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BROWN PLUMAGE JAPANESE QUAILS ARE THE BEST BIRDS POPULATION FOR THE LARGE-SCALE EGG PRODUCTION

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Abstract

This study was conducted to investigate the effect of the line of Japanese quails on several production traits of 800 hatched eggs in three populations differ in plumage color, Brown-line (n = 300), Black-line (n = 220) and White-line (n = 280). Variables growth traits were examined on weekly intervals, namely live body weight (LBW), egg weight (EW), egg numbers (EN), hen day production (HD%) and feed conversion ratio (FCR) in the entire investigated period. Results indicated the presence of a significant effect of the studied lines on the majority of investigated traits. Concerning LBW, Black-line showed higher values than Brown and White lines respectively, in the last three weeks of measurements. Concerning EW, no obvious superiority was recorded for each investigated line except for the 10th week, in which significant ($P<0.01$) higher values of Brown-line were observed over the other two lines. Meanwhile, Brown-line had exhibited significantly ($P<0.01$) higher EN and HD% values over Black and White lines, respectively. On the contrary, FCR in White-line scored higher values starting from the 10th week to the end of the experiment (12th week) than Black and Brown lines, respectively. In conclusion, this study demonstrated the obvious superiority of Brown-line over Black and White lines in the egg production traits measured. Since Black-line showed relatively higher values in LBW, we may suggest it for meat production. Meanwhile, Brown-line is the best-suited population for egg production. The observed data can be used by breeders in the large-scale egg production purposes of Japanese quails.

***Key words**:* Japanese quails, production traits, eggs, weight.

Introduction

Japanese quails (*Coturnix coturnix japonica*) is the smallest farmed avian species. This small sized birds belong to the same family of chicken and pheasant (Phasianidae) and characterize with obvious similarity in their physical characteristics and behavior (Gecgel *et al.,* 2015). It is well known that Japanese quails are increasingly been widespread in poultry industry sector for meat and egg production worldwide (Dhaliwal *et al.,* 2004). These hardy birds can live in small cages (44 birds/ m^2) and inexpensive to keep (Priti and Satish, 2004). Furthermore, they have high egg production capacity, and attend sexual maturity in about 6 weeks of age. Japanese quails get their full egg production rates at around 50 days of age (Krishna *et al.,* 2015) and their substantial capacity to benefit from food is well established (Al-Daraji *et al.,* 2010, Al-Salhie *et al.,* 2017, Beski, 2019). Furthermore, many Japanese quails' populations characterize with interesting resistance to many aggressive diseases that invade chickens, with subsequent minimization for medication and vaccination strategies (Santos *et al.,* 2011).

The quails† genetic quality is one of the controlling factors in the success of Japanese quails economically, so the selection of good quality quails is extremely mandatory (Al-Shuhaib *et al.,* 2019, Dzuriatmono *et al.,* 2019). It is necessary to estimate genetic parameters for Japanese quails to set a breeding program up (Vali *et al.,* 2005). A selection program not only affects the egg production traits but also the feather color, which is associated with several candidate genes that have a likelihood with feather color. It has been found that the variations in feather colors have a strong linkage with quantitative traits (Delmore *et al.,* 2016).

Yet, it is observed that most farmers faced a problem to get a good quality of quail line for meat or egg production (Nasar *et al.,* 2016). As well, information about growth performance and feather color mutations are not enough to estimate their use for commercial

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production. For instance, many kinds of research indicated that white-feathered quails have been found to exert less body weight characters than the brown quails (Minvielle *et al.,* 2005, Petek *et al.,* 2004). Therefore, it is mandatory to compare among Japanese quails having different plumage colors to investigate to assess which one is best in terms of eggs and meat production. Thus, the proposition of the advantageous improvement strategy could be conducted by making a direct comparative study between different lines of quails. Several recent studies have been conducted to compare the productive traits in these lines of quails (Al-Khafajy *et al.,* 2018, Inci *et al.,* 2015). However, more accurate large-scale data are required to get more concise results to assess the best Japanese quails and other related birds whether in terms of eggs or meat production (Al-Shuhaib *et al.,* 2018). Therefore, this study aims to observe and determine the meat and egg production performance of three lines of Japanese quails having three distinct colors, Black-line, Brown-line and White-line. The necessity of this study can be attributed to characterize the production performance between the three lines and to help improve the breeding strategy in each specified line.

