006-2009.
Yannakopoulos, A.L., 1992. Greek experiences with Gamebirds. Anim. Breed. Abstr. 60:3375.
Yıldırım, İ., 2005. The effects of hatching egg weight and breeder age on embryo development and hatching result in broiler. Selçuk University Journal of the Faculty of Agriculture 19(37):87-91.