The Effects of Different Breeding Systems on Egg Productivity and Egg Quality Characteristics of Rock Partridges

O. Özbey\(^1\) and F. Esen

Department of Animal Science, Veterinary Faculty, University of Fırat, 23119 Elazığ, Turkey

ABSTRACT This study was carried out to investigate the effects of different breeding systems (breeding on the ground and in the cage) on the egg production and egg characteristics of Rock Partridges. Egg production values of the ground and cage system groups were determined as 41.30 and 49.40%, respectively, and this difference was found to be significant (\(P < 0.05\)). The weight values of the eggs were 23.86 g in the ground system and 22.08 g in the cage system (\(P < 0.05\)). The difference between the shape index values, which were determined as 75.39 in the ground system and as 77.65 in the cage system, was statistically significant (\(P < 0.05\)). In addition, the values for yolk index (48.42 and 44.11), albumen index (1.45 and 1.66), Haugh unit (83.24 and 86.78), shell weight (2.39 and 2.86), yolk weight (8.55 and 7.89), and albumen weight (12.46 and 11.78) obtained in the ground and cage system, respectively, were obtained to be statistically different (\(P < 0.05\)). It was observed that the Rock Partridges could be bred in ground and cage systems during the egg production period, and although the investment cost and equipment expenditure increase in cage breeding, the egg quality, shape index, albumen index, and Haugh unit of Rock Partridges decrease dramatically in ground breeding.

Key words: Rock Partridge, breeding system, egg productivity, egg quality

2007 Poultry Science 86:782–785

INTRODUCTION

Partridge breeding is becoming widespread because it enables high productivity in small breeding areas within short time and without great investments when compared with other winged breeding. Partridges are bred for a variety of purposes such as for eggs, meat, and hunting preserves. Partridges can easily adapt to the environment in natural life. However, because intensive breeding limits the freedom of movement of the partridges, they are dependent on the environmental conditions where they are living. The shelter conditions have an important role when breeding is practiced through ground or cage system or by both systems, and they affect the financial income on a large scale. Therefore, success in partridge breeding depends on environmental conditions like other stock raising activities (Çetin et al., 1997; Kırıkcı et al., 1999; Özek, 2001a,b).

In the European Union, battery cages for laying hens will be prohibited beginning in 2012, meaning that alternative housing systems, including free range or outdoor, are being developed. The consequences of alternative housing systems (especially outdoor systems) for egg quality are currently unclear. Some studies have described the effects of different housing systems on egg quality (Torges et al., 1976; Pavlovski et al., 1981), but there has been little research on egg quality of current breeds in outdoor systems (Leyendecker et al., 2001a,b).

Kırıkcı et al. (1999) obtained 43.84% egg production rate in a group of Rock Partridges subjected to artificial lighting and 38.45% in the group under natural lighting conditions. Rock Partridge egg weights range between 19.16 and 22.50 g (Woodard et al., 1982; Kırıkcı et al., 1999, 2004b).

As outdoor systems become more important, their effects on egg characteristics (external and internal) need to be clear. Another factor influencing egg quality is layer age (Lapao et al., 1999; Silversides and Scott, 2001), and changes in egg quality with advancing age may be dependent on environmental circumstances, such as housing conditions. The evaluation of eggshell quality characteristics has been well documented for domestic fowl (Yannakopoulos and Tserveni-Gousi, 1986; Poyraz, 1989; Tserweni-Gousi and Yannakopoulos, 1990; Scott and Silversides, 2000) and pheasant (Song et al., 2000; Kırıkcı et al., 2004a). However, information that concerns evaluation of shell quality in partridges is limited. Song et al. (2000) indicated that shape index of the partridge eggs is 78.00 and eggshell thickness is 0.232 mm. Kırıkcı et al. (1999, 2002, 2004a,b) discussed the important role of partridges as game birds and the problems associated with hatchability. These findings indicate the need for more detailed research in this area.
The purpose of this study was to determine the effects of different breeding systems (breeding in cage and on the ground) on the egg quality and egg characteristics of Rock Partridges.

**MATERIALS AND METHODS**

**Animals and Husbandry**

The materials of this research consisted of Rock Partridge produced in the Veterinary Faculty Research and Application Farm of Firat University. In the study, a partridge flock includes 275 partridge chicks.

