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The effect of the age of Japanese quails on certain egg quality traits and their relationships

Lukáš Zita*, Zdeněk Ledvinka, and Ludmila Klesalová

Department of Animal Husbandry, Faculty of Agrobiology, Food and Natural Resources Czech University of Life Sciences, Prague, Czech Republic

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ABSTRACT

The effect of age on the egg quality traits of Japanese quails (*Coturnix coturnix japonica*) were investigated. One hundred female quails were used in the study. The quails were placed in wire cages (3 females per cage) and fed a mixture with 11.2 MJ ME and 19.7% of crude protein throughout the experiment. Feed and water were given *ad libitum*. Eggs were collected on 2 consecutive days during the 4-week period when the quails were from 9 to 49 weeks of age. A total of 2,060 eggs were examined. Egg quality traits were significantly affected by the age of the quails, with the exception of egg shape index and yolk colour. A rapid increase in the egg weight was found at the beginning of laying, the highest weight (13.02 g) was found in the 25th week of age, with a subsequent gradual decrease in egg weight until the end of the laying period at 49 weeks of age. Despite frequent fluctuations, the albumen index, albumen weight, albumen proportion, Haugh units score, eggshell weight and eggshell strength decreased with increasing age, but the yolk proportion, eggshell proportion increased with the quails' age. The egg weight was positively correlated ($P \le 0.001$) with yolk weight, albumen weight and eggshell weight (0.70, 0.90 and 0.58, respectively). The Haugh unit score was positively correlated with the albumen index (0.94; $P \le 0.001$).

Key words: Japanese quail, age, yolk, albumen, eggshell

Introduction

Several factors influencing the production and quality characteristics of quail eggs have been reported. However, information about the relationship between the external and internal traits of eggs and the age of the quail are rather limited (NARAYANANKUTTY et al., 1989; NAZLIGUL et al., 2001).

The age of quails influences egg weight. NAGARAJAN et al. (1991), GONZALEZ (1995), ALTAN et al. (1998), NAZLIGUL et al. (2001) and ORHAN et al. (2001) found that egg

*Corresponding author:

Ing. Lukáš Zita, PhD., Department of Animal Husbandry, Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences Prague, Kamycka 129, 165 21, Prague 6 - Suchdol, Czech Republic, Phone: +420 224383 053; E-mail: zita@af.czu.cz

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weight increased with the age of the quail. The shape index of the eggs may be affected by the age of layers in many poultry species. GONZALEZ (1995) and ORHAN et al. (2001) describe a decrease in the egg shape index with the age of Japanese quails. On the other hand, ALTAN et al. (1998) reported that the egg shape index did not change with the quails' age.

The albumen weight increased with the quails' age (NAZLIGUL et al., 2001). Quail eggs have lower proportions of albumen than those from hens (FLETCHER et al., 1983). A decrease in albumen index with age was reported by SACHDEV et al. (1989). On the other hand, NAGARAJAN et al. (1991) and ORHAN et al. (2001) observed that the albumen index increased with the quails' age. The Haugh unit score is the accepted unit for measuring the albumen quality of eggs. Of all the egg quality traits, only the Haugh unit score is considered the best objective mathematical expression to measure egg quality (KONDAIAH et al., 1983). With the increasing age of the quails, the Haugh unit score may decrease (NAZLIGUL et al., 2001; ORHAN et al., 2001) or not change (ALTAN et al., 1998).

The yolk weight in Japanese quail increased with their age (NAZLIGUL et al., 2001). Quail eggs have higher proportions of yolk than those from hens (FLETCHER et al., 1983). The yolk index increased with the quails' age (NAGARAJAN et al., 1991; GONZALEZ, 1995). In contrast, ORHAN et al. (2001) found that the yolk index decreased with the age.

Eggshell quality characteristics are also affected by the age of the quails. Many authors have reported that eggshell weight increases and eggshell thickness decreased with quails' age (GONZALEZ, 1995; ALTAN et al., 1998; NAZLIGUL et al., 2001; ORHAN et al., 2001). Eggshell thickness, however, was not influenced by the age of the quail (NAGARAJAN et al., 1991). Compared to hens' eggs, those from quail had poorer shell quality, as judged by shell thickness and shape (FLETCHER et al., 1983).

The aim of the present study was to determine the influence of the age of Japanese quails on the characteristics of their eggs. Correlations between some egg quality traits were also determined.

Materials and methods

Conditions of the experiment. The monitoring was carried out on 100 female Japanese quails (*Coturnix coturnix japonica*). The quails (Pharaoh strain) used for the study were the progeny of generation 32 obtained from a single hatching and were placed in wire cages (3 females per cage - 400 cm^2 per quail). A temperature of 14 to 23 °C was maintained. The lighting regime consisted of 16 h of light and 8 h of darkness. The quails were fed a mixture with 11.2 MJ ME and 19.7% crude protein throughout the experimental period. Feed and water were given *ad libitum*.

Egg quality analysis. A total of 2,060 eggs of the quails were used during the experiment, and all measurements were performed on each egg. The eggs were collected over 2 consecutive days during the 4-week periods when the quails were from 9 to 49 weeks of age and weighed using an electronic scale with an accuracy of 0.01 g. The length and width of the eggs were measured with a digital calliper to the nearest 0.01 mm. Deformation of the eggshell and its strength were evaluated using the QC-SPA device (TSS England). Eggshell thickness was measured with a the QCT device (TSS England). The length and width of the thick albumen and yolk were measured by digital calliper. The albumen height was determined by the QCH and QCM+ device (TSS England). The height of the thick yolk was recorded with a spherometer. The colour of the yolk was determined according to the La Roche scale (scores 1-15). The albumen and yolk were weighed, but the eggshell was weighed after removal of the rest the albumen. The weight of each albumen, yolk and eggshell was recorded to an accuracy of 0.01 g. The proportions of yolk, albumen, and eggshell were calculated in relation to egg weight and expressed as percentages. The egg shape index (ESI), albumen index (AI), yolk index (YI) and Haugh units score (HU) were also computed.

Calculations and statistical analysis. The egg shape index (ESI) was determined using the following equation (ANDERSON et al., 2004):

$$\text{ESI} = \frac{\text{width of egg}}{\text{length of egg}} \times 100\ (\%)$$

The albumen index (AI) and yolk index (YI) were calculated the same as for laying hen eggs in accordance with HEIMAN and CARVER (1936) and FUNK (1948), respectively:

$$\text{AI} = \frac{\text{albumen height}}{(\text{long diameter of albumen} + \text{short diameter of albumen}) / 2} \times 100\ (\%)$$

$$\text{YI} = \frac{\text{yolk height}}{\text{yolk diameter}} \times 100\ (\%)$$

Haugh units scores (HU) were calculated per replicate from the values obtained from albumen height (in millimeters) and egg weight (in grams) by employing the formula (HAUGH, 1937):

$$\text{HU} = 100 * \log(\text{albumen height} + 7.57 - 1.7 * \text{egg weight}^{0.37})$$

All the data of egg quality were analysed using the Univariate, Means, and GLM procedures (SAS 9.2; 2010). The significance of differences between the weeks of the laying period was tested by the Scheffe's test at the levels of significance of $P \leq 0.05$, 0.01 and 0.001. Correlations between egg quality traits were determined according to the

PROC CORR procedure of the SAS 9.2 statistical package (2010) by Pearson correlation coefficients by linear estimation.

Results

Table 1 shows that the average egg weight was significantly (P≤0.001) influenced by the week of age. A rapid increase in the egg weight was found at the beginning of laying period in 9th week of age, highest weight in the 25th week of age, with a subsequent gradual decrease in egg weight until the end of the laying period in the 49th week of age. The egg shape index was not significantly influenced by the week of age. The albumen index significantly (P≤0.001) decreased with the progression of the laying period. The albumen weight increased to the 25th week of age, with a subsequent gradual decrease until the end of the laying period. The albumen proportion gradually decreased, opposite to that of the yolk. The Haugh unit score demonstrated a declining trend during the laying period.

Table 1. Average values of egg weight, egg shape index and parameters of albumen quality in consecutive weeks of age (Mean ± SEM)

Week of age	Egg weight (g)	Egg shape index (%)	Albumen index (%)	Albumen weight (g)	Albumen proportion (%)	Haugh unit score
9	$11.96^{b} \pm 0.32$	77.97 ± 0.28	$12.47^{a} \pm 0.21$	$7.07^{ab} \pm 0.28$	$58.87^{a} \pm 0.35$	$90.13^{ab} \pm 0.69$
13	$12.69^{ab} \pm 0.21$	77.64 ± 0.19	$12.33^{a} \pm 0.14$	$7.30^{ab} \pm 0.19$	$57.47^{ab} \pm 0.23$	$90.88^{a} \pm 0.46$
17	$12.29^{ab} \pm 0.54$	78.77 ± 0.47	$12.38^{a} \pm 0.36$	$7.11^{ab} \pm 0.47$	$57.78^{ab} \pm 0.59$	$90.50^{ab} \pm 1.17$
21	$13.00^{a} \pm 0.30$	77.54 ± 0.26	$10.47^{b} \pm 0.20$	$7.38^{ab} \pm 0.27$	$56.65^{ab} \pm 0.33$	$85.98^{cd} \pm 0.65$
25	$13.02^{a} \pm 0.31$	77.38 ± 0.27	$10.54^{b} \pm 0.20$	$7.53^{a} \pm 0.27$	$57.79^{ab} \pm 0.33$	$87.13^{bc} \pm 0.66$
29	$12.78^{ab} \pm 0.33$	77.37 ± 0.28	$9.86^{b} \pm 0.22$	$7.25^{ab} \pm 0.28$	$56.45^{ab} \pm 0.36$	$85.10^{cd} \pm 0.70$
33	$12.46^{ab} \pm 0.27$	77.84 ± 0.24	$10.29^{b} \pm 0.18$	$7.10^{ab} \pm 0.24$	$56.88^{ab} \pm 0.30$	$85.47^{cd} \pm 0.59$
37	$12.39^{ab} \pm 0.24$	78.24 ± 0.21	$9.53^{b} \pm 0.16$	$7.09^{ab} \pm 0.21$	$57.08^{ab} \pm 0.27$	$83.89^{cd} \pm 0.52$
41	$12.40^{ab} \pm 0.26$	78.02 ± 0.22	$8.92^{b} \pm 0.17$	$6.98^{ab} \pm 0.22$	$56.19^{ab} \pm 0.28$	$82.98^{d} \pm 0.55$
45	$12.36^{ab} \pm 0.26$	77.82 ± 0.23	$8.88^{b} \pm 0.17$	$6.92^{b} \pm 0.23$	$55.82^{b} \pm 0.29$	$82.90^{d} \pm 0.57$
49	$12.23^{ab} \pm 0.27$	78.23 ± 0.24	$9.84^{b} \pm 0.18$	$6.91^{b} \pm 0.24$	$56.17^{ab} \pm 0.30$	$85.15^{cd} \pm 0.59$
Overall mean	12.52	77.85	10.39	7.14	56.93	86.15
P≤	0.001	NS	0.001	0.05	0.001	0.001
SEM	0.03	0.08	0.07	0.03	0.10	0.13

NS - non significant; SEM - standard error of mean; ^{abcd} means with common superscripts do not differ significantly, determined by Scheffe's test

Age was a significant (P≤0.001) factor, clearly affecting the yolk index (Table 2). The yolk index reached a relatively high value in the first week of the laying period, followed by a marked drop in the 13th and 17th weeks of age, with the index then maintaining an approximately steady value until the 33[th] week of age when the highest value was reached. From the 37[th] week of age onwards, the index continued to decrease significantly. The yolk weight was significantly ($P \leq 0.001$) influenced by the week of age, when the lowest weight was found at the beginning of the laying period, with subsequent gradual increase with age. At the end of the laying period a slight decrease in yolk weight was determined. The yolk proportion increased intensively during the first four weeks of the laying period ($P \leq 0.05$). From week 17, the proportion remained steady and high until the end of the laying period. The yolk colour was not influenced by the age.

Table 2. Average values of some traits of yolk quality in consecutive weeks of age (Mean ± SEM)

