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Effect of selection for body weight in Japanese quails (*Coturnix coturnix Japonica*) on some production traits

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ABSTRACT

The aim of the study was to identify quails which have different body weight for some production traits such as egg production, egg characteristics, daily feed consumption and feed conversion ratio (FCR). The selection was based on body weight in Japanese quail over two generations using 150 quails (120 female and 30 male). These groups consisted of Low Body Weight (LBW), High Body Weight (HBW) and control. Average body weights for females at the end of five weeks were 182.3±0.5, 159.5±0.34, and 141.7±0.55 for LBW, HBW and control groups respectively. There were significant differences between females and males in body weight across the generations. Significant differences were observed for total egg production and egg width for Group X Generation's interactions. Also, statistically significant differences were found for egg quality parameters such as yolk index, yolk height, yolk diameter, albumin length, and albumin width among generations. As a result, body weight is a very important factor in selection studies and it also increases the efficiency of the selection program with other selection features.

Keywords: Body weight, Egg, Generation, Japanese quails.

INTRODUCTION

Generally, most of the breeding programs are based on economic criteria in the poultry industry. In many countries, universities, several governmental institutions, commercial companies or small unit breeders have produced their lines containing desirable traits. Recently, the Japanese quail has been proven to be an excellent model for many selection programs. They have been preferred by scientists because of the relatively small size of the adults, short time to sexual maturity, less labor and space intensive, and sufficient quantity of egg production. Additionally, quails can be utilized for meat production within a month and mature at an early age of 6 weeks, such that female birds generally reach whole yield by approximately two months (Jatoi *et al*., 2013). The studies on Japanese quails generally focus on improvement of egg production in the early periods or the body weight of fixed age quails during short- and long-term selection programs (Marks, 1996; Yolcu, 2005; Minville, 2004; Narinc and Aksoy, 2012). To date, many selection studies have been performed in the fourth or fifth weeks of quails' body weight (Nestor *et al*., 1983; Marks, 1991; Antony *et al*., 1996; Oguz and Turkmut, 1999; Steigner *et al*., 1992; Khaldari *et al*., 2010).

Selection studies have indicated that there is a highly by positive genetic correlation between the body weight of the female and its egg qualities in poultry (Marks, 1993; Alkan *et al*., 2010). Furthermore, the high mortality observed in quails with low body weight is related to the presence of a small yolk sac (Skewes *et al*., 1988).

The current study aimed to determine the effects of body weight selection in the fifth week of egg production of quails on egg characteristics, daily feed consumption, and feed conversion ratio (FCR).

MATERIALS AND METHODS

Experimental animals and treatments: This study was performed at the Poultry Unit of the Animal Science Department of the Ahi Evran University. Quails were mated conventionally (1 male + 4 females) and fed on a diet of 200 g CP and 2900 kcal ME per kg, as suggested by National Research Council (1994). The eggs from parental populations were placed in the incubator and put in the developmental machine for 15 days and were then taken to the hatchery. Water containing 3% sugar was given to newly hatched chicks. All quails were fed on a diet containing 230 g CP and 2900 kcal ME per kg for the first three weeks. Later, all of them were fed on a diet of 200 g CP and 2900 kcal ME per kg. Quails were raised in cages with controlled temperature for the first three weeks. Quails were transferred into cages (six floors each containing three different compartments) during the breeding period. Four

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females and one male quail were placed into each cage compartment. The current study was performed in a facility with 18 hours of illumination per day. A total of 150 quails were used for each generation and were classified in to three treatment groups, control, low and high body weight groups in the fifth week's quail. Selection intensity was applied 10% for male and 40% for females for two generations.

Measurement of Production Traits: Egg weight, yolk ratio, yolk index, albumen index, Haugh unit, shape index and shell weight were determined as egg quality parameters. All eggs collected from each treatment group were weighed individually. Shell weight, shell thickness (measuring the thickness of three spots on the egg air cell, equator and sharp end), yolk index, yolk height (mm), yolk diameter (cm), albumen index, albumen height (mm), albumen length (cm), and albumen width (cm) were measured according to Altan *et al.* (1995). Haugh units (HU) were calculated from the formula based on the height of the thick albumen using tripod micrometers (Stadelman, 1986). The egg shape index was calculated using egg width/length. These egg parameters were recorded from the maturity age (35 days old) to 20 weeks of age and the average egg weight values were calculated during the selection period. Egg production was calculated as hen-housed for each generation. Daily feed consumption and feed conversion ratio (FCR) were determined for the studied populations.

Statistical analyses: The data were evaluated using SPSS 16.0 statistical software package. Differences between generations were determined by F-test statistics. Analyses of variance were done in order to compare groups and an LSD test was applied to data in order to determine what factors lead to differences in the features.

RESULTS AND DISCUSSION

Average body weight in the parental populations was determined as 160 g for females (Fig. 1) and 149 g for males in this study (Fig. 2). The fifth week body weight (g) for each generation and groups including female and male are presented in Table 1. The first generation female body weights were from 171.5 to 143.9 g and the control group had a mean body weight of 158.4 g. The high body weight value for the first generation females (171.7 g) was similar to that of Toelle *et al.* (1991).

The second generation of high body weight female group was higher than the parental and first generations. The body weight differences between groups of generations were highly significant, except the parental generations ($P<0.01$). Previous selection studies also supported that the body weight of the populations significantly increased from the first generation (Marks, 1996; Oguz and Turkmut, 1999; Yolcu, 2005). The second generation female body weights for all groups were higher than male body weights. Previous studies have demonstrated that body weight gains in female populations increased during the selection periods (Toelle *et al*. 1991; Kocak *et al*., 1995; Tigli *et al*., 1996). Their observations were congruent with the results of the present study. The feed consumption, egg production, feed conversion ratio are presented in Table 1. Egg weight, shell weight, yolk weight, albumen weight and egg geometry characteristics are presented in figures 3 and 4.

Albumen weight values ranged from 6.10 g to 7.51 g. Celik *et al.* (2014) reported albumen weights between 5.68 g and 7.88 g. Additionally, Altinel *et al.* (1996), Seker *et al*. (2005), and Fidan (2005) reported weights of 6.89 g, 6.77 g, and 7.25 g, respectively. There were no significant differences between yolk ratios in quails selected for body

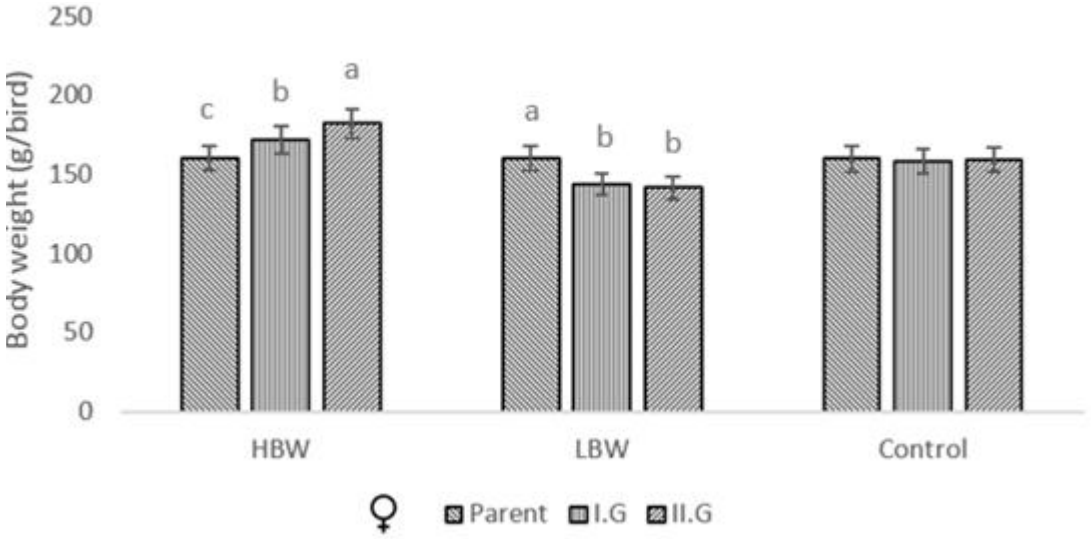

Fig 1: Effect of Selection on body weight change in female Japanese quail. Each bar represents the mean±SEM value (n=120). The different letters show the significant differences within the treatments ($P<0.05$). (G- Generation; HBW- High Body Weight; LBW- Low Body Weight)

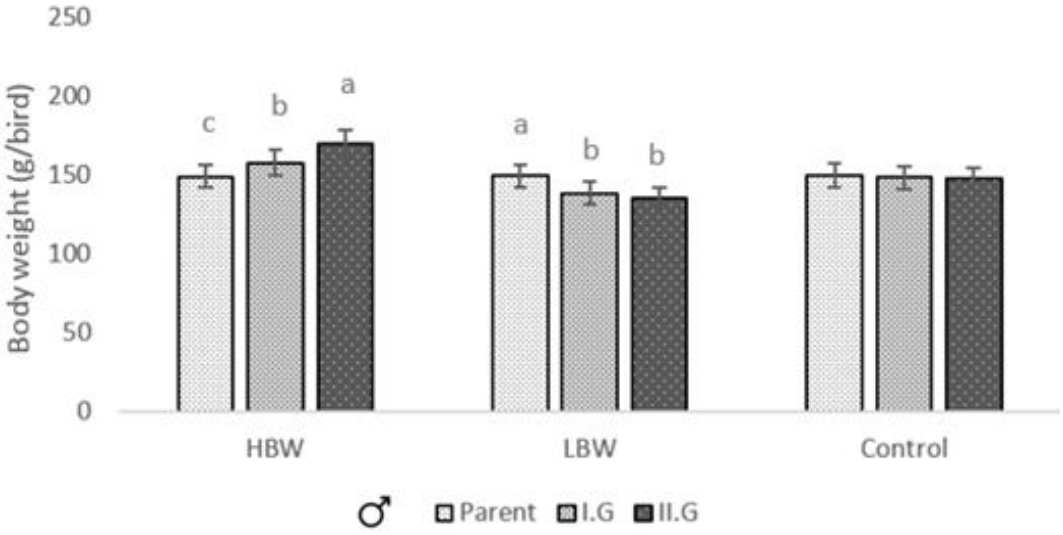

Fig 2: Effect of Selection on body weight change in male Japanese quail. Each bar represents the mean±SEM value (n=30). The different letters show the significant differences within the treatments (P<0.05). (G- Generation; HBW- High Body Weight; LBW- Low Body Weight)

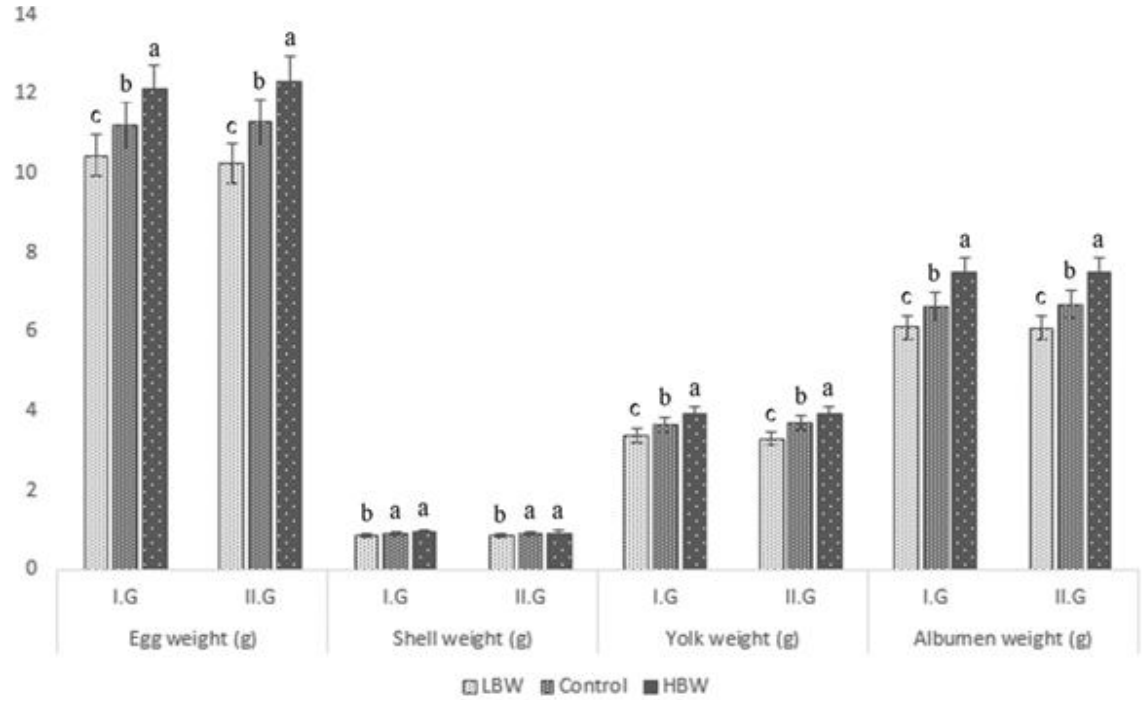

Fig 3: Effect of Selection on some egg weight traits in male Japanese quail. Each bar represents the mean±SEM value (n=120). The different letters show the significant differences within the treatments (P<0.05). (G- Generation; HBW- High Body Weight; LBW- Low Body Weight)

weight, whereas egg production, and egg weight between groups differences significantly (P <0.05). Quails in the high group of second generation had the highest feed intake (39.2g) and the lowest in low group of first generation (33.1g). Improvement in FCR is due to the population's genetic structure, and to a certain extent, diet and environmental conditions (Varkoohi *et al*., 2010). Improved FCR for a certain body weight could be partially due to lower maintenance costs and lower fat deposition of birds with higher growth rate (Pym, 1979).

The present results illustrated that when maternal body weights increase in selected populations of high body weight quails, the egg weight increased. Many studies have found a significant relationship between high levels of egg

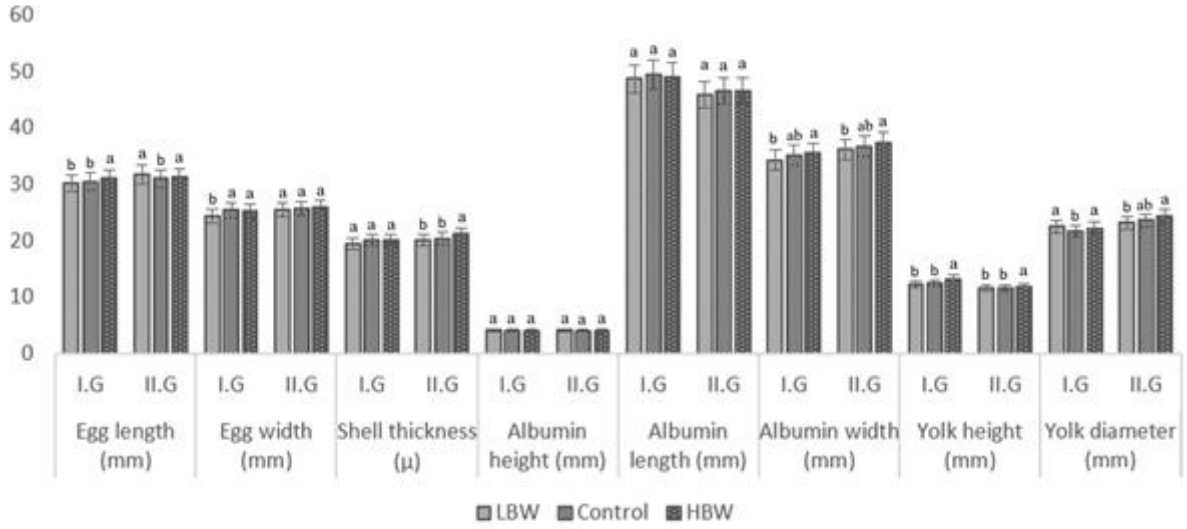

Fig 4: Effect of Selection on egg geometry change in male Japanese quail. Each bar represents the mean±SEM value (n=120). The different letters show the significant differences within the treatments (P<0.05). (G- Generation; HBW- High Body Weight; LBW- Low Body Weight)

Table 1: Performance and some egg quality traits of generations in Japanese quails (Mean±SEM).

Traits	Group	I. Generation	II. Generation	Generation Mean
Egg production (%)	Low	72.6± 0.54 b	75.3±0.72 b	73.6±0.19 b
	Control	70.9± 0.41 c	71.9 ±2.41 c	71.4±0.24 c
	High	75.7± 1.55 a	78.9± 2.16 a	77.3±1.21 a
	Mean	73.9± 0.81 B	75.9± 1.53 A	*Generation X Group: P<0.017*
Daily feed intake (g)	Low	33.1± 0.36 c	33.5± 0.29 c	33.3± 0.16 c
	Control	35.6± 0.14 b	35.4± 0.32 b	35.5± 0.12 b
	High	37.9± 0.46 a	39.2± 0.36 a	38.6± 0.51 a
	Mean	35.4± 0.23 A	36.11± 0.24 A	*Generation X Group: NS*
Feed conversion ratio	Low	4.03± 0.42 b	4.11± 0.41 b	4.06± 0.25 b
	Control	4.12± 0.38 a	4.24± 0.53 a	4.17± 0.46 a
	High	4.01± 0.19 b	3.85± 0.36 c	3.91± 0.14 c
	Mean	4.04± 0.25 A	4.01± 0.34 A	*Generation X Group: NS*
Yolk ratio	Low	32.34±0.15 a	32.26±0.18 a	32.31±0.14 a
	Control	32.52±0.19 a	32.71±0.17 a	32.61±0.17 a
	High	32.34±0.18 a	31.72±0.18 a	32.03±0.19 a
	Mean	32.59±0.17 A	32.52±0.18 A	*Generation X Group: NS*
Albumen ratio	Low	58.47±0.21 b	59.46±0.20 b	58.97±0.28 b
	Control	59.22±0.26 ab	59.24±0.24 b	59.23±0.22 ab
	High	61.88±0.20 a	60.91±0.25 a	61.39±0.24 a
	Mean	59.11±0.22 A	59.40±0.23 A	*Generation X Group: NS*
Shape index	Low	80.71±2.58 c	80.2±2.12 c	80.44 c
	Control	82.85±2.29 a	82.91±1.85 a	82.55 a
	High	81.25±1.97 b	81.45±2.03 b	81.46 b
	Mean	81.51 A	81.54 A	*Generation X Group: NS*
	Low	91.45±2.69 a	91.49±1.98 a	91.44 a
Haugh Unit	Control	90.67±2.47 b	90.68±2.14 b	90.65 b
	High	90.29±2.61 b	90.13±2.21 b	90.18 b
	Mean	90.84 A	90.70 A	*Generation X Group: NS*
	Low	0.54±0.05 b	0.51±0.03 b	0.525 b
Yolk index	Control	0.54±0.06 b	0.52±0.03 b	0.530 b
	High	0.58±0.03 a	0.56±0.04 a	0.570 a
	Mean	0.553 B	0.530 A	*Generation X Group: P<0.013*

weights and maternal body weight (Strong *et al.,* 1978; Marks, 1993; Leeson *et al*., 1991). Similarly, it was observed that an increasing proportion of egg weights led to increased shell weight. When the egg production values were evaluated, the groups with high body weight reached 182 g in the fifth week of the second generation had a greater advantage than the other groups. Nestor *et al*. (1983) found differences for egg production in three different groups that supported our findings. The egg yolk weights of different studies ranged from 3.49 to 3.80 g (Altinel *et al*., 1996; Seker *et al.,* 2005; Fidan, 2005). In the present study, the egg yolk weight ranged between 3.31 and 3.92g. The egg weight values for the control group, as presented in Fig. 3, were from 10.95 to 11.65 g. Same range values determined from different studies that used the same age control groups (Dikmen and Ipek, 2006; Altan *et al.,* 1998). The selection studies for body weight gain in poultry illustrated that there were increases in both egg weight and feed consumption (Harms *et al.,* 1982; Leeson and Summers, 1987; Inal *et al*., 1996). On the other hand, Cherry *et al.* (1987) reported that there were no significant differences for yolk proportion of eggs with low body weight and normal lines in chickens; these results were consistent with our study. On the other hand, many studies showed that the yolk ratio of large eggs is lower than that of small eggs (Denoff and Rende 1983; Marion *et al*., 1966). The egg quality characteristics by generation are given in Table 1. The shape index of eggs in the selection lines was different from the control group. Similarly, Turkmut *et al.* (1999) found that the shape index of selection lines was significantly affected.

Altan *et al.* (1998) reported that there were no significant changes in body weights, shell qualities, Haugh units, and egg productions in the selected quail lines. In the present study, the Haugh unit, which is one of the best criteria for egg qualities, was important in the low body weight group. However, the generation x group interaction was not significant. Average Haugh units were calculated as 90.13 and 91.49 for the two generations in our study. The Haugh units reported in different studies ranged from 87.791 to 88.450 (Celik *et al.,* 2014), 68.479 (Altinel *et al.,* 1996), and 88.930 (Nazligul *et al*., 2001). The average yolk indices ranged between 0.662 and 0.686 (Celik *et al.,* 2014) and 0.450 (Turkmut *et al*., 1999). In the current study, the yolk index ranged between 0.51 and 0.58. The average shell thickness was between 0.194 mm and 0.211 mm in the present study. These values are smaller than the 0.251 mm determined by Celik *et al.* (2014) and consistent with 0.189 mm obtained by Altinel *et al.* (1996), and 0.214 reported by Fidan (2005).

Albumen height values ranged between 4.57 and 4.70 in the current study. Celik *et al*. (2014) reported these values between 4.229 and 4.539 cm. The other study results for albumen height values ranged between 3.64 cm (Ozcelik 2002) and 4.12 cm (Kaya and Aktan, 2011). González (1995) reported that the albumen heights at 8, 12, 17, 21, 25, 30, 34, and 39 weeks in quails were 4.92, 4.64, 4.62, 4.28, 3.28, 4.13, 4.18, and 4.04 cm, respectively.

In conclusion, on the fifth week, body weights of quail, low and high aspects of the application of the selection at the end of two generations on egg production and characteristics are as follows: During the selection, the body weights of the second generation females for all groups were higher than male body weights. The present study demonstrated that there was no significant difference between yolk ratios in quails selected for body weight; whereas significant differences were determined for feed intake, feed conversion ratio, egg production, and weight between the groups. Furthermore, when maternal body weights increased in quails selected for high body weight, the egg weight increased. Haugh units, was significant in the low body weight groups, but the generation x group interaction was not significant in the selected groups. In the selection process, egg weight decreased in the low weight group, and increased egg weight in the high group. In conclusion, body weight is a very important factor in selection studies. Moreover, body weight selection increases the efficiency of the selection program with other selection features.

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