Journal of Animal and Veterinary Advances 10 (24): 3201-3206, 2011
ISSN: 1680-5593

Effect of Hatch Weight on Egg Production, Hatchability and Egg Quality Characteristics in Pheasant (*Phasianus colchicus*)

[1]Orhan Ozbey, [1]Fikret Esen and [2]Mehmet Hanifi Aysondu
[1]Department of Animal Science, Faculty of Veterinary, University of Firat, 23119 Elazig, Turkey
[2]Department of Animal Science, Kemaliye Haci Ali Akin MYO.,
University of Erzincan, 24620 Erzincan, Turkey

Abstract: This study was conducted to determine essential criteria for the selection of hatch weight in pheasants (*Phasianus colchicus*). The pheasants were divided into three groups in accordance with hatch weight (Group I<20.00 g, Group II 20.01-22.00 g and Group III>22.01 g) in this study. Hatch weight was found to have significant effect on the age and weight of sexual maturity in research groups ($p<0.05$). The differences between the values for egg production and egg weight in research groups were statistically significant ($p<0.05$). While the highest egg production was obtained in Group I which had the lowest hatch weight, the highest egg weight average was determined in group III which had the highest hatch weight. The differences between the groups in terms of values for some hatchability features (Hatchability performance, fertility rate and hatchability of fertile eggs) showed that hatch weight had significant effect on hatchability features ($p<0.05$). Among the egg quality features of the groups, the differences between the values for shape index, shell weight, shell thickness and haugh unit were found as significant and hatch weight was determined to have significant effect on these parameters ($p<0.05$). It was concluded that a selection program can be established in pheasants with the lowest hatch weight for the parameters of egg production, shell weight and shell thickness and in those with the highest hatch weight for the parameters of sexual maturity weight, egg weight, hatchability features, shape index and haugh unit.

Key words: Pheasant, hatch weight, egg production, hatchability, egg quality, Turkey

INTRODUCTION

Breeding of the pheasant which is a poultry species has become popular recently as it offers a significant alternative source for animal-originated protein in human nutrition. Therefore, there is a need to conduct detailed studies in order to determine both the efficiency of hatching studies for breeding companies and hatching characteristics, internal and external quality features of pheasant eggs and the factors affecting these features for commercial companies. In nature, pheasants begin egg production in the spring. The initiation of early hatching may be related to factors including the genotype of the flock, health status, age, lightening, feeding and temperature under intensive conditions. Pheasants lay their first eggs at the average age of 34-40 weeks and the mean weight at sexual maturation varies between 900 and 1200 g under convenient conditions. The hatching season lasts for approximately 16-20 weeks. It is not suitable to obtain eggs from female pheasants younger than 8 months of age (Cetin and Kirikci, 2000).

It is well-known that there is a strong phenotypic correlation between the egg characteristics (Egg weight, egg shape and internal quality characteristics of eggs) and hatch weight. As the hatch weight is mostly affected by the egg weight, it significantly affects the live weight in the first few weeks but this effect decreases by age (Sefton and Siegel, 1974). A significant relationship between hatching egg weight and hatch weight in poultry animals has been reported in several studies (Marks, 1975; Sachdev *et al*., 1990; Tservfeni-Gousi and Yannakopouios, 1990). There is no positive correlation between the chick weight which is expressed as the percentage of the egg weight and egg weight (Shanaway, 1987). On the other hand, it has been reported that there is a significant positive correlation between live weight and egg weight in quails under different environmental conditions (Marks, 1975).

In various studies, different values ranging from 19.38-54.09% for the mean egg production (Cetin *et al*., 1997; Demirel and Kirikci, 2009; Kirikci *et al*., 2003b; Tepeli *et al*., 2002; Yilmaz, 2004) and from 28.10-33.36 g for

Corresponding Author: Orhan Ozbey, Department of Animal Science, Faculty of Veterinary, University of Firat, 23119 Elazig, Turkey

the mean egg weight (Cetin *et al*., 1997; Demirel and Kirikci, 2009; Blake *et al*., 1987; Kirikci *et al*., 2005; Woodard and Snyder, 1978; Woodard *et al*., 1983) have been recorded in pheasants. These differences have been thought to be due to the difference in age and genotype of the pheasants.

The mean values for hatchability of total eggs, the fertility rate and the hatchability of fertile eggs have been reported to vary from 29.46-62.03; 47.27-83.04 and 41.54-76.6%, respectively in previous studies (Cetin *et al*., 1997; Demirel and Kirikci, 2009; Kirikci *et al*., 2003b; Mashaly *et al*., 1983; Tepeli *et al*., 2002; Yannakapoulos, 1992; Yilmaz, 2004).

In studies aiming to determine quality features of pheasant eggs; the values of 77.87-81.24%, 2.768-3.222 g and 2.02-2.70 mm have been reported for the means of shape index, shell weight and shell thickness, respectively (Kirikci *et al*., 2003a, 2004, 2005; Tservfeni-Gousi and Yannakopouios, 1990).

Among the internal quality characteristics; the values reported in previous studies ranged from 9.03-11.4 g for the mean yolk weight; 9.03-11.4 g for the mean yolk index, 16.10-18.42 g for the mean albumen weight; 1.23-1.79% for the mean albumen index and 77.2-96.33 for the mean Haugh unit. It has been noted that while the albumen index was increased by the hatching age, the Haugh unit value was decreased by age (Gunlu *et al*., 2007; Kirikci *et al*., 2005, 2003a; Kuzniacka *et al*., 2005; Seker *et al*., 2005; Tservfeni-Gousi and Yannakopouios, 1990).

This study was conducted to determine the effect of chick hatch weight on the age and weight at sexual maturation, egg production, hatching and egg quality characteristics in the ring-necked pheasants. It is believed that the findings of the current study shall contribute to the improvement of pheasant breeding and to the relevant literature and also to the selection studies performed according to hatch weight.

MATERIALS AND METHODS

Animals and husbandry: The study material included a total of 225 chicks 45 males and 180 females which were obtained from the eggs of 42 weeks old brood stock ring-necked pheasants (*Phasianus colchicus*). These pheasants were originated from the same hatching and were bred under similar management and feeding conditions at the Training, Research and Practice Center of the Veterinary Faculty, Firat University.

The chicks obtained from the eggs were weighed with the scale balanced at 0.01 g precision and were then, grouped according to their hatch weights as follows:

- Group 1: Hatch weight <20.00 g
- Group 2: Hatch weight 22.00-22.00 g
- Group 3: Hatch weight >22.01 g

The pheasants were placed in the main machines for the 1st 4 weeks according to chick weight groups with each group containing a total of 75 chicks (15 males and 60 females) and then in the augmentation cages until 32 weeks and after the 32nd week in the mating cages at the male:female ratio of 1:4.

The pheasants were fed with chick initiation bait consisting of 28% HP until the 8th week of the augmentation period and afterwards with augmentation bait consisting of 20% HP. The pheasants were given a ration consisting of 18% HP *ad libitum* during the hatching period and water was provided through the automatic drinking bowls. No lightening other than sunlight was applied until the first egg was obtained from the pheasants. After the first egg was obtained, extra lightening in addition to sunlight was applied which was increased 1 h week^{-1} and was finally fixed at 16 h.

When the hatching period was achieved, it was observed that 13 males and 52 females in group I, 14 males and 55 females in group II and 14 males and 57 females in group III could survive.

The 1st day of hatching was accepted as the day of the sexual maturation and the sexual maturity weights were obtained by weighing the pheasants on the same day with the scale balanced at 0.01 g precision.

Following the determination of the quality characteristics, eggs were divided into six in each group for six repeats in order to investigate the hatching characteristics. The eggs were disinfected by formaldehyde, placed in the hatching machine and the number of chicks obtained from the hatching was recorded. The numbers of eggs with progeny (With an embryo or embryo draft) and those without progeny (Without an embryo or embryo draft) were then defined by cracking the eggs.

The eggs of each group were collected and counted at the same hour of each day beginning from the obtaining the first egg. The daily egg production (%) was calculated by dividing the number of eggs to the number of pheasants. The individual records of the pheasants were kept starting from age of 34 weeks till age of 54 weeks with 4 weeks intervals.

Hatching characteristics: The hatchability performance, fertility rate and hatchability of fertile eggs were calculated using the equation (Ozbey and Esen, 2007; Yannakopoulos and Tserveni-Gousi, 1986):

$$\text{Hatchability of total eggs} = \left[\frac{\text{The number of chicks}}{\text{Number of eggs loaded into the machine}}\right]\times 100$$

$$\text{Hatchability of fertile eggs (\%)} = \left[\frac{\text{The number of chicks}}{\text{Number of fertilized eggs are loaded into the machine}}\right]\times 100$$

$$\text{Fertility rate} = \left[\frac{\text{Number of fertilized eggs}}{\text{Number of eggs loaded into the machine}}\right]\times 100$$

Egg quality analyses: The eggs selected randomly once every 15 days on the same day were used to define external quality features. The selected eggs were given numbers and weighed with the scale balanced at 0.01 mg precision and then measured by a digital caliper at the longest and shortest edge in order to designate the shape index.

The shape indexes of the eggs were calculated using the following equation (Ozbey and Esen, 2007; Yannakopoulos and Tserveni-Gousi, 1986):

$$\text{Shape index (\%)} = \frac{\text{Short edge}}{\text{Long edge}}\times 100$$

In order to determine the internal quality features of the eggs, they were cracked on a glass surface and the height of yolk and albumen, yolk diameter, albumen length and width were measured after 5 min using a digital caliper. The yolk was separated from the albumen and measured with the membrane. The shells were washed under tap water and left to dry for 24 h. The dried shells were weighed with the membrane and shell weights were determined. After the measurement, three pieces of shell were selected to measure the shell thickness using a micrometer at the sharp, blunt and middle sections.

The equation was used to find some internal quality features of the eggs (Ozbey and Esen, 2007; Yannakopoulos and Tserveni-Gousi, 1986):

$$\text{Yolk index} = \frac{\text{Yolk height}}{\text{Yolk diameter}}\times 100$$

$$\text{Albumen index} = \text{Albumen height}/(\text{Long diameter of albumen} + \text{Short diameter of albumen}/2)\times 100$$

$$\text{Shell thickness} = \frac{(\text{Pointed end}+\text{Equator}+\text{Blunt end})}{3}$$

$$\text{Shell membrane thickness} = \frac{(\text{Pointed end}+\text{Equator}+\text{Blunt end})}{3}$$

$$\text{Haugh unit} = 100\times\log(\text{Albumen height} + 7,57-1.7\times \text{Egg weight}^{0.37})$$

The width and length of the eggs were measured in centimeters, the weight as grams, the yolk and albumen heights, the yolk diameter, the albumen length and the width and shell thickness were measured as mm.

Statistical analysis: Data were loaded and analyzed using the SPSS (2002) 11.5 packet program. The mean values of the groups were analyzed using the variance analysis followed by the Duncan test. Percentages were analyzed using the χ^2-test (Petrie and Watson, 1999).

RESULTS

The age and weight at sexual maturation, egg production and egg weight values in the hatch weight groups of the pheasant chicks are shown in Table 1.

The differences between the groups for age and weight at sexual maturation, egg production and egg weight values were statistically significant ($p<0.05$). The statistical analyses showed that the chick hatch weight had a significant effect on the age and weight at sexual maturation, egg production and egg weight ($p<0.05$).

Among the hatching characteristics; the values for the hatchability of total eggs, fertility rate and hatchability of fertile eggs in the hatch weight groups are shown in Table 2. The differences between the groups for hatchability of total eggs, fertility rate and hatchability of fertile eggs were significant ($p<0.05$).

Among the egg quality characteristics; the values obtained for the shape index, shell weight, shell thickness,

Table 1: The age and weight of sexual maturity, egg production and egg weight of pheasant

	Hatch weight			
Ozellikler	Group I (n:52) <20.00 g	Group II (n:55) 20.01-22.00 g	Group III (n:57) >22.01 g	p-value
Age of sexual maturity (day)	271.65±6.34^a	263.57±7.280^b	254.72±8.620^c	*
Weight of sexual maturity (g)	114524.00±9.53^a	1256.36±11.23^b	1343.35±14.31^c	*
Egg production rate (%)	50.39±3.11^a	47.38±2.760^b	44.84±3.210^c	*
Egg weight (g)	28.32±1.23^a	31.23±1.630^b	32.89±1.540^c	*

Table 2: Some hatchability characteristics of pheasant eggs

	Hatch weight			
Ozellikler (%)	Group I (n:120) <20.00 g	Group II (n:120) 20.01-22.00 g	Group III (n:120) >22.01 g	p-value
Hatchability of total eggs	54.32±8.16[a]	59.63±7.92[b]	64.82±8.78[c]	*
Fertility rate	57.76±7.59[a]	62.43±8.47[b]	68.34±9.24[c]	*
Hatchability of fertile eggs	66.42±7.31[a]	72.73±8.13[b]	77.45±8.49[c]	*

[a-c]The differences of means holding different letters in the same row are important (*p<0.05); values are given as $\bar{x} \pm S\bar{x}$

Table 3: Some quality characteristics of pheasant eggs

	Hatch weight			
Ozellikler	Group I (n:50) <20.00 g	Group II (n:50) 20.01-22.00 g	Group III (n:50) >22.01 g	p-value
Shape index (%)	83.540±1.16	79.710±1.15[ac]	75.730±1.19[c]	*
Shell weight (g)	3.060±0.64[a]	3.450±0.86[b]	3.760±0.93[c]	*
Shell thickness (mm)	0.263±0.02[a]	0.298±0.03[b]	0.311±0.03[c]	*
Yolk weight (g)	10.370±0.61	10.580±0.72	10.660±0.59	NS
Albumen weight (g)	18.890±0.54	18.430±0.65	17.790±0.72	NS
Yolk index (%)	48.950±2.76	49.580±2.91	50.330±2.80	NS
Albumen index (%)	1.976±0.73	1.912±0.87	1.889±0.92	NS
Haugh units	96.430±0.83[a]	92.560±1.02[b]	89.870±0.94[a]	*

[a-c]The differences of means holding different letters in the same row are important (*p<0.05); NS: Non Significant (p>0.05); values are given as $\bar{x} \pm S\bar{x}$

yolk weight, albumen weight, yolk index, albumen index and haugh unit in the pheasant groups are shown in Table 3.

While the differences between the groups for shape index, shell weight, shell thickness and haugh unit values were significant (p<0.05) no significant differences were obtained for the yolk weight, albumen weight, yolk index and albumen index values (p>0.05).

DISCUSSION

In the present study, three groups from a flock of ring-necked pheasants at the same age were formed according to hatch weight in order to make comparisons in terms of age and weight at sexual maturation, egg productions and weights, hatchability characteristics and egg quality characteristics.

The values obtained here for egg production and egg weight were similar to those reported in previous studies conducted in pheasants in terms of positive and negative correlations with the exception of slight differences (Blake *et al*., 1987; Cetin *et al*., 1997; Demirel and Kirikci, 2009; Kirikci *et al*., 2003b, 2005; Tepeli *et al*., 2002; Tservfeni-Gousi and Yannakopouios, 1990; Woodard and Snyder, 1978; Woodard *et al*., 1983; Yilmaz, 2004).

The difference between the groups in terms of the values for age and weight at sexual maturation, egg production and egg weight was significant (p<0.05). The analyses of the results showed that the chick hatch weight had a significant effect on the age and weight at sexual maturation, egg production and egg weight (p<0.05).