Materials and Methods

Experimental design

Initially, a total of (800) newly hatched quail chicks (Brown-line n = 300, Black-line n = 220, White-line n = 280) were randomly picked up from the available stock. All three lines were purchased from the directorate of Agricultural research / Ministry of Agriculture, Baghdad, Iraq, in which all these three lines were raised from many generations. Birds were kept under the same management conditions throughout the study at the poultry research farm of the College of Agriculture, Al-Qasim Green University. In the first two weeks' chicks exposed to continuous lighting and gradually reduced to 16 hr light and 8 hours of darkness. The temperature in quails† house was 38ºC in the first two weeks, then gradually reduced to around 20ºC in the 6th week (Al-Khafajy *et al.,* 2018). The included Japanese quails' populations were divided into two main periods; rearing period and production period. The rearing period was started from one day of birth until five weeks old. Quails at this period were fed with a starter diet consisting of 3020 Kcal/kg of feed metabolizable energy and 24% crude protein. In the meantime, chicks were kept on deep litter in individual barriers. Subsequently, the second period, production period, was started from the 6th week to the 12th week. In this period, males were excluded from the experiment and equal numbers of three populations of females (Brown-line, n = 80, Black-line, n = 80 and White-line, n = 80) were included in the study. All females of these three populations were raised in a battery cage system (Hussein *et al.,* 2019). The birds were kept under the same living conditions and received the same feed. In this production period, female quails were fed with a first laying diet consisting of 2950 Kcal/Kg of feed metabolizable energy and 20.5% crude protein (Recommended composite feed from the directorate of agricultural research/Ministry of Agriculture, Baghdad, Iraq). Birds were fed *ad libitum* and water was freely available during the study. Farm biosecurity and standard hygienic precautions were maintained strictly to prevent the outbreak of any potential infection bacterial or fungal infection (Sarhan *et al.,* 2019; Al-Shuhaib *et al.,* 2020). Sex determination was performed by observing the cloaca foam in the males at the end of 5th week (Alkan *et al.,* 2008; Hussein *et al.,* 2002).

Productive data recording

Concerning LBW, records were taken weekly for both sexes at the period of one day to 5th week of age, with a total of 800 chicks included. Following 5th week, the recording of live body weight (LBW) at the sexual maturity was restricted only on the separated females, with a total of 240 quails included. Then both egg weights (EW) and egg numbers (EN) for each line were identified by on weekly intervals (6th week-12th week). Subsequently, hen day production (HD%) was calculated, since HD% is one of the most important parameters for evaluation of egg production performance in livestock. In analyzed weeks, starting from the first day to the 12th week of birth, feed consumption ratio (FCR) was calculated since it gives a clear evaluation for broiler quails production performance in the entire analyzed period.

Statistical analysis

The collected data were analyzed by the general linear model procedure of SAS statistical package software (SAS, 2012) to explore the influence of each analyzed line (Brown, Black, and White) on the production traits measured. DuncansC multiple range test was applied in the comparison between means. The following General Linear Model (GLM) procedure was fitted to the following data; $Y_{ij} = \mu + L_i + e_{ij}$.

Where Y_{ij} is the dependent variable, μ is the overall mean, L_i is the effect of lines (Brown, Black, and White) on the production traits recorded, e_{ij} is the random residual effect of each observation. *P*-values of less than 0.05 were considered statistically significant for all comparisons. Interaction between variables was computed using univariate analysis in the general linear

model procedure of SAS statistical package ver. 9.

Results

Regarding the first five weeks of raising period (1st - 5th week), in which both sexes were recorded, our results showed significantly high values of LBW ($P < 0.01$) restricted between Brown-line and Black-line over White-line. The superiority of the Brown-line at the 1st, 2nd and 4th week was recorded, while Black-line showed higher values in the 3rd and 5th week than the other investigated lines. More remarkable superiority of Black-line after separating the two sexes from each other was observed, with exception to the 7th, 8th and 9th week, in which the Brown-line had higher body weight values. However, our results showed significantly higher values of LBW ($P < 0.01$) for the Black-line and Brown-line females in most of the analyzed weeks than the White-line table 1.

Non-significant differences in EW between the three studied lines in almost all studied weeks were observed table 2. Only one exception for this non-significant observation was detected in Brown-line. This line had exhibited significantly ($P < 0.05$) higher values of EW in the 10th week.

The same line (Brown-line) had also shown higher EN values than Black and White lines respectively in the majority of the investigated weeks table 3.

The recorded values in table 4 referred to significantly higher values of HD% ($P < 0.01$) in the Brown-line than White-line and Black-line respectively. However, White-line had given higher values of HD% only in the 6th and 7th week.

Significantly higher values for FCR ($P < 0.01$) in the Brown-line in studied 4th week to 9th week were observed. Thereafter, White-line and relatively Black-line, had scored significantly ($P < 0.01$) higher values of FCR in 10th week to 12th week than the Brown-line.

Discussion

This comparative evaluation of three different lines of quails is being conducted to find the best line convenient for egg/meat production which is considered as the

Table 1: Effect of the line of Japanese quails on live body weight (LBW).

Lines	Mean ± SE (gm)											
	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	9th week	10th week	11th week	12th week
Brown	35.0 ±0.11a	74.30 ±0.05a	100.10 ±0.05c	162.0 ±0.11a	208.3 ±0.05b	211.13 ±0.01b	224.3 ±0.05a	229.8 ±0.06a	226.3 ±0.05a	220.5 ±0.07b	226.5 ±0.05b	226.0 ±0.05b
Black	34.0 ±0.05c	71.50 ±0.07c	110.80 ±0.05a	159.0 ±0.06b	210.8 ±0.05a	211.4 ±0.07a	220.5 ±0.05b	219.5 ±0.06b	224.6 ±0.05b	231.0 ±0.05a	231.5 ±0.08a	229.5 ±0.05a
White	34.5 ±0.05b	72.50 ±0.08b	104.2 ±0.05b	151.3 ±0.06c	203.6 ±0.05c	204.13 ±0.08c	215.5 ±0.05c	212.5 ±0.07c	206.5 ±0.05c	209.3 ±0.06c	211.3 ±0.05c	213.0 ±0.07c
Level of sig.	**	**	**	**	**	**	**	**	**	**	**	**

Means having different letters in the same column differed significantly. ** ($P < 0.01$). Measurements were recorded in gm.

Table 2: Effect of the line of Japanese quails in mean egg weight (EW).

Lines	Mean ± SE (gm)						
	6th week	7th week	8th week	9th week	10th week	11th week	12th week
Brown	8.10±0.95a	9.90±0.05a	10.80±0.07a	10.90±0.05a	11.10±0.08a	11.20±0.05a	11.20±0.06a
Black	9.30 ±0.08 a	9.90 ±0.05 a	10.70±0.06a	11.00 ±0.07a	11.10±0.05a	11.20±0.07a	11.30±0.05a
White	9.30 ±0.06 a	10.00±0.05a	10.60±0.07a	10.80 ±0.05a	10.60±0.08b	11.20 ±0.05a	11.30±0.06a
Level of sig.	NS	NS	NS	NS	*	NS	NS

Means having with the different letters in the same column differed significantly. *($P < 0.05$).

Table 3: Effect of the line of Japanese quails in mean egg number (EN).

Lines	Mean ± SE						
	6th week	7th week	8th week	9th week	10th week	11th week	12th week
Brown	38.60 ±0.05c	59.70 ±0.05a	70.30 ±0.05a	69.40 ±0.05a	69.10 ±0.05a	70.70 ±0.05a	78.30 ±0.05a
Black	39.90 ±0.05b	57.70 0.05±c	61.90 ±0.05b	61.60 ±0.05b	56.40 ±0.05c	64.40 ±0.05b	71.80 ±0.05b
White	49.10 ±0.05a	59.40 ±0.05b	60.90 ±0.05c	60.60 ±0.05c	62.00 ±0.05b	61.30 ±0.05c	66.00 ±0.05c
Level of sig.	**	**	**	**	**	**	**

Means having different letters in the same column differed significantly. **($P < 0.01$).