Week of age	Yolk index (%)	Yolk weight (g)	Yolk proportion (%)	Yolk colour
9	$49.11^{bc} \pm 0.34$	$3.44^{b} \pm 0.09$	$28.96^{b} \pm 0.26$	4.87 ± 0.07
13	$47.66^{cd} \pm 0.22$	$3.79^{ab} \pm 0.62$	$29.84^{ab} \pm 0.17$	4.70 ± 0.05
17	$46.81^{cde} \pm 0.57$	$3.72^{ab} \pm 0.16$	$30.31^{ab} \pm 0.44$	5.04 ± 0.12
21	$46.82^{cde} \pm 0.32$	$3.99^{a} \pm 0.09$	$30.76^{a} \pm 0.24$	4.93 ± 0.07
25	$46.82^{cde} \pm 0.32$	$3.95^{a} \pm 0.09$	$30.31^{ab} \pm 0.25$	4.81 ± 0.07
29	$48.05^{c} \pm 0.34$	$3.89^{a} \pm 0.09$	$30.63^{ab} \pm 0.26$	4.95 ± 0.07
33	$51.90^{a} \pm 0.29$	$3.82^{a} \pm 0.08$	$30.73^{ab} \pm 0.22$	4.78 ± 0.06
37	$50.81^{ab} \pm 0.26$	$3.80^{ab} \pm 0.70$	$30.73^{ab} \pm 0.19$	4.85 ± 0.06
41	$47.34^{cd} \pm 0.27$	$3.83^{a} \pm 0.07$	$30.96^{a} \pm 0.21$	4.92 ± 0.06
45	$45.25^{de} \pm 0.28$	$3.78^{ab} \pm 0.08$	$30.65^{ab} \pm 0.21$	5.00 ± 0.06
49	$44.15^{e} \pm 0.29$	$3.72^{ab} \pm 0.08$	$30.62^{ab} \pm 0.22$	4.98 ± 0.06
Overall mean	47.80	3.80	30.43	4.87
P≤	0.001	0.001	0.05	NS
SEM	0.11	0.01	0.08	0.02

NS - non significant; SEM - standard error of mean; ^{abcde} means with common superscripts do not differ significantly, determined by Scheffe's test

Eggshell quality is an important indicator of egg value (Table 3). The week of age had a significant ($P \leq 0.001$) effect on the eggshell weight. Eggshell weight increased with age, and reached its peak in the 29[th] week of age, with a subsequent gradual decrease in eggshell weight until the end of the laying period. The eggshell proportion tended to increase towards the end of the laying period ($P \leq 0.001$). Eggshell thickness, despite frequent fluctuations, demonstrated a declining tendency, in particular towards the end of the laying period ($P \leq 0.001$). Eggshell strength was also affected ($P \leq 0.01$) by the week of age. Despite frequent fluctuations, the eggshell strength decreased in the course of the laying period.

Table 3. Average values of traits of eggshell quality in consecutive weeks of age (Mean ± SEM)

Week of age	Eggshell weight (g)	Eggshell proportion (%)	Shell thickness (mm)	Shell strength ($g.cm^{-2}$)
9	$1.01^{c} \pm 0.04$	$12.16^{b} \pm 0.22$	$0.189^{b} \pm 0.003$	$1,441.97^{ab} \pm 59.00$
13	$1.11^{ab} \pm 0.03$	$12.70^{ab} \pm 0.14$	$0.186^{b} \pm 0.001$	$1,564.85^{ab} \pm 39.14$
17	$1.08^{abc} \pm 0.07$	$11.91^{b} \pm 0.36$	$0.194^{ab} \pm 0.005$	$1,563.08^{ab} \pm 99.78$
21	$1.08^{abc} \pm 0.04$	$12.59^{ab} \pm 0.20$	$0.184^{b} \pm 0.003$	$1,536.62^{ab} \pm 55.61$
25	$1.08^{abc} \pm 0.04$	$11.90^{b} \pm 0.20$	$0.195^{ab} \pm 0.003$	$1,592.18^{ab} \pm 56.13$
29	$1.13^{a} \pm 0.04$	$12.93^{ab} \pm 0.22$	$0.213^{a} \pm 0.003$	$1,632.26^{a} \pm 59.84$
33	$1.04^{bc} \pm 0.03$	$12.38^{ab} \pm 0.18$	$0.190^{b} \pm 0.002$	$1,374.34^{ab} \pm 50.40$
37	$1.03^{bc} \pm 0.03$	$12.19^{ab} \pm 0.16$	$0.192^{ab} \pm 0.002$	$1,460.78^{ab} \pm 44.62$
41	$1.04^{abc} \pm 0.03$	$12.84^{ab} \pm 0.17$	$0.191^{b} \pm 0.002$	$1,426.09^{ab} \pm 47.14$
45	$1.02^{bc} \pm 0.03$	$13.53^{a} \pm 0.18$	$0.183^{b} \pm 0.002$	$1,309.29^{b} \pm 48.23$
49	$1.00^{c} \pm 0.03$	$13.21^{ab} \pm 0.19$	$0.181^{b} \pm 0.002$	$1,352.89^{ab} \pm 49.89$
Overall mean	1.06	12.65	0.19	1,467.74
P≤	0.001	0.001	0.001	0.01
SEM	0.003	0.05	0.001	12.33

SEM - standard error of mean; ^{abc} means with common superscripts do not differ significantly, determined by Scheffe's test

Table 4. Correlations between the averages of some egg quality traits

Trait	Yolk weight (g)	Albumen weight (g)	Eggshell weight (g)	Yolk proportion (%)	Albumen proportion (%)	Eggshell proportion (%)	Albumen index (%)
Egg weight (g)	0.70 ***	0.90 ***	0.58 ***	-0.12 ***	0.28 ***	-0.37 ***	-
Yolk weight (g)	-	0.36 ***	0.39 ***	0.61 ***	-0.38 ***	-0.23 ***	-
Albumen weight (g)	-	-	0.44 ***	-0.48 ***	0.67 ***	-0.54 ***	-
Eggshell weight (g)	-	-	-	-0.10 ***	-0.01 NS	0.18 ***	-
Haugh unit score	-	-	-	-	-	-	0.94 ***

*** P≤0.001; NS - non significant

The correlations between some egg quality traits are presented in Table 4. Egg weight positively correlated with yolk weight, albumen weight and eggshell weight. The correlation of egg weight with yolk proportion and eggshell proportion were negative, but that of egg weight with albumen proportion was positive. The albumen weight positively correlated with the albumen proportion, but negatively with yolk proportion and eggshell proportion. The Haugh unit correlated highly positively with the albumen index.

Discussion

In the present study, egg quality traits were affected by the age of the quails, with the exception of egg shape index and yolk colour. There was an increase observed in the egg weight to the 25th week of age, with a subsequent gradual decrease in egg weight until the end of the laying period. Numerous authors (NAGARAJAN et al., 1991; GONZALEZ, 1995; ALTAN et al., 1998; NAZLIGUL et al., 2001; ORHAN et al., 2001) have reported egg weight continuously increasing with increasing age. Our results thus correspond more to those reported by RI et al. (2005), who reported increasing egg weight only between the 6th and 32nd weeks of age. The egg shape index was not significantly influenced by the week of age and this corresponds with the findings by ALTAN et al. (1998). However, GONZALEZ (1995), and ORHAN et al. (2001) all confirm a decreasing tendency in the egg shape index with increasing age.

The albumen index decreased with the progression of the laying period. A decrease in albumen index with age was reported by SACHDEV et al. (1989). Both NAGARAJAN et al. (1991) and ORHAN et al. (2001) reported, however, that the albumen index increased with age. The albumen weight increased to the 25th week of age, with a subsequent gradual decrease in the albumen weight until the end of the laying period. Our results found only partial correspondence with the findings of NAZLİGUL et al. (2001), who reported increasing albumen weight with age. The albumen proportion gradually decreased. A decreasing tendency of the albumen proportion was also reported by FLETCHER et al. (1983), who reported a lower albumen proportion in Japanese quails compared to hens. Despite numerous deviations, the Haugh unit scores demonstrated a declining trend, corresponding with the results reported by NAZLIGUL et al. (2001), ORHAN et al. (2001), and this is in contrast with ALTAN et al. (1986), who observed no changes in the Haugh unit values in the course of the laying period.

The yolk index reached a relatively high value in the 9th week of age and in the 33rd week of age, when the highest value was reached. From the 37th week onwards, the index continued to decrease significantly. The results of yolk index showed that the yolk index was affected by age of quails. This finding is partially in agreement with ORHAN et al. (2001), who reported a decreasing yolk index with increasing age. However, both NAGARAJAN et al. (1991) and GONZALEZ (1995) reported increasing yolk index values with the increasing age of quails. The lowest yolk weight was found at the beginning of the laying period, with a subsequent gradual increase with age. At the end of the laying period a slight decrease in yolk weight was determined. NAZLİGUL et al. (2001) found that the weight of the yolk increased with age. A significantly higher yolk proportion to egg weight, compared to hens‘ eggs, was reported by FLETCHER et al. (1983). The yolk colour values showed irregular fluctuations which is in agreement with NAGARAJAN et al. (1991).