While the lowest values for the age of sexual maturation and egg production were found in the chicks of the third group, the highest values for these parameters were found in the first group. While the lowest values for the weight at sexual maturation were found in the first group chicks, the highest values for this parameter were determined in the third group. The highest mean for the egg weight was obtained in the third group chicks with high hatch weight.

The values obtained here for hatching characteristics were similar to those reported in previous studies conducted in pheasants in terms of positive and negative correlations with the exception of slight differences (Cetin *et al*., 1997; Demirel and Kirikci, 2009; Kirikci *et al*., 2003b; Tepeli *et al*., 2002; Yilmaz, 2004; Mashaly *et al*., 1983; Yannakapoulos, 1992).

The analyses of the results showed that the hatch weight of the chicks had significant effect on the hatchability of total eggs, fertility rate and hatchability of fertile eggs (p<0.05). When the hatch weights of the chick groups were compared in terms of hatching results, it was found that hatchability of total eggs, fertility rate and hatchability of fertile eggs increased as the hatch weight increased. While the lowest values for the hatchability of total eggs, fertility rate and hatchability of fertile eggs were found in the first group chicks, the highest values for these parameters were found in the third group.

The values obtained here for the egg quality characteristics were found to be similar to those reported in previous studies conducted in pheasants in terms of positive and negative correlations with the exception of slight differences (Gunlu *et al*., 2007; Kirikci *at al*., 2003a,

2004, 2005; Seker *et al*., 2005; Kuzniacka *et al*., 2005; Tservfeni-Gousi and Yannakopouios, 1990). There was a negative correlation between the hatch weight and shape index and Haugh unit. As the hatch weightincreased, zthe shape index and the haugh unit decreased. On the other hand, the shell weight and thickness showed significant increases as the hatch weight increased ($p<0.05$).

It was found that chick hatch weight had a significant effect on the shape index, shell weight, shell thickness and Haugh unit ($p<0.05$). The lowest values for the shape index and the Haugh unit were found in the chicks of the third group whereas the highest values for these parameters were obtained in the first group. While the lowest values for the shell weight and shell thickness were found in the first group, the highest values for these parameters were obtained in the third group.

Improvement studies toward the increase of egg production and egg weight in pheasants will help increase the efficiency of production. It should therefore be given priority to the development and expansion of high quality brood material required in the pheasant breeding just after the hatching.

CONCLUSION

In this study, it was showed in the current study that the chick hatch weight had significant effects on the age and weight at sexual maturation, egg production and egg weight, hatching and egg quality characteristics in ring-necked pheasants. Thus, the establishment of a selection program which uses the pheasants with higher hatch weight in terms of the weight at sexual maturation, egg weight, hatching characteristics, shell weight and shell thickness and uses those with lower hatch weight in terms of the age at sexual maturation, egg production, shape index and Haugh unit would be reasonable.

REFERENCES

Blake, A.G., R. Balander, C.J. Flegal and R.K. Ringer, 1987. Ahemeral light-dark cycles and egg production parameters of ring-necked pheasant (*Phasianus colchicus*). Poult. Sci., 66: 258-263.

Cetin, O. and K. Kirikci, 2000. Alternative Poultry Breeding. Pheasant-Partridge Selcuk University, Konya, Turkey.

Cetin, O., C. Tepeli and K. Kirikci, 1997. Breeding possibilities of pheasants (*P. colchicus*) in intensive conditions and cold climatic zone. I. Egg production and hatchability characteristics. Vet. Bil. Derg., 13: 5-10.

Demirel, S. and K. Kirikci 2009. Effect of different egg storage times on some egg quality characteristics and hatchability of pheasants (*Phasianus colchicus*). Poult. Sci., 88: 440-444.

Gunlu, A., K. Kirikci, O. Cetin and M. Garip, 2007. Effect of hen age on some egg quality characteristics of pheasants (*P. colchicus*). Proceedings of the Current Problems of Breeding, Health, Growth and Production of Poultry Symposium, Feb. 14-17, Ceska Budejovice, Czech Republic, pp: 211-215.

Kirikci, K., A. Gunlu and M. Garip, 2005. Some quality characteristics of pheasant eggs with different shell colors. Turk. J. Vet. Anim. Sci., 29: 315-318.

Kirikci, K., A. Gunlu, O. Cetin and M. Garip, 2003a. Some quality characteristics of pheasant (*P. colchicus*) eggs. J. Food. Agric. Environ., 1: 226-228.

Kirikci, K., C. Tepeli, A. Gunlu and O. Cetin, 2003b. Production characteristics of pheasants (*Phasianus colchicus*) in different breeding regimes. Turk. J. Vet. Anim. Sci., 27: 907-910.

Kirikci, K., O. Cetin, A. Gunlu and M. Garip, 2004. Effect of hen weight on egg production and some egg quality characteristics in pheasants (*Phasianus colchicus*). Asian Aust. J. Anim. Sci., 17: 684-687.

Kuzniacka, J., Z. Bernacki and M. Adamski, 2005. Effect of the date of egg-laying on the biological value of eggs and reproductive traits in pheasants (*Phasianus colchicuc*). Folia Biologica, 53: 73-78.

Marks, H.L., 1975. Relationship of embryonic development to egg weight, hatch weight, and growth in Japanese quail. Poult. Sci., 54: 1257-1262.

Mashaly, M.M., K.R. Kratzer and O.D. Keene, 1983. Effect of photoperiod on body weight and reproductive performance of ringneck pheasants. Poult. Sci., 62: 2109-2113.

Ozbey, O. and F. Esen, 2007. The effects of different breeding systems on egg productivity and egg quality characteristics of rock partridges. Poult. Sci., 86: 782-785.

Petrie, A. and P. Watson, 1999. Statistics for Veterinary and Animal Science. Blackwell Science, Oxford.

SPSS, 2002. SPSS for Windows Runs on Windows 98. SPSS, Chicago, IL.

Sachdev, A.K., S.D. Ahuja, P.C. Thomas and S.K. Agrawal, 1990. Effect of egg weight and storage periods of hatching egg on growth in japanese quail. Poult. Abst, 16: 2702-2702.

Sefton, A.E. and P.B. Siegel, 1974. Inheritance of body weight in Japanese quail. Poult. Sci., 53: 1597-1603.

Seker, I., S. Kul, M. Bayraktar and O. Yildirim, 2005. Effect of layer age on some egg quality characteristics and egg production in Japanese quail (*Coturnix coturnix japonica*). Istanbul Vet. Fak. Derg., 31: 129-138.

Shanaway, M.M., 1987. Hatching weight in relation to egg weight in domestic birds. World Poult. Sci. J., 43: 107-115.

Tepeli, C., K. Kirikci, O. Cetin and A. Gunlu, 2002. The effects of different light periods on some production characteristics in pheasants (*Phasianus colchicus*). Indian J. Anim. Sci., 72: 960-962.

Tservfeni-Gousi, A.S. and A.L. Yannakopouios, 1990. Quality characteristics of pheasant eggs and effect of egg weight and shell quality on chick weight. Arch. Geflugelk, 542: 54-56.

Woodard, A.E. and R.L. Snyder, 1978. Cycling for production in the pheasant. Poult. Sci., 57: 349-352.

Woodard, A.E., H. Abplanalp, J.M. Pisenti and R.L. Snyder, 1983. Inbreeding effects on reproductive traits in the ring-necked pheasant. Poult. Sci., 62: 1725-1730.

Yannakapoulos, A.L., 1992. Grek experiences with gamebirds. Anim. Breed. Abstr., 60: 3375-3375.

Yannakopoulos, A.L. and A.S. Tserveni-Gousi, 1986. Quality characteristics of quail eggs. Br. Poult. Sci., 27: 171-176.

Yilmaz, M.R., 2004. Production characteristics of pheasants (*Phasianus colchicus*) different breeding regimes at mating season. Doctoral Thesis, Selcuk Univ. Health Sciences Institute, Konya.