Partridges were selected randomly 1 mo before the beginning of mating season and separated into 2 groups. The partridges in the first group were located into the cages, which had the measurements 1 × 1 × 1 m. A total of 13 male and 39 female partridges were allocated into the cages, each including 1 male and 3 females. In the second group, the same numbers of partridges were allocated into the compartments on the ground, which had the measurements of 1.2 × 1.2 × 3 m.

The partridges were kept at 15 to 25°C, and 12 h/d of lighting was applied during rearing period. Lighting was increased 1 h/wk and kept constant when 16 h of light daily was reached. The chicks were fed a starter diet containing 28% crude protein from hatch to 5 wk of age and then fed 24% crude protein from 5 to 12 wk of age and 16% crude protein from 12 to 32 wk of age. Water was provided from automatic water cups. Sexing was determined at 32 wk of age.

**Egg Quality Analyses**

The first egg was obtained within 34 wk of age in all the groups. The eggs obtained from the partridges were collected and recorded daily during the research period of 8 wk from 34 to 41 wk of age. To determine the egg quality characteristics of the partridges, 30 eggs from each group were used at 38 wk of age.

The egg weights were recorded, and the shape index was measured by an instrument (BV. Apparatenfabreik Von Doorn, 0.001 mm, Nieuwegein, the Netherlands) with the following formula:

\[
\text{Shape index} = \frac{\text{short border}}{\text{long border}} \times 100
\]

(Yannakopoulos and Tserveni-Gousi, 1986).

After that, the eggs were broken 1 by 1 on a flat layer with a waiting period of 5 min. Shell thickness was a mean value of measurements at 3 locations on the egg (air cell, equator, and sharp end) by using a dial gauge with the following formula:

\[
\text{Shell thickness} = \frac{\text{sharp point thickness} + \text{equator thickness} + \text{blunt thickness}}{3}
\]

(Yannakopoulos and Tserveni-Gousi, 1986).

Albumen height was measured by a tripod micrometer (Mitutoyo, 0.01 mm, Kawasaki, Japan), albumen length and width by a compass (Swordfish, 0.02 mm, Tokyo, Japan), and then the albumen index was calculated with the following formula:

\[
\text{Albumen index} = \frac{\text{albumen height}}{\text{long diameter of albumen} + \text{short diameter of albumen}/2} \times 100
\]

(Yannakopoulos and Tserveni-Gousi, 1986).

Yolk height and yolk diameter were measured by the same instruments mentioned above and the yolk index was calculated with the following formula:

\[
\text{Yolk index} = \frac{\text{yolk height}}{\text{long diameter of yolk} + \text{short diameter of yolk}/2} \times 100
\]

(Yannakopoulos and Tserveni-Gousi, 1986).

Haugh units were calculated using the Haugh unit formula:

\[
\text{Haugh unit: } 100 \times \log (\text{albumen height} + 7.57 - 1.7 \times \text{egg weight}^{0.37})
\]

(Nesheim et al., 1979).

**Statistical Methods**

One-way ANOVA was used to determine the significance of differences between egg production and egg quality characteristics of the various groups. The significance of the differences among the groups has been determined by Duncan’s multiple range test (Petrie and Watson, 1999). Statistical analysis was done using the SPSS 11.0 program package (SPSS, 2001).

**RESULTS AND DISCUSSION**

The values for egg productivity and the external quality of the partridge eggs, which were obtained from different breeding systems, are presented in Table 1, and the internal quality characteristics and component values of the partridge eggs are given in Table 2.

In the comparison of the breeding systems, statistically significant differences were obtained between the values for egg productivity and shape index in favor of cage system and between the values for egg weight in favor of ground system ($P < 0.05$; Table 1).

As seen in Table 2, whereas there was no significant difference between cage and ground systems in terms of shell thickness ($P > 0.05$), statistically significant differ-
ences were observed in terms of yolk index, yolk weight, and albumen weight in favor of the ground system and in terms of shell weight, albumen index, and Haugh unit values in favor of the cage system ($P < 0.05$).

The values for egg production were determined as 41.30 and 49.40% in the ground and cage system groups, respectively, and this difference was found to be significant ($P < 0.05$). The weight values of the eggs, which were selected to assess the egg quality, were calculated as 23.86 g in the ground system and as 22.08 g in the cage system ($P < 0.05$). These values were similar to the egg weight values of Rock Partridges reported by some researchers (Woodard et al., 1982; Yannakopoulos, 1992; Kirikci et al., 1999, 2002; Song et al., 2000; Ozek, 2001a,b; Gunlue et al., 2003; Tilki and Saatci, 2004). In another study that investigated the productivity characteristics of the Rock Partridges at different management conditions, it was observed that the Rock Partridges located in the cage system had an egg productivity percentage of 16% and egg weight of 18.99 g. On the other hand, the Chukar Partridges located on the ground had an egg production percentage of 47% and egg weight of 19.31 g (Cetin et al., 1997). The comparison of the results of the current study with those of Cetin et al. (1997) showed that the values for egg weight were higher in the Rock Partridges than those of the Chukar Partridges, and breed factor may therefore be responsible for this.

The values obtained for the shape index were significantly higher in the ground system (75.39) than in the cage system (77.65; $P < 0.05$). The breeding system has been reported to have a significant effect on the egg shape index in previous studies, as well (Pavlovski et al., 1994b; Kirikci et al., 1999, 2002, 2004b; Song et al., 2000; Gunlue et al., 2003; Tilki and Saatci, 2004). The shape index difference between the groups can be an outcome of the difference in egg weight. The fact that the low value for shape index was obtained in the ground system in which the egg weight was higher supports the suggestion of a negative correlation between the egg weight and the shape index (Poyraz, 1989; Grunder et al., 1991).

Yolk index values calculated in the present study (48.42 and 44.11 in the ground and cage systems, respectively), which differed significantly between the breeding systems ($P < 0.05$), were similar to previous reports (Kirikci et al., 1999, 2002, 2004b; Song et al., 2000; Gunlue et al., 2003; Tilki and Saatci, 2004). Also, the difference between the values for albumen index in the ground (1.45) and cage (1.66) systems was significant ($P < 0.05$). These values were observed to be higher than those reported in some studies (Kirikci et al., 1999, 2002, 2004b; Song et al., 2000; Gunlue et al., 2003). The high value of the egg weight and the low value of the Haugh unit in the ground system support the presence of a negative correlation between the egg weight and the albumen index (Ambrosen and Rotenberg, 1981; Choi et al., 1983; Roque and Soares, 1994).

Whereas a significant difference was obtained in the values for Haugh unit between the ground (83.24) and cage (86.78) systems ($P < 0.05$), no statistically significant difference was found in terms of shell thickness ($P > 0.05$). The Haugh unit value, which is considered as an important indicator of the quality of egg albumen, is reported to be low in the free range system in comparison with the supported ground and cage systems (Mostert et al., 1995), with which the results of this study are also in agreement. In addition, the Haugh unit values obtained here are similar to some previous reports (Kirikci et al., 1999, 2002, 2004b; Gunlue et al., 2003; Tilki and Saatci, 2004). The high value of egg weight and the low value of the Haugh unit in the ground system support the suggestion that there is a negative correlation between the egg weight and the Haugh unit (Ambrosen and Rotenberg, 1981; Choi et al., 1983; Roque and Soares, 1994).

The differences between the ground and the cage systems in terms of the values of shell weight (2.39 and 2.86 g), albumen weight (12.46 and 11.78 g), and yolk weight (8.55 and 7.89) were significant ($P < 0.05$), whereas no difference was found in terms of albumen weight ($P > 0.05$). These values were also similar to the previous reports (Pavlovski et al., 1994b; Kirikci et al., 1999, 2002, 2004b; Song et al., 2000; Gunlue et al., 2003; Tilki and Saatci, 2004).

When the shell weight and shell thickness were evaluated together with respect to the eggshell quality, it was observed that the eggs of the groups that had low egg weights at the beginning had relatively more shell than the others. The observation that light eggs possessed more and thicker shell compared with the heavy eggs justifies the reports of many researchers. In fact, Roland (1979) reported that the egg weight and shell quality have a negative relationship, and as the egg weight increases the shell quality would therefore decrease.

It is concluded that the ground and cage breeding systems have essential effects on egg production and egg quality characteristics. This study, which provided valuable data for the construction of future studies on this topic, emphasized that although the ground and cage breeding systems can be applied in partridge breeding, the ground system may be more advantageous in terms of animal welfare and economy. In addition, in our country, which is undergoing a European Union integration process, the range system, which provides further movement area for the animals, has to be applied in addition to the ground system, which is an alternative to the traditional...
cage breeding system. Then, it would be possible to carry out parallel studies with the developed countries in which the well-being of the animals and natural productions are important priorities.

REFERENCES


SPSS. 2001. 11.0. SPSS for Windows. SPSS, Chicago, IL.