Eggshell weight increased with age, and reached its peak in the 29th week of the laying period, with a subsequent gradual decrease in eggshell weight until the end of the laying period. Our results only partially correspond with the findings of NAZLİGUL et al. (2001), who reported a higher eggshell weight with age. Eggshell thickness, despite frequent fluctuations, demonstrated a declining tendency, in particular towards the end of the laying period. Similar conclusions were reported in the works of GONZALEZ (1995), ALTAN et al. (1998), NAZLIGUL et al. (2001) and ORHAN et al. (2001). YANNAKOPOULOS and TSERVENI-GOUSI (1987), on the other hand, reported eggshell thickness increasing with age in hens. NAGARAJAN et al. (1991) found no relationship between the age and the eggshell thickness in Japanese quails.

Egg weight positively correlated with yolk weight, albumen weight and eggshell weight. The results of our experiment are in accordance with the findings of BAUMGARTNER (1994) and MINVIELLE et al. (1997), who found correlations between egg weight and the weights of its component parts to be well above 0.5. On the other hand, BAUMGARTNER et al. (2008) demonstrated that the correlation between egg weight and the yolk weight, albumen weight and eggshell weight (computed from the averages of investigated traits in 20 generations) was non-significantly lower (0.432, 0.438 and 0.234, respectively). Egg weight was positively correlated with albumen weight (YANNAKOPOULOS and TSERVENI-GOUSI, 1987). In hens‘ eggs significant correlations were reported between the Haugh unit scores and other egg quality traits (BARKER et al., 1962; KOTAIAH et al., 1975).

Conclusion

Monitoring of the quality traits of Japanese quails‘ eggs is important when considering health and food safety, and storage stability. In our study, despite frequent fluctuations, the albumen index, albumen weight, albumen proportion, Haugh units, eggshell weight, and eggshell strength decreased with increasing age, but the egg shape index, yolk proportion, and eggshell proportion increased. The change in some egg quality traits of Japanese quails with age may affect the eggs´ storage length or perhaps even their hatchability. Like other poultry species, hatching results are largely dependent on the quality of the eggs. With the increasing age of the quails, the biological value and quality of eggs needed for successful development of the embryo slowly decrease. In order to obtain more results and draw more clear-cut conclusions, it is necessary to conduct further investigations into the problems associated with the storage of Japanese quails‘ eggs and changes in their quality in combination with hatchability results.

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References

ALTAN, O., I. OGUZ, Y. AKBAS (1998): Effects of selection for high body weight and age of hen on egg characteristics in Japanese quail *(Coturnix coturnix japonica)*. Turk. J. Vet. Anim. Sci. 22, 467-473.

ANDERSON, K. E., J. B. THARRINGTON, P. A. CURTIS, F. T. JONES (2004): Shell characteristics of eggs from historic strains of single comb white leghorn chickens and relationship of egg shape to shell strength. International J. Poultry Sci. 3, 17-19.

BARKER, R. C., S. L. DAVIS, D. R. MORBLE (1962): A comparison of different methods of measuring internal quality using eggs from 23 strains of Single Comb White Leghorns. Poultry Sci. 41, 1624-&.

BAUMGARTNER, J. (1994): Japanese quail production, breeding and genetics. World Poultry Sci. J. 50, 269-274.

BAUMGARTNER, J., J. KONCEKOVA, J. BENKOVA, D. PESKOVICOVA, J. SIMENOVOVA, J. SCUKA (2008): Changes in egg quality traits associated with long-term selection for lower yolk cholesterol content in Japanese quail. Czech J. Anim. Sci. 53, 119-127.

FLETCHER, D. L., W. M. BRITTON, G. M. PESTI, A. P. RAHN, S. I. SAVAGE (1983): The relationship of layer flock age and egg weight on egg component yields and solids content. Poultry Sci. 62, 1800-1805.

FUNK, E. M. (1948): The relation of yolk index determined in natural position to the yolk index as determined after separating the yolk from the albumen. Poultry Sci. 27, 367.

GONZALEZ, M. (1995): Influence of age on physical traits of Japanese quail *(Coturnix coturnix japonica)* eggs. Ann. Zootech. 44, 307-312.

HAUGH, R. R. (1937): The Haugh unit for measuring egg quality. US Poultry Mag. 43, 552-573.

HEIMAN, V., J. S. CARVER (1936): The albumen index as a physical measurement of observed egg quality. Poultry Sci. 15, 141-148.

KONDAIAH, N., B. PANDA, R. A. SINGHAL (1983): Internal egg-quality measure for quail eggs. Indian J. Anim. Sci. 53, 1261-1264.

KOTAIAH, T., V. B. AVYAGARI, IQBALUDIN, S. C. MOHAPATRA (1975): Egg-quality traits as affected by method of housing. Indian J. Poultry Sci. 10, 78-84.

MINVIELLE, F., J. L. MONVOISIN, J. COSTA, A. FRENOT (1997): Quail lines selected for egg number based on pureline or crossbred performance. Proceedings of the 12th Symposium on Current Problems in Avian Genetics (Aviagen), Pruhonice (Czech Republic). pp. 99-103.

NAGARAJAN, S., D. NARAHARI, I. A. JAYAPRASAD, D. THYAGARAJAN (1991): Influence of stocking density and layer age on production traits and egg quality in Japanese quail. Brit. Poultry Sci. 32, 243-248.

NARAYANANKUTTY, K., A. JALALUDEEN, A. RAMAKRISHNAN (1989): Effect of age on quality characteristics of Japanese quail *(Coturnix coturnix japonica)* eggs. Cheiron 18, 97-98.

NAZLIGUL, A., K. TURKYILMAZ, H. E. BARDAKÇIOGLU (2001): A study on some production traits and egg quality characteristics of Japanese quail. Turk. J. Vet. Anim. Sci. 25, 1007-1013.

ORHAN, H., C. ERENSAYIN, S. AKTAN (2001): Determining egg quality characteristics of Japanese quails *(Coturnix coturnix japonica)* at different ages. Hayvansal Üretim. 1, 44-49.

RI, E., K. SATO, T. OIKAWA, T. KUNIEDA, H. UCHIDA (2005): Effects of dietary protein levels on production and characteristics of Japanese quail eggs. J. Poultry Sci. 42, 130-139.

SACHDEV, A. K., S. D. AHUJA, R. GOPAL (1989): Feed consumption, egg production and egg-quality traits as influenced by cage-tier locations of Japanese quail. Indian J. Anim. Sci. 59, 860-865.

SAS INSTITUTE INC. (2010): The SAS System for Windows. Release 9.2.

TSERVENI-GOUSI, A. S. (1987): Relationship between parentel age, egg weight and hatching weight of Japanese quail. Brit. Poultry Sci. 28, 749-752.

YANNAKOPOULOS, A. L., A. S. TSERVENI-GOUSI (1987): Effect of breeder quail age and egg weight on chick weight. Poultry Sci. 9, 1558-1560.

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Istražen je učinak dobi japanskih prepelica (*Coturnix coturnix japonica*) na određena obilježja kvalitete njihovih jaja. Istraživanje je provedeno na sto prepelica. Prepelice su tijekom pokusa bile smještene u žičane kaveze (tri ženke po kavezu) i hranjene mješavinom s 11,2 MJ ME i 19,7% sirovih proteina. Hranu i vodu dobivale su *ad libitum*. Jaja su bila sakupljana dva uzastopna dana tijekom četiri tjedna kad su prepelice bile u dobi od 9 to 49 tjedana. Ukupno je bilo pretraženo 2060 jaja. Dob prepelica značajno je utjecala na pokazatelje kvalitete jaja osim na oblik i boju žumanjka. Brzo povećanje mase jaja ustanovljeno je u početnoj fazi nesenja. Najveća masa (13,02 g) bila je dostignuta u dobi od 25 tjedana, a potom se postupno smanjivala sve do kraja razdoblja leženja odnosno do dobi od 49 tjedana. Unatoč čestim kolebanjima, indeks bjelanjka, masa bjelanjka, proporcija bjelanjka, vrijednosti Haughove jedinice, masa ljuske i čvrstoća ljuske smanjivali su se s povećanjem dobi, dok su se proporcija žumanjka i proporcija ljuske povećavali s dobi prepelica. Masa jajeta bila je u pozitivnoj korelaciji ($P \leq 0,001$) s masom žumanjka (0,70), masom bjelanjka (0,90), i masom ljuske (0,58). Omjer Haughove jedinice bio je u pozitivnoj korelaciji s indeksom bjelanjka (0,94; $P \leq 0,001$).

Ključne riječi: japanska prepelica, dob, žumanjak, bjelanjak, ljuska jajeta