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Comparative Growth and Production between Black and Brown Japanese Quail (*Coturnix japonica*) Performance under Sudan conditions

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Abstract

This study was conducted to compare between Black and Brown Japanese quail (strains) Growth and production performance under Sudan condition. A total of 123 [Black (n=93) and Brown (n=30)]. The birds were allocated into 22 cages according to the full sib families (from one day old – 10 weeks of age). Feed intake (FI), body weight (BW), body weight gain (WG), feed conversion ratio (FCR), protein efficiency ratio (PER), energy efficiency ratio (EER), age at first egg (AFE), body weight at first egg (BWFE) and liveability were determined. With the exception of liveability all other parameters were not affected by bird strain. However the Black Japanese quail had higher values than the Brown in most of the studied parameters. (FCR) for quails ranged between 2.36 to 6.99, (AFE) was determined as 9.49 week in Black strain whereas in Brown strain as 9.04 week. The overall mean of (BWFE) was 199.87g for Black strain and 195.92g for brown strain.

Keywords: liveability, Body weight, Body weight gain.

Introduction

Although world's poultry industry depends mainly on chicken production for both meat and egg, now there is an interesting in other poultry species for food production or genetic conservation resