COMPARATIVE STUDY OF HATCHABILITY AND FERTILITY RATE AMONG LOCAL QUAILS

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ABSTRACT

An experiment was conducted to evaluate fertility, hatchability, egg weight and egg production traits from three different lines of local quails. A total number of 945 eggs (334, 321 and 290 for desert, brown and white, respectively), from 20 weeks of age were used in the study. White quail significantly (P≤0.05) produce higher egg weight (12.79 ± 0.08 g), chicks' weight (8.89± 0.02 g), percentage of mortality (2.34 ± 0.70 %) and Hen-day egg production (79.33 ± 0.98 %) comparing with other local quails. While local brown quail have significantly (P≤0.05) higher percentages of fertility and hatchability which averaged 79.11 and 86.80%, respectively. The higher total number of egg and low mortality percentage (0.93 ± 0.40 %) were recorded for desert local quail. The significant positive correlation (P≤0.001) were observed between the eggs weight and chick weight, fertility and hatchability, eggs weight and hatchability were arrived 0.276, 0.180 and 0.872, respectively. But non significant negative correlation recorded between chick weight with both of fertility and hatchability. These results show that there are good among of variance in performance production among different local quails, its means the selection process among these types of bird can play major role to speed up and increasing the economical traits of local quail in Iraqi Kurdistan region.

Keywords: Local quail, Egg weight, HD, Fertility, Hatchability, Mortality.

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دراسة المقارنة في النسبة الفقس والخصوبة بين السلالات المحلية من السمان

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المستخلص

تم إجراء تجربة لتقييم النسبة الخصوبة والفقس ووزن البيض وإنتاج البيض من ثلاثة خطوط مختلفة من السمان المحلي. ومع استخدام 945 بيضة (334 ، 321 و 290 من كل للصحراء والبني والأبيض، على التوالي)، عند عمر 20 أسبوعًا من خلال هذه الدراسة. ينتج السمان الأبيض بشكل كبير عند مستوى (P≤0.05) وله أعلى وزن بيض (12.79 ± 0.08 جم)، وزن الكتاكيت (8.89 ± 0.02 جم)، نسبة الهلاكات (2.34 ± 0.70٪) وإنتاج بيض الطير (79.33 ± 0.98٪) مقارنة مع السمان المحلية الأخرى. في حين أن السمان البني المحلي لديه نسب عالية (P≤0.05) من الخصوبة و الفقس التي بلغ متوسطها 79.11 و86.80 ٪، على التوالي. في حين وجد ارتفاع في العدد الإجمالي للبيض و انخفاض في نسبة الهلاكات (0.93 ± 0.40 ٪) في السمان الصحراوي المحلي. وقد لاحظ بأن وجود أرتباط وراثي موجب معنوية (P≤0.001) بين وزن البيض ووزن أفراخ، والخصوبة والفقس، ووصل وزن البيض ونسبة الفقس إلى 0.276 و 0.180 و 0.872 على التوالي. ولم توجد أية فروق معنوية (ارتباط وراثي السالب) بين وزن الافراخ مع كل من الخصوبة والفقس. توضح هذه النتائج وجود تباين كبير في الأداء إنتاجي بين السمانات المحلية الثلاثة، وأشارت نتائج الدراسة أن عملية الانتخاب بين هذه الأنواع من الطيور يمكن أن تلعب دورًا رئيسيًا في تسريع وزيادة السمات الاقتصادية للسمان المحلي في إقليم كردستان العراق.

الكلمات المفتاحية: السمان محلي, وزن بيض, انتاج بيض اليومي, نسبة خصوبة و الفقس و نسبه الهلاكات.

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INTRODUCTION

Local quail is one of the importance genetic resources because of its adaption to environment. Different lines of quail are nowadays bred in Kurdistan Region as supply the local markets with testy types of eggs and meet. It has also assumed worldwide importance as a laboratory bird model for research Kayang *et al.*, (22). Females start laying egg after 35 days and after 50 days they reach their full production by (50) days, high rate of egg production. With 3 to 4 generations per year the quail has a short generation interval, with 3 to 4 generations per year and the economy of production results from its small body size, faster growth rate, early sexual maturity Alkan *et al.*, (3) . Due to short egg incubation period (17 days) and because of high reproductive properties, quail has become remarkably have increased its popular in poultry industry for commercial production of egg Minvielle, (24). Compared to commercial layers quail hen is a bird that is highly potential to produce eggs with maximum number (350) weighting 10-12 grams each, which is 20 times her body weight Hrnčár *et al.*, (16). Moreover, as proved by scientific experiments in laboratories, quail is resistance to diseases accompanied by high egg production. In addition, its meat has a unique taste. These characteristics have made this bird highly appropriate for scientific experimentations Scholtz *et al.*, (33). Genetic parameters need to be estimated well, improvement in the traits of the bird, and this is highly important in measures taken to create an efficient breeding program (Vali *et al.*, (37). The traits of egg production and plumage color can be remarkably affected by a selection program. Moreover different candidate genes determine the plumage color which is correlated with quantitative traits Delmore *et al.*, (11). In addition, egg characteristics, abdominal fat, and body weight have a significantly effect on the plumage color Minvielle *et al.*, (25). It should be noted that recent genotyping studies have focused on the plumage color phenotype which it has been found as the major reactive expression of the complicated genetic composition among Japanese quails Badyaev *et al*., (4). Breeds and genotypes have been reported to different egg quality and hatchability Alkan *et al.*, (2). one of the most significant characteristics of parent stock performance has been stated to be fertility and hatchability (which are reproductive traits) Hunton, (18). The interaction between paternal and maternal gametes to make a viable zygote is referred to as fertility which is expressed in terms of the quantity of fertile eggs per bird. However, the ratio between unfertilized eggs and fertile eggs producing viable birds is referred to as hatchability Barbato *et al.*, (6). Moreover, hatchability is the composite of the maternal contribution in the survival of the embryos and the ability of the embryos to survive Savegnago *et al.*, (33) the survival of embryos can be influenced by various factors including as it can affected by numerous factors such as fertility, egg quality, handling of eggs and management conditions during incubation and hatching, handling of eggs, egg quality and fertility. Furthermore, it has been reported that weight of the day-old chick and hatchability can affect egg quality and fertility Farooq *et al.*, (12). Therefore present study aimed comparing among three lines of local quail for egg performance traits in Kurdistan region, Iraq.

MATERIALS AND METHODS

Location of the experiment

The experiments were carried out at Grdarasha Research Centre, Animal Resources department, College of Agriculture Engineering Science, Salahaddin University-Erbil.

Incubation and hatching

A total of 945 fertile eggs were collected from three different lines, desert, (n=334), brown (n=321), and white, (n=290) line (Figure 1). The gathered eggs were numbered based on the line and kept for a period of ten days in a storeroom with relative humidity of 75 - 80% and temperature 15 - 20 °C. After egg collection for 10 days, the eggs were placed in an electric incubator for pedigree hatching. The eggs were incubated for 15 days then were transferred to the hatchery part for another three days.

Figure1. The studied three quails, including desert, brown, and white populations (right to left, respectively) in the current study of both sexes that photographed at the hatching time

Experimental design and housing

The parent stock 20 weeks old was divided into ten families per line; the mating system was in a ratio of three females to one male, which were kept together in separate cages. The eggs were gathered separately from the cages in which each family were kept separately in three lines. The collected eggs were later transferred to the incubator. The incubation time period for quails is 17-18 days. After hatching, the offspring of each cage were identified manually. During the first 3 weeks of their age, All of the offspring were raised in battery brooders and then were transferred to growing cages until 6 month of age. The birds were housed in 38 cages each for male and female quails, and each cage housed 8 quails. water and Feed were supplied *ad-libitum*. The group was fed with 24% protein and 2900 k cal - ME/ Kg between 1-35 days of age, and then changed to a ration contained 23%protein with 2820 K cal - ME / Kg during the egg production period and light provided for 24 hours.

Measurement of Traits

Hatch weight; The hatched quail weight was taken at the hatchery before transferred to the breeding farm

Fertility: Fertility was specified according to total eggs set as in following equation:

$$\textbf{Fertility Percentage} = \frac{\textbf{Number of fertile eggs}}{\textbf{Total egg set}} \times \frac{100}{1}$$

Hatchability; Hatchability was shown basis on total eggs set and fertile eggs and as in this equation.

$$\textbf{Hatchability percentage based on fertile egg} = \frac{\textbf{Number of hatced chicks}}{\textbf{Total fertile eggs}} \times \frac{100}{1}$$

Hatchability percentage on the base of total egg set (reproductive capacity)

$$\frac{\textbf{Hatched chicks}}{\textbf{Total egg set}} \times \frac{100}{1}$$

Mortality rate: The mortality percentage was calculated on weekly basis for the first 6 weeks. The following formula was employed:

$$\textbf{Mortality rate} = \frac{\textbf{Number of dead quails per the week}}{\textbf{Number of quails in the begining of the week}} \times \frac{100}{1}$$

Hen-Day

From the first day of sexual maturity (50% of birds laid eggs), the numbers of the egg (the gathered eggs) and egg weight (gm) were recorded on a daily basis, and it was continued up to two weeks following maturation. A sensitive electronic scale was used to take the egg for each quail hens.

Part-lay Hen Day Production (% HDP)

$$\textbf{\% HDP} = \frac{\textbf{Total egg laid}}{\textbf{No.of birds housed} \times \textbf{No.of days since hen laid}} \times 100$$

Statistical analysis

To analyze the data for quail egg production, the PROC GLM (General Linear Model) procedure SAS, (31) was utilized. Fixed effects study was: using the following model, quail lines were fitted:

$$Y_{ij} = \mu + A_i + \varepsilon_{ij}$$

Where: Y ij = Egg production, egg weight, quail chick weight, egg weight/ chick weight, % Mortality, % Fertility, % Hatchability of j^{th} quail, of i^{th} line (Ai, i=1, brown, i=2, desert and i=3,white); μ = Population mean; ε_{ij} = random error. It was assumed to be independently and normally distributed with mean zero and variance $\delta^2 e$.

In order to calculate the significant difference amongst three lines of quail, Duncan's multiple range for a parameter was employed. The PROC Corr procedure SAS, (31) was used to define the simple correlation among egg

weight, chick weight, fertility and Hatchability.

RESULTS AND DISCUSSION

Egg and hatch weight : Table 1show the results of lines effect on egg weight, chick weight and chick: egg weight ratios of three different line plumage colors. Different weights were significantly (p≤0.05) observed for desert, brown and white quail eggs which were respectively 12.42 ± 0.20, 11.68 ± 0.33 and 12.79 ± 0.14. This difference could be contributed to the fact that the studied lines were. Also, chick weight of three lines had a significant effect. However, there was no significant differences were detected in chick: egg weight ratios. A total clear superiority of White line of egg weight, chick weight and chick: egg ratio than that of their counterparts. These findings were agreement with results of Hussain *et al*., (18) indicated that the egg weight can be a significantly (P≤0.01) affected by lines. Similarly, Nwachukwu *et al.,* (28) weight of hatched chicks was higher in the white lines compared to brown lines of quails. As reported by Faruque *et al*., (13) and Islam *et al*., (20) White line quails had a higher percentage values of chick: egg weight ratio (65.25%) compared to brown, Black, and Japanese chicks. As observed in the current study increased egg weight led to higher chick weight. Similarly, Seker *et al*., (34) showed that there was a significant higher correlation between the chick weight and egg weight, the chick weight increase due to increasing egg weight.

Table 1. Chick weight, egg weight and chick: egg weight ratio of local quail as affected by genotype

Local lines	Weight of incubated eggs (g)	Chick weight (g)	Chick: egg weight ratio (%)
Desert	**12.42 ± 0.11^{b}**	**8.41 ± 0.05^{b}**	**68 ±0.92^{a}**
Brown	**11.68 ± 0.12^{c}**	**7.96± 0.06^{c}**	**68.3 ±0.46^{a}**
White	**12.79 ± 0.08^{a}**	**8.89 ± 0.02^{a}**	**70 ±0.85^{a}**

The different litter at each colum means there are significant difference between means.

Fertility and Hatchability=The data in Table 2, showed that the fertility rate and hatchability percentage were significantly higher (p≤0.05) for eggs produced from different plumage color lines of quails, while the brown line had given the highest 79.11 ±0.43 and 86.80 ±0.79 values in fertility and hatchability traits than desert and white. This hatchability value is more than the values observed by Khurshid *et al.*, (2004) who reported the hatchability percentage on total egg set as 55.14%. However, they were less than those reported by Farooq *et al.*, (12) and Daikwo *et al.,* (9) with respectively 61.31±1.93 and58%. These results were also in the line with those of the study conducted by Nwachukwu *et al.,* (28) who reported that the fertility and hatchability percentage can be significantly affected by different color variants of quails. Unlike these findings; however, Yang et al., (40) indicated that white light color led to eggs production with higher hatchability percentages. Furthermore, Islam *et al.,* (20) reported that the lowest hatchability of incubated eggs belonged to black quails (31.03%) and the height to quails genotype (71.01%). While, Vali *et al.*, (37) and Wahab *et al.*, (39) were recorded non-significant differences (P≤0.05) for fertility and hatchability between two quail strains.

Mortality

The results in Table 2 show a significant (P≤ 0.01) influence on the mortality rate among different plumage color lines of quails. The mortality rate of the white lines 2.34 ±0.40 was higher than that of the desert 0.93 ±0.70 and brown1.20 ±0.57. These results are similar to those observed in a previous finding of the study by Vieira and Moran, (38) who observed a lower level of mortality among heavier quails hatched from heavier eggs compared to lighter chicks hatched from smaller eggs. In line with this finding, Inci *et al.,* (19) reported that the mortality rate of the wild-type quails was lower than that of the white-type quail. While, Nwachukwu *et al.,* (28) reported that the mortality non-significant differences between Panda white and Cinnamon brown of quail.

Table 2. Hatch weight, fertility, hatchability and Mortality of local quail as affected by genotype

Local lines	Fertility (%)	Hatchability (%)	Mortality (%)
Desert	72.54 ± 0.59[c]	81.20 ± 0.88[b]	0.93 ±0.40[b]
Brown	79.11 ± 0.43[a]	86.80 ± 0.79[a]	1.20 ±0.57[b]
White	76.65 ±0.89[b]	85.30 ± 0.93[a]	2.34 ±0.70[a]

The different litter at each colum means there are significant difference between means.

Egg production

According to the results of the current study hen day (HD) egg productions traits were significantly influenced by the lines. This was observed in the white line which proved to have remarkably significant values (P≤0.01) in the hen day than other two lines (Table 2), where white birds are lighter than desert and brown. In quite agreement with this finding, Nestor and Bacon, (27) figured out that heavy Japanese quail had lower egg production and light quails had higher egg production. They contributed this difference to the fact that small-size quails had higher number of mature ovarian follicles. Jatoi *et al.*, (21) and Bagh *et al.*, (5) also reported the similar findings. Another study that reported by Genchev, (2012)who conducted an experiment on two breeds of Japanese quails Pharaoh (PH) and Manchurian Golden (MG) breeds, they concluded that egg production was very high significantly (P≤0.001) in both breeds with mean egg production intensity of 75,8% and 80.5% in PH and MG breeds, respectively. Dauda *et al*., (10) indicated that the hen-day egg production was 25.77 in the 3rd month of lay, while number of part-period egg was 62.43±0.23 eggs / hen.

Table 2. Total egg numbers and egg production of local quail as affected by genotypes

Quail lines	Number of egg	Hen-day(HD)
Desert	334	70.23±0.39 [b]
Brown	321	75.23±0.57[ab]
White	290	79.33±0.98[a]

The different litter at each column means there are significant difference between means.

Egg number

As found in the current study up to 20 weeks of ages, the white line laid a significantly (P≤0.01) higher number of eggs in (23.80±0.71) compared to other lines (Table 2). This finding is in good agreement with the results of the study stating that different plumage color lines of quails affect the egg number Al-Kafajy *et al.*, (1). In line with this finding Yilmaz and Caglayan, (2008) reported that white lines were remarkably superior regarding the number of eggs. This finding has also been approved by other reports showing that different lines of quails have significantly different egg production Islam *et al*., (20) and Rahman *et al*., (29). Daikwo *et al.*, (8) have also reported similar results, i.e. quail hens lay an average number of 248 eggs per year. (Narinc *et al.*, 2014) showed that the total eggs number (EN) up to 20 weeks of age was 78.89 in Japanese quail. Vali, (2007) who studied the egg production of two strains of quail (i.e. CO: Coturnix Japanese; and Ra: Range quail Coturnix ypisilophorus). There was indicated significant (p≤0.01) difference of lying (%) for a period of 135 days of ages in two quail strains (CO and Ra) was 73.42 and 74.12 respectively. According to the results reported by Hassan and Abd–Alsattar, (18) white, black and brown quail varieties were insignificantly different in terms of egg number traits. Salih, (30) reported a non- significantly (p>0.05) difference among three quail lines as (white, light brown and dark brown) regarding egg number. In terms of egg productivity and live body weight, the results of the current study revealed egg production and body weight were negatively correlated. This correlation was vivid in the white and brown lines because the white line showed lower body weight values and higher egg productivity values compared to the brown line. The results of the studies carried out by Silva a *et al.*, (35) and Baylan, (7) also showed a similar negative correlation in several quail variations.

Correlation in between Fertility and Hatchability Parameters in the three local quails

Correlations for incubated eggs weight, chick weight, fertility and hatchability of eggs laid by quails of different plumage color lines are at different levels (Table 3). The correlation coefficient was determined between the incubated eggs weight and chick weight,

percent fertility and percent hatchability, weight of incubated eggs and hatchability in three lines were in positive significant (r = 0.276, 0.180 and 0.998, respectively). Whereas, the fertility and hatchability had were negative correlation with the chick weight. Nwachukwu *et al.*, (28)who reported similar findings in significant correlation between Panda white and Cinannon brown quails regarding their hatchability and fertility parameters. However, as opposed to the results of the current study, Khurshid *et al.*, (23), Alkan *et al.*, (2) and Daikwo *et al*., (9) reported a significant correlation coefficients (r = 0.96) between egg weight and chick weight.

Table 3. Correlation Coefficients of incubated eggs weight, chick weight, fertility and hatchability obtained from quails of different plumage color lines

	Weight of incubated eggs	Chick weight	Fertility	Hatchability
Weight of incubated eggs	-			
Chick weight	**0.276****	-		
Fertility	**0.173**	**-0.090** $^{n.s}$	-	
Hatchability	**0.180***	**-0.086** $^{n.s}$	**0.998*****	-

*****P ≤ 0.001, **P ≤ 0.01, *P ≤ 0.05, ns = non significant**

CONCLUSION

According to the results obtained in the present study, reproductive properties were higher in both white lines compared with the brown and desert lines. Moreover, white quails were found to have better performance regarding HD and egg production trait, while the brown line had higher in fertility and hatchability. In addition, as white quails were particularly preferred for egg production purposes. The significant positive correlation observed between fertility and hatchability, incubate egg weight and chick weight parameters were suggestive of phenotypic associations that could be exploited to influence the outcome of incubation of quail eggs. These results show that breeder can make the selection process among these types of bird to speed up and increasing the economical traits of local quail in Iraqi Kurdistan region.

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