Comparison Among Three Quail (*Coturnix coturnix* spp) Lines in Their Productive Performance

Shekhmou Hussen*(1) and Jameela Saleh(1)

(1). Department of Animal Production, Duhok University, Kurdistan Region, Iraq.
(*Corresponding author: Dr. Shekhmous Hussen; E-mail: sheikhmous68@gmail.com).

Received: 12/09/2019 Accepted: 17/10/2019

Abstract

A total of 600 quail chicks from 3 lines (White-W, Light Brown-Lb and Dark brown-Db) were brought from Department of Animal production, Faculty of Agriculture, Sallah-Aldein University, Erbil, KR-Iraq. This work was conducted at the Poultry Farm of Animal Production Department, College of Agricultural Engineering Sciences, University of Duhok, Kurdistan region, Iraq. The aim of experiment was to investigate the productive performance of three quail lines under Duhok region environment during 2016. The birds were reared in cages and the feed was supplied manually and submitted ad libitum. The following characters were studied during growth and egg production stages: Live body weight (BW), body weight gain (WG), feed intake (FI), feed conversion ratio (FCR), sexual maturity, egg weight (EW), egg number (EN), egg mass (EM), mortality rate, fertility and hatchability. The main results from the present study could be summarized as follow: BW trait was highly significant differed ($p<0.01$) among the studied lines at 1, 2 and 3 weeks old; and was differed significantly ($p<0.05$) at 4 weeks old, where brown lines surpassed white ones. Other traits (WG, FI, FCR, EW, EN, EM, fertility and hatchability) didn't differ significantly ($p>0.05$) among the studied lines at all studied ages. The lowest mortality rate was recorded to Lb line (0 %). As conclusion, the Lb line had the best productive performance.

Key words: Quail, Meat production, Egg production.

Introduction:

Quail birds are valuable resource for meat and eggs, in addition to resistance to hard environmental conditions. Nowadays, different lines of quail are reared in Kurdistan region in order to provide the local markets with delicious kinds of meat and eggs.

Rearing Japanese quail is consider as an economic method for egg production, due to their early sexual maturity (35 days), high annual egg numbers (250–270 eggs), resistance perfectly to common poultry diseases and more persistence for egg production with high level up to 1.5 years (Murakami and Ariki, 1998). Piao *et al*., (2004) studied two quail lines and its crosses, which were very small line (SS), random bred population (RR) and their crosses (SR). They concluded that the differences in body weight (BW) among three groups, were highly significant ($p<0.01$), and the RR quail was heavier than SS birds. The SR crossbreds were intermediate between the two parental lines, and the weight of SR females at the age of four or six weeks was a little above that of the average of the value of the parents. Rezvannejad *et al*., (2013) concluded that there were significant differences ($p<0.05$) between the means of weight gain

(WG) in two Japanese quail lines. Drumond *et al*., (2015) studied the performance of four strains of quails (L1, L2, L3 and L4) and their crosses, to evaluate the average daily feed intake (FI) and feed conversion ratio (FCR) at 35 and 42 days old. They reported that there were significant differences in both FI and FCR among the studied genotypes from hatch to 35 days of age. Hussen *et al*., (2016a), stated that BW and FCR in Japanese quail are affected significantly by selection, while both WG and FI are not. In another investigation conducted by Daikwo *et al*., (2011) on Japanese quail in tropical environment (Nigeria). The author concluded that there is a significant correlation between hatching chick weight and egg weight (EW). In an experiment conducted by Mahipal *et al*., (2001) whose study three quail lines (B, H and M) and their crosses, they found that the crosses surpassed significantly their parents for age at first egg, egg number (EN) and EW. They concluded that the crosses and reciprocal crosses recorded significantly ($p<0.05$) higher averages of both fertility and hatchability (95.5% and 70.9, respectively) than their pure lines. Hussen *et al*., (2016b) concluded that EW trait in J. quail is responded to selection.

The aim of experiment was to investigate the productive performance of three quail lines under Duhok environmental conditions.

Materials and Methods

A total of 600 quail chicks from 3 lines (White-W, Light brown-Lb and Dark brown-Db) were brought from Department of Animal production, Faculty of Agriculture, Sallah-Aldein University, Erbil. This work was conducted at the poultry farm of Animal Production department, College of Agriculture, University of Duhok, Kurdistan region, Iraq, 2016.

Housing and rearing:

The healthy unsexed chicks from each line were distributed during the growth period (from 1-35 days old) in cages (85X85X 85cm) with two replications for each. Then at 35 days old, the healthy birds were sexed and redistributed on the cages as separate families (15 females and 8 males) having 18 replications for each line (diallel cross design).

The birds were supplied with metal feeders and plastic drinkers. The house and the equipment were thoroughly washed and disinfected. The lighting was supplied continuously in the first two days, and then decreased 2 hr. /week, until 35 days old (which become 15 hr. lighting and 9 hr. darking at day). The temperature inside the house was averaged (36º C) in the first week, and then it was decreased gradually by 2 Cº/ week, up to 8 weeks of age, using fans (Figure 1).

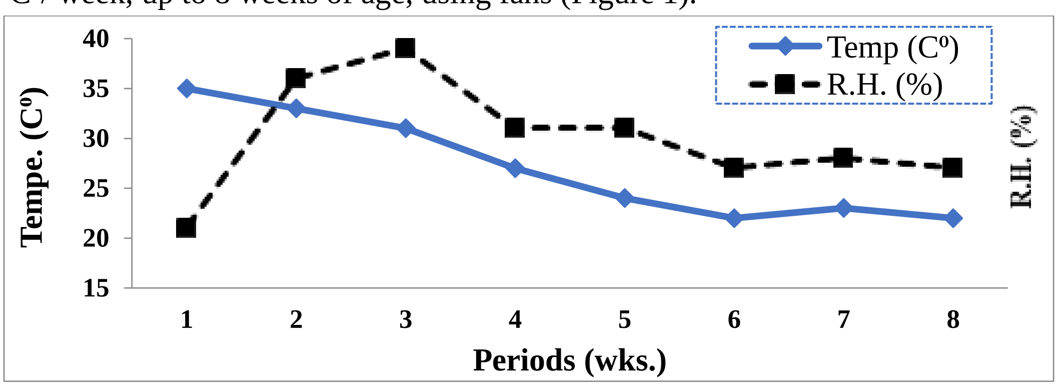

Figure 1. Temperature (Cº) and relative humidity (%) during the trial periods (wks.)

The feed was supplied manually and submitted ad libitum, which included three rations (Table 1); starter (2900 ME/kg & 24 % CP) from 1 day to 21 days old, grower (2700 ME/kg & 22 % CP) from 22 -42 days old and layer or breeder (2800 ME/kg &18 % CP) from 43 days to end of trial), respectively, according to Lesson and Summers (2005).

Table 1. Rations and its chemical composition which were submitted to the quail chicks during the experimental periods.

Ingredients %	Starter (0-4 wks.)	Grower (4-6 wks.)	Breeder (6-end trial)
Yellow corn	40	50	60
Soya bean meal 44%	50	35	22
Wheat bran	3.4	7.2	4.7
Vegetable oil	4	3.5	2
Limestone	1.5	3	9
Dicalcium phosphate	0.8	1	2
Salt (Na cl)	0.2	0.2	0.2
Vitamins and Minerals	0.1	0.1	0.1
Total	100	100	100
Chemical composition:			
ME / Kg diet	2850	2850	2737
Crude Protein %	26	21	15.7
C/P ratio	109.6	135.7	174.3
Standard C/P ratio	110	140	175
Ca+2	0.9	1.48	3.93
P	0.63	0.64	0.74

The Studied Traits:

The following characters were studied during the experiment:

Live body weight and body weight gain: Chicks body weight (BW) of each replicate within each line were weighed (in gm.) weekly and individually from 0 up to 6 weeks of age, using a sensitive digital balance (accuracy up to 1 gm.). The body weight gain (WG) was calculated by using the following equation:

$$\text{WG (gm.)} = \text{BW (at the second week)} - \text{BW (at the first week)}$$

Feed intake and Feed Conversion Ratio: Feed intake (FI) of both growing and laying periods in each cage was recorded weekly (in gm.) and the feed conversion ratio (FCR) was calculated using the following two equations (Hussen, 2000):

1- For growing period:

$$\text{FCR} = \text{(Feed intake during a certain period) / weight gain during the same period}$$

2-For laying period:

$$\text{FCR} = \text{(Feed intake during a certain period) / egg mass during the same period}$$

Sexual maturity: The sexual maturity age of the birds within each line was determined by the age of quail in which the egg production percentage was reached 50%.

Egg Production: The egg weight (EW) in gram and egg numbers (EN) were recorded daily, since the first day of sexual maturity, the egg mass (EM) was computed within each line according to the following equation:

$$\text{EM (gm.)} = \text{(Egg number in a certain period)} * \text{(Average egg weight in the same period)}$$

Fertility and hatchability: Eggs of each family (replication) within each line were collected separately and stored in room with average 12.5 C°, for 7 successive days. Then all eggs incubated on 37.5 C° with 55-60 % relative humidity; for 14 days; and then, the temperature was decreased to 36.8 C° and relative humidity was increased up to 65-70 %, for the last 3 days of incubation. The fertility and hatchability were calculated as following (Hussen, 2000):

Fertility % = (No. of hatched chicks + No. of dead embryo) / (No. of all incubated eggs) * 100

Hatchability % = [(No. of hatched chicks) / No. of fertile eggs] * 100

Statistical analysis:

The experiment was designed as CRD, and the collected data was analysed using SAS (SAS 9.1, 2010) software via two models of GLM. The used GLM models were applied on all quantitative productive performance as following:

$$Y_{ijkl} = \mu + L_i + R_j + e_{ijk} \quad \text{(Model for period of 1- 0-35 days old)}$$

Where: Y ijkl: The observations of the studied trait; μ = Overall mean; Li: The fixed effect of line; Rj: The effect of replication; eijk: Random error; i: line; j: Replication; k: individual (bird).

$$Y_{ijkl} = \mu + L_i + S_j + R_k + e_{ijkl} \quad \text{(Model 2- for period of 36-49)}$$

Where: Y ijkl: The observations of the studied trait; μ = Overall mean; Li: The fixed effect of line; Sj: The fixed effect of the sex; Rk: The effect of replication; eijkl: Random error; i: line; j: sex; k: Replication; l: individual (bird).

The differences between the means were analysed using Duncan multiple range test (Duncan, 1955).

Results and Discussion:

I- Growth traits:

Body weight:

The effect of line on the body weight (BW) traits during the growth period is shown in table (2). It can be noticed that the three lines are not significantly different at 0 and 5 weeks of age. This means that the initial and final growing period weights in unsexed quail is limited by a certain body weight range, which reflects the homogeneity in live weight for such birds.

Table 2. The effect of quail's line on the body weight trait (gm.) at different ages.

Line / Age (wk.)	White n=195	Light brown n=201	Dark brown n=157	Sig.
0	7.09±0.07	7.02±0.07	7.23±0.08	Ns
1	30.94±0.34c	32.47±0.29b	34.34±0.34a	**
2	70.66±0.47b	71.73±5ab	73.22±0.73a	**
3	108.46±0.65b	111.4±0.71a	112.62±0.79a	**
4	143.98±0.81b	146.98±0.9a	146.07±0.96ab	*
5	167.96±1.98	168.85±1.38	170.45±1.5	Ns

Ns = non-significant; *=significant at (p<0.05); **=highly significant (p<0.01); Values= (means ± SE). Means having different letters within each row differ significantly.

During the earlier growing periods, the quail birds showed significant differences between lines. At (1, 2 and 3) weeks of age, the Dark brown line recorded significantly (p<0.01) the highest BW (34.34, 73.22 and112.62 gm., respectively), While White birds recorded the lowest weights (30.94, 70.66 and 108.46 gm., at the same previous ages, respectively). Moreover, at (4) weeks of age, BW of Light brown quail lines were significantly differed than others, but White birds remained the lighter line, and differed significantly (p<0.05) compared to Dark brown and Light brown. This result is in an agreement with that which was found by Chahil *et al*., (1975); Okamoto *et al*., (1982) and Gerken and Zimmer (1988) who reported that in the breeding works, the parental lines were not much different in body weight.

The general effect of line, sex and their interaction at 42 days of age on body weight for parent stock is shown in table (3). The result showed that there was not any significant effect of line on body weight trait at 42 days old. However, the body weight at 42 days of age was significantly differed ($p<0.01$) between both sexes, where females recorded higher body weight (208.8 gm.) than males (163.5 gm.), this result confirm that genetically, the quail males are lighter than females' counterparts. This finding is in agreement with the results of Baumgartner (1994) and Minvielle *et al*., (2000). With respect to the interaction between line and sex, there was a significant ($p<0.05$) interaction, where light brown line interacted with female gender to show the highest body weight at 42 day of age (205.9gm).

Table 3. The effect of line, sex and their interaction on quail's body weight (gm.) at 42 days of age.

Line	**White n=138**	**Light brown n=138**	**Dark brown n=138**	**Sig.**
	188.4 ± 1.8	191.3 ± 2.1	187.7 ± 2.3	Ns
Sex	**Male n = 144**		**Female n = 270**	Sig.
	163.5 ± 1.1b		208.8 ± 1.1 a	**
Interaction	**White**	**Light brown**	**Dark brown**	**Sig.**
Male	166.9 ± 1.8	164.0 ± 1.8	159.5 ± 2.2	*
Female	199.8 ± 1.7	205.9 ± 1.8	202.8 ± 1.9	

Ns = non-significant; *=significant at ($p<0.05$); **=highly significant ($p<0.01$); Values= (means ± SE). Means having different letters within each row differ significantly.

However and according to the Duhok equation for J. quail, that reported by Hussen *et al*., (2016 b), who found that the BW at 42 days old, should be equal (195.8 gm.), this result is true just for Lb line (*Coturnix coturnix japonica*), While both W and Db lines didn't contradict with Duhok equation, because of higher male BW with lowest female BW in W line and vice-versa for Db line at 42 days old, which confirms the interaction between the sex and line in such birds.

Weight gain:

Figure (2) illustrating weight gain trait during different periods of growth (0-5 weeks). The results showed that there were not significant differences among studied lines for all studied periods. Moreover, the weight gain generally increases from (1) day old up to (2) week of age, but it was almost constant during the period from (2-3) weeks old in all lines then gradually decreases up to five weeks of age. The weight gain during the periods from (0-1) and (4-5) weeks, were approximately the same. Knizetova (1996) found that the selection for earlier live body weight in quail at (4) week of age resulted in the improvement of weight gain.

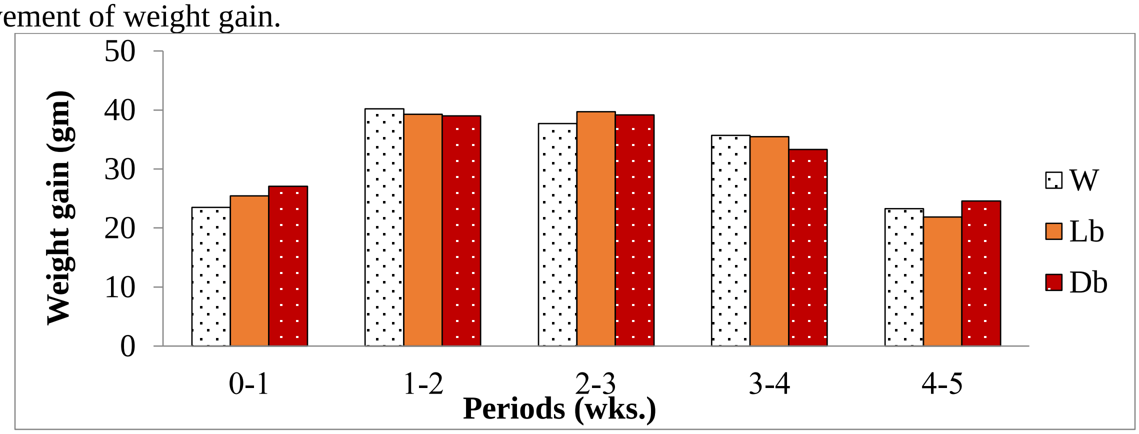

Figure 2. Weight gain (gm.) during the growing periods (wks.).

Feed intake:

The results of feed intake represented in figure (3). The figure showed that the Light brown line consumed (non- significantly) feed less than white and dark brown lines, during all trial periods (0-5weeks).

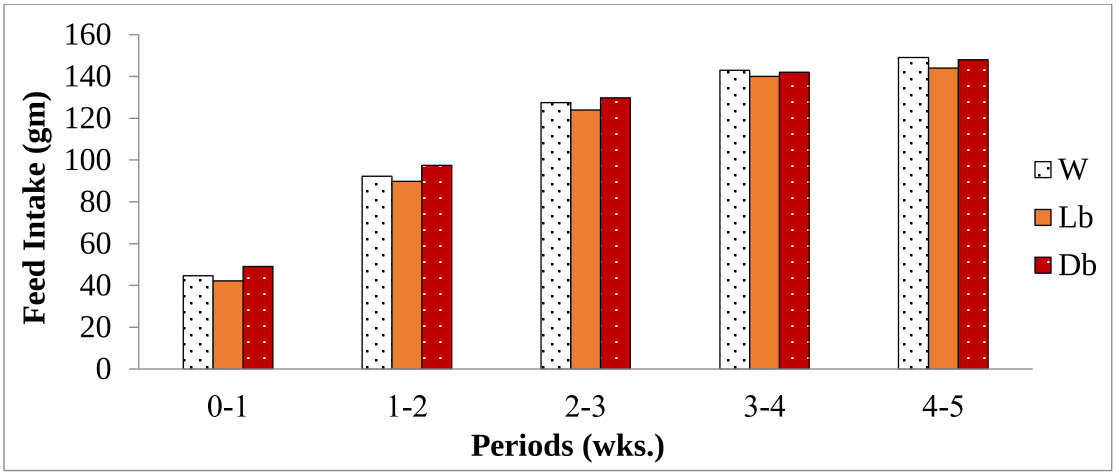

Figure 3. Feed intake (gm.) during the growth periods (wks.).

Feed intake of Dark brown line during (0-3) weeks was the marginally higher than the other two lines. On the other hand, the feed intake during the period from (3-4) week and the period from (4-5) week of both Dark brown and White lines were the same. This finding is in agreement with the findings of Marks (1993) who reported that there were no significant differences among different lines of quail for feed intake.

Feed conversion ratio:

The result from figure (4) illustrates that there were insignificant differences in feed conversion ratio among the three studied lines for all the studied periods. The lowest and the highest feed conversion ratio was calculated during (0-1) and (4-5) weeks of age, respectively. Also, the FCR in White and Dark brown lines during the periods from (0-1, 1-2, 2-3 and 3-4) weeks, were higher than that of Light brown line.

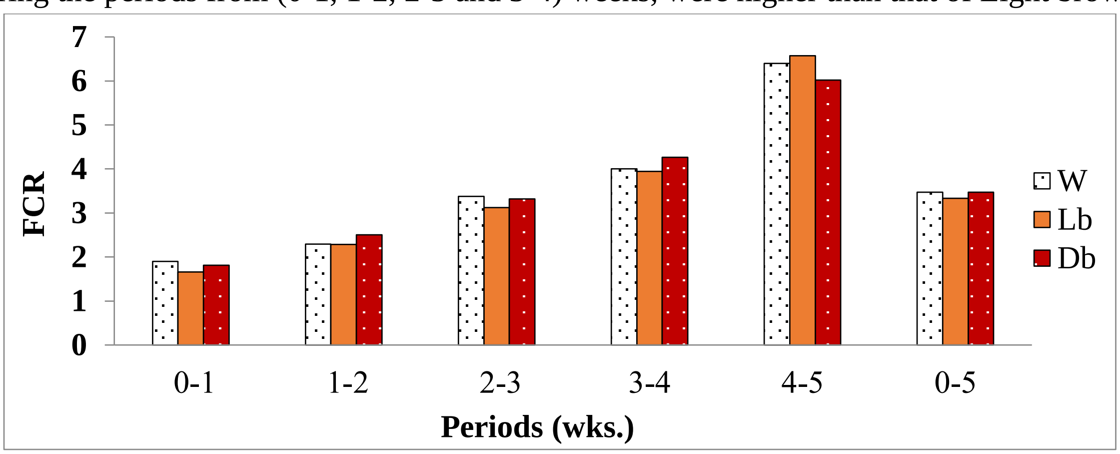

Figure 4. Feed conversion ratio during the growth periods (wks.).

While during the period from (4-5) week, the Light brown line had higher value of FCR than other two lines. Generally, feed conversion ratio during the growth period (0-5 wks.), resulted in (3.68, 3.34 and 3.47) for white, light brown and dark brown lines, respectively, these values were generally more than the values that were reported by Marks (1993).

II- Egg production traits:

Egg characters:

Table (4) illustrating the effect of line on the age at sexual maturity and egg production characters (egg weight, egg number and egg mass). As shown, there were insignificant differences among lines for sexual maturity age.

Table 4. The effect of quail's line on the age at sexual maturity and egg production characters for 2 weeks after maturation.

Trait \ Line	Character	White n=90	Light brown n=90	Dark brown n=90	Sig.
Age at sexual maturity (days)	ASM	36.83±0.17	37.67±0.21	37.17±0.48	Ns
Egg weight	EW1	9.87±0.1ab	9.9±0.4a	9.74±0.6b	*
	EW2	10.17±0.43	10.12±0.5	10.06±0.3	Ns
	AEW	10.02±0.24	10.01±0.26	9.9±0.02	Ns
Egg number	ENW1	5.22±0.14	5.05±0.17	4.75±0.39	Ns
	ENW2	5.68±0.12	5.88±0.14	5.42±0.32	Ns
	TEN	10.9±0.18	10.93±0.21	10.17±0.68	Ns
Egg mass	EMW1	51.65±1.39	49.99±1.65	46.27±3.84	Ns
	EMW2	57.97±1.29	59.42±1.44	54.71±3.22	Ns
	TEM	109.00±1.82	109.33±2.01	100.65±6.76	Ns

ASM = Age at sexual maturity; EW1= Egg weight at the first week of production after maturation was completed; EW2=Egg weight at the second week of production after maturation was completed; AEW = Average egg weight after maturation was completed. ENW1= Egg number at the first week of production after maturation was completed; ENW2 = Egg number at the second week of production after maturation was completed; TEN= Total egg numbers. EMW = Egg mass during the first week of production after maturation was completed; EMW2 = Egg mass during the second week of production after maturation was completed; TEM = Total egg mass. Ns = non-significant; *=significant at (P<0.05); Values= (means ± SE). Means having different letters within each row differ significantly.

White line reaches sexual maturity earlier than both brown lines. With regard to egg weight trait, it can be noticed from Table (4) that Light brown line recorded the heaviest egg at the first week of production and surpassed the Dark brown line significantly (p<0.05). This result may due to the late sexual maturity of Light brown line birds. However, there were no significant differences among lines for average egg weight, egg number and egg mass (Table 4) during the studied two weeks. Sakunthala *et al*., (2010) reported a range of (42–56) days for age at sexual mathurity, they recorded the mean value of egg weight was ranged from (11.7–12.3 gm.). Moreover, the result of egg number is in agreement with that obtained by Saatci *et al*., (2006) and Khaldari *et al*., (2010) who found that an obvious increasing trend for mean values of egg weight was from (9 – 12) weeks of age.

Feed Intake:

The histogram in figure (5) shows that the feed intake trend to increase from seventh week old (42 days) to eighth week old (56 days) in studied lines with no significant differences (p>0.05) among them. Also the Dark brown birds at 42 day consumed the highest amount of feed (242.1 gm.), followed by Light brown (241.96 gm.), while White birds consumed the lowest amount (241.74 gm.), but at the eighth week old (56 days), the White birds consumed the highest amount of feed (248.7gm.) compared to both brown lines (247.96 gm. and 247.82 gm., for Light and Dark brown, respectively).

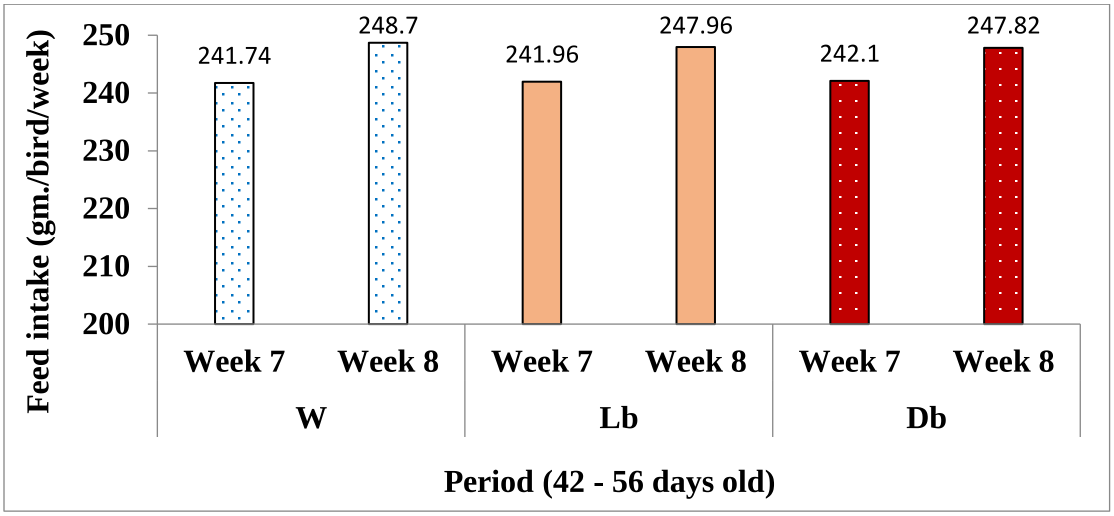

Figure 5. Feed intake (gm. /week) during the period from (42-56 days).

Similar results were reported by Albino and Barreto (2003) and Barreto *et al*., (2007), who determined that the feed intake for quail ranged from (210-231 gm. feed /bird/week). However, Mori *et al*., (2005) observed average of 259 gm. of feed intake/bird/week at laying period. Moreover, Berwary *et al*., (2015) stated that the feed consumed by Japanese quail birds during the period from 12-16 weeks of age was (886 gm./ bird/week), and the quantity was raised up to 992 gm. / bird when quail birds were genetically improved.

Feed conversion ratio:

Figure (6) represents feed conversion ratio for the first two weeks period of laying. From the statistical point of view, there were insignificant ($p>0.05$) differences among the studied lines for FCR. It can be observed that the feed conversion ratio of White, Light brown and Dark brown lines during the seventh week were (4.68, 4.84 and 5.23) respectively, while in eighth week were (4.29, 4.17 and 4.53), respectively.

However, the white line recorded the best one at seventh week compared to both brown lines. But in the eighth week the Light brown FCR was the best followed by White line. These results are disagreement with the results of Mori *et al*., (2005) who recorded feed conversion ratio an average (3.86) in different genetic groups of meat-type quail.

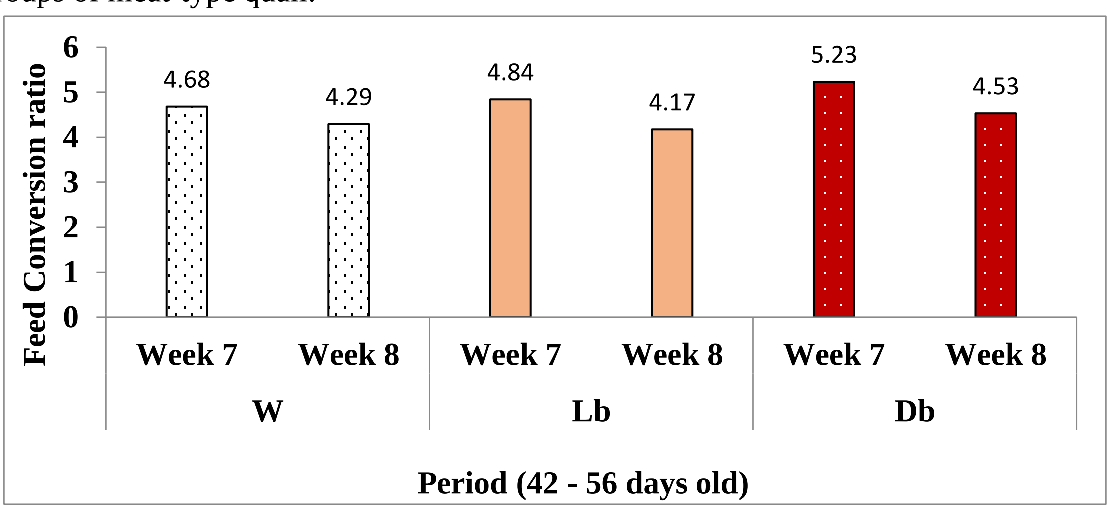

Figure 6. Feed conversion ratio during the period from (42-56 days.).

Moreover, the feed conversion values for all lines were not within the normal range, which may due to that the feed intake were not constant for all studied lines. However, Berwary *et al*., (2015) mentioned that the FCR in Japanese quail birds (Light brown line) during the period from 12-16 weeks of age was 3.38, and it was decreased to 3.31, when the birds are genetically improved.

Mortality rate:

It can be noticed from figure (7), that the differences among the three lines were not significant. However, the highest mortal percentage of quail lines were recorded in Db line (2.01%), followed by W line (1.55%) and no any mortal bird was recorded in Lb line during the whole experimental period.

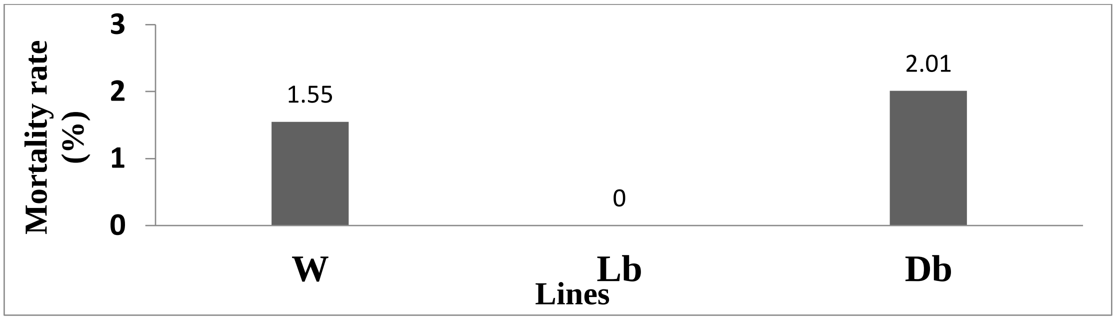

Figure 7. Mortality rate (%) during the whole period in parent stock lines.

Generally, the Dark brown line may have the lowest immunity compared to other two lines. The results of the present study are disagreement with the findings of (Consitantini and Panella, 1982; Shoukat *et al*., 1988 and Vieira and Moran,1998) who reported that quails with higher body weight and which hatched from heavier eggs showed less mortality rate than the small chicks which hatched from the smaller eggs.

Fertility and hatchability:

Fertility and hatchability percentages are illustrating in figure (8). The results showed that the fertility percentage in pure line families (W*W, Lb*Lb and Db*Db) didn't differed significantly (p>0.05) and were (86%, 87% and 85%), respectively. In addition, the hatchability percentage in the same pure families were differed insignificantly and had values of (88%, 89% and 90), respectively. However, Murakami and Ariki (1998) found that fertility percentage was (88%) and hatchability percentage was (75%) when the ratio of females per male was two to three. Shanaway (1994) and Khurshid *et al*., (2004) reported hatchability improvement with an increase in eggs weight of Japanese quails.

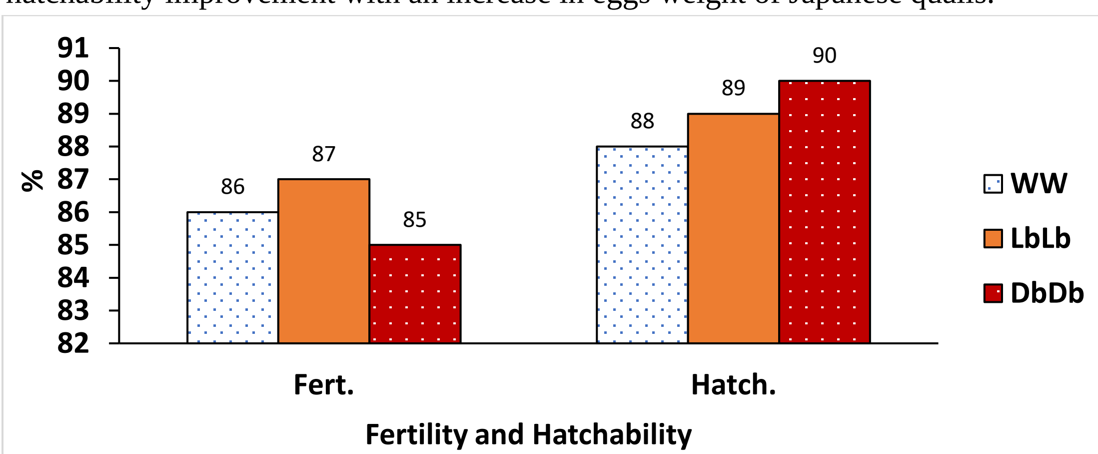

Figure 8. The effect of lines on fertility and hatchability percentages.

Conclusions:

-Based on the overall performance, it can be concluded that the Light brown line (Lb) resulted in the best productive performance either for meat yield or for egg production characters. So, the mentioned line could be used as sire or dam in the breeding programs.

-But, the Dark brown line (Db), is very closely to its counterpart Lb, in most studied trait, in spite of some fluctuations related to the performance. So, in case of unavailable Lb birds, it could be use Db line as alternative.

-The quail White line is not bad for egg production traits.

References:

Albino, L.F.T.; and S.L.T. Barreto (2003). Criação de codornas para produção de ovos e carne. Viçosa: Aprenda Fácil. 268p.

Barreto, S.L.T.; B.J.S. Quirino; C.O. Brito; R.T. Umigi; M.S. Araujo; T.C. Rocha; and C.G. Pereira (2007). Efeitos de níveis nutricionais de energia sobre o desempenho e a qualidade de ovos de codornas européias na faseinicial de postura. Revista Brasileira de Zootecnia. 36(1): 86- 93.

Baumgartner, J. (1994). Japanese quail production, breeding and genetics. Worlds Poult. Sci. J., 50: 227-235.

Berwary, M.S.; R.A. Oramari; and S.H. Hussen (2015). Correlated response to selection for residual feed intake in Japanese quail (*Coturnix coturnix japonica*). Journal of University of Duhok. 18(1): Pp 135-144.

Chahil, P.S.; W.A. Johnson; and P.E. Schilling (1975). Combining ability in a diallel cross of three lines of *Coturnix coturnix japonica*, Poult. Sci., 54: 1844–1849.

Consitantini, F.; and F. Panella (1982). Correlation between egg weight, chick weight and broiler performance. Poult. Abst., 10:164.

Daikwo, S.I.; Dim, N.I.; and M.O. Momoh (2011). Hatching characteristics of japanese quail eggs in a tropical environment. International Journal of Poult. Sci., 10 (11): 876-878.

Drumond, E.S.C.; A.V. Pires; R.C. Veloso; C.M. Bonafe; I.G. Pereira; L.S. Costa; and L.R.A. Abreu (2015). Performance of meat type quails in diallel cross. Arq. Bras. Med. Vet. Zootec., 67 (1): 235-241.

Duncan, D.B. (1955). Multiple range and multiple F tests. Biometrics. 11: 1-42.

Gerken, M.; and S. Zimmer (1988). Juvenile body weight and gonad development in a diallel cross among lines of Japanese quail (*Coturnix coturnix japonica*). 76(5): 775-780.

Hussen, S.H. (2000). Interaction between some environmental factors and different genotypes in some Egyptian local strains of chickens. Ph.D. Thesis, Ain Shams Univ., Cairo, Egypt.

Hussen, S.H.; A.M.A. Al-Khdri; and A.M. Hassan (2016- a). Response to selection for body weight in J. quail (*Coturnix coturnix japonica*). Iranian Journal of Applied Animal Science (IJAS). 6(2): 453-459.

Hussen, S.H.; A.M. Hassan; and A.M.A. AL-Khdri (2016- b). Estimation of some genetic parameters for egg quality traits in Japanese quail (*Coturnix coturnix japonica*). Journal of University of Duhok. 19 (1): 32-37 (Special Issue).

Khaldari, M.; A. Pakdel; Y.H. Mehrbani; J.A. Nejati; and P. Berg (2010). Response to selection and genetic parameters of body and carcass weights in Japanese quail selected for 4-week body weight. Poult. Sci., 89: 1834-1841.

Khurshid, A.; M. Farooq; F.R. Durranit; K. Sarbiland; and A. Manzoor (2004). Hatching performance of Japanese quails. Livestock Res. Rural. Dev., 16: 1-5.

Knizetova, H. (1996). Growth and carcass traits of Japanese quail. Zivoc. Vyroba., 41:225–233.

Lesson, S.; and J.D. Summers (2005). Commercial poultry nutrition. 3rd edition, University books, P.O. Box. 1326, Guelph, Ontario, Canada ISBN 978-1-904761-78-5.

Mahipal, R.P.; Y.P. Venkateshwarlu; V.L. Prasad; K. Eshwaraiah; and R.V. Ravinder (2001). Combining ability analysis of a diallel cross involving three quail lines for production traits. Indian Journal of Poult. Sci., 36(2): 147-152.

Marks, H.L. (1993). Carcass composition, feed intake and feed efficiency following long- term selection four-week body weight in Japanese quail. Poul. Sci., 72: 1005-1011.

Minvielle, F.; J.L. Monvoisin; J. Costa; and Y. Maeda (2000). Long-term egg production and heterosis in quail lines after within-line or reciprocal recurrent selection for high early egg production, Brit. Poult. Sci., 41:150–157.

Mori, C.; E.A. Garcia; A.C. Pavan; A. Piccinin; M.R. Scherer; and C.C. Pizzolante (2005). Desempenho e qualidade dos ovos de codorna de quarto grupos genéticos. Revista Brasileira de Zootecnia. 34(3): 864- 869.

Murakami, A.E.; and J. Ariki (1998). Produção de codornas japonesas. Jaboticabal: FUNEP, 79p (Report).

Okamoto, S.; Y. Hatate; and T. Matuo (1982). Heterosis in reciprocal crosses between large and small lines of Japanese quail, *Coturnix coturnix japonica*, Jpn J. Zootech. Sci., 53: 424–428.

Piao, J.; S. Okamoto; S. Kobayashi; Y. Wada; and Y. Maeda (2004). Purebred and crossbred performances from a Japanese quail line with very small body size. Anim. Res., 53: 145–153.

Rezvannejad, E.; A. Pakdel; A.S.R. Miraee; Y.S.R. Mehrabani; and M.M. Yaghoobi (2013). Analysis of growth characteristics in short-term divergently selected Japanese quail lines and their cross. The Journal of Applied Poultry Researchjapr.oxfordjournals.org J Appl Poult. Res., 22 (4): 663-670.

Saatci, M.; H. Omed; and I.A. Dewi (2006). Genetic parameters from univariate and bivariate analyses of egg and weight traits in Japanese quail. Poult. Sci., 85: 185-190.

Sakunthala, D.K.; B.R. Gupta; M.G. Prakash; S. Qudratullah; and A.R. Reddy (2010). Genetic study on growth and production traits in two strains of Japanese quails. Tamilnadu J. Veterinary & Animal Sciences. 6: 223-230.

SAS, Inc. (2010). SAS User's Guide, Ver. 9.1: Statistics. SAS Institute Inc., Cary, NC.

Shanaway, M.M. (1994). Quail production systems. A review. Animal production and health division, FAO Rome, Italy.

Shoukat, A.; M.S. Chaudhry; M.A. Bhatti; A. Ahmed; and M.S. Zaman (1988). Studies on the effect of egg weight on the weight gain, feed consumption, feed efficiency and mortality in Japanese quails. Pakistan. J. Sci., 39-40:157- 160.

Vieira, S.L.; and E.T. Moran (1998). Broiler yields using chicks from egg weight extremes and diverse strains. J. Appl. Poult. Res., 7:339-346.

مقارنة بين ثلاثة خطوط من السمان (*Coturnix coturnix spp*) في أدائها الإنتاجي

شيخموس حسن حسين*[1] وجميلة حيران صالح[1]

(1). قسم الإنتاج الحيواني، كلية علوم الهندسة الزراعية، جامعة دهوك، العراق.

(*للمراسلة: د. شيخموس حسين، البريد الإلكتروني: sheikhmous68@gmail.com).

تاريخ الاستلام: 2019/09/12 تاريخ القبول: 2019/10/17

الملخص

تم إحضار عدد 600 صوصاً من 3 خطوط من السمان (الأبيض والبني الفاتح والبني الغامق) من مزرعة قسم الإنتاج الحيواني، جامعة صلاح الدين، أربيل، إقليم كوردستان–العراق. وقد تم تنفيذ هذا البحث في مزرعة قسم الإنتاج الحيواني بكلية علوم الهندسة الزراعية، جامعة دهوك، عام 2016. وكان الهدف من البحث هو دراسة الأداء الإنتاجي لثلاثة خطوط من السمان ومقارنتها تحت ظروف بيئة محافظة دهوك. تم رعاية الطيور في أقفاص وقدم العلف يدوياً وبشكله الحر. وتم دراسة الخصائص الإنتاجية التالية خلال فترتي النمو وإنتاج البيض: وزن الجسم الحي، والزيادة الوزنية، والإستهلاك الغذائي، ومعامل التحويل الغذائي، والنضج الجنسي، ووزن البيض، وعدد البيض، وكتلة البيض، ونسبة النفوق، والخصوبة والفقس. ويمكن تلخيص أهم نتائج هذا البحث بالآتي: أظهرت صفة وزن الجسم الحي فروقات عالية المعنوية ($p<0.01$) بين خطوط السمان المدروسة في الأسابيع الثلاثة الأولى من العمر، كما أبدت فروقاً معنويةً ($p<0.05$) في عمر 4 أسابيع، حيث تفوق خط السمان البني الغامق على نظيره الأبيض. أما باقي الخصائص الإنتاجية (الزيادة الوزنية، والاستهلاك العلفي وتحويله، ووزن البيض وعدده وكتلته، ونسبتي الخصوبة والفقس) فلم تختلف فيما بين الخطوط الثلاثة المدروسة معنوياً ($p>0.05$) وفي كل الأعمار. كانت أقل نسبة نفوق من نصيب خط السمان البني الفاتح (0 %). وكاستنتاج فإن الخط البني الفاتح أظهر أفضل أداء إنتاجي.

الكلمات المفتاحية: السمان، إنتاج اللحم، إنتاج البيض.