cornerstone for breeders' demands. This study showed obvious LBW superiority toward the Black-line and with a little extent to Brown-line. This trait, alongside the other production-related traits, was measured successively on a weekly basis. In the present study, a variety of fluctuated LBW values were commonly observed among the three investigated lines in this trait. These variations may be due to both genetic and non- genetic factors. However, the present study found that it is profitable to raise quails for the first five weeks of age because the weight gain progress attends its highest ratio in this short period of life. On the other hand, several reports were suggested that the LBW was affected by the gender of the birds (Akbarnejad *et al.,* 2015, Khaldari *et al.,* 2010). This is since females are bigger in body size than males, so it is profitable to be raised after two sexesC separation. However, many researchers have relatively agreed with our recorded LBW values as these data have indicated relatively high carcass weight for both Brown and Black lines than the White line (Minvielle *et al.,* 2005; Petek *et al.,* 2004; Sogut *et al.,* 2015). Interestingly, the recorded LBW values in the Brown-line were decreased at 9th to 12th weeks of the experiment. These reduced LBW values may be related to the high efforts performed by this line to produce a higher number of eggs (Pu *et al.,* 2016). For this reason, larger amounts of the consumed food were utilized in egg production and maintenance requirements instead (Yamane *et al.,* 2007).

The present study detected a remarkable role for plumage color in egg production. This observation comes in line with a mass of results that found significant differences in egg production among different lines of quails (Ashok and Reddy, 2010; Hussein *et al.,* 2020). Interestingly, there are several different results about egg production in Japanese quails, some of these in concert with our present study and others are not. However, no easy explanation for these differences is plausible, but the variation in the environmental conditions and sampling error caused by a limited sample size could not be excluded from such explanation (Prado-Gonzalez *et al.,* 2003).

The most important parameters of feed consumption are based on FCR, which is usually measured as the ratio of feed intake to weight gain (Varkoohi *et al.,* 2010). However, there is considerable interest in breeders worldwide to improve FCR values, being a major objective in most breeding programs (Yi *et al.,* 2018). The best FCR values were recorded at almost the first five weeks of age for the White-line, followed by Black-line and Brown-line, respectively. However, after sexual maturity, Brown-line scored better FCR, as well as HD%, values than both Black and White lines. These values indicated that the most economic line in the egg production period is the Brown-line, due to its low FCR.

In conclusion, it can be stated from the obtained data of the current investigation obvious superiority of the Brown-line for egg production and relative superiority of the Black-line for meat production. However, the present

Table 4: Effect of the line of Japanese quails in Hen day production (HD%).

Lines	Mean ± SE (HD%)						
	6th week	7th week	8th week	9th week	10th week	11th week	12th week
Brown	48.20 ±0.05c	74.66±0.07b	87.90±0.05a	86.80±0.08 a	86.40±0.05a	88.40±0.06 a	97.80±0.05 a
Black	49.80±0.06b	72.10±0.05c	77.30±0.06c	77.00±0.05 c	70.50±0.08c	81.60 ±0.05c	90.90±0.06c
White	65.90 ±0.05a	79.40±0.07a	82.10±0.05b	82.10±0.08 b	86.10±0.05b	85.50±0.06b	92.80±0.05b
Level of sig.	**	**	**	**	**	**	**

Means having different letters in the same column differed significantly. **(P < 0.01).

Table 5: Effect of the line of Japanese quails on feed conversion ratio (FCR).

Lines	Mean ± SE (kg/kg)											
	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	9th week	10th week	11th week	12th week
Brown	2.04 ±0.01a	1.41 ±0.01a	2.30 ±0.05a	2.80 ±0.05b	2.40 ±0.05a	4.10 ±0.05c	3.90 ±0.05b	3.80 ±0.05b	4.20 ±0.05b	3.40 ±0.05b	3.20 ±0.05b	2.30 ±0.05b
Black	1.76 0.01b	1.50 ±0.05a	1.80 ±0.05b	3.10 ±0.05a	2.50 ±0.05a	5.70 ±0.05a	5.00 ±0.05a	4.30 ±0.05a	4.60 ±0.05a	4.10 ±0.05a	2.80 ±0.05c	2.70 ±0.05a
White	1.42 ±0.01c	1.48 ±0.01a	1.80 ±0.05b	2.96 ±0.01ab	1.98 ±0.01b	5.50 ±0.05b	3.90 ±0.05b	3.70 ±0.05b	4.00 ±0.05c	4.04 ±0.05a	3.90 ±0.05a	2.70 ±0.05a
Level of sig.	**	NS	**	**	**	**	**	**	**	**	**	**

Means having different letters in the same column differed significantly. **(P < 0.01).

study did not suggest breeders consider the White-line for large-scale production purposes, whether in eggs or meat production. This study could be used to assist breeders to choose the best-suited line of Japanese quails for their intended particular production program.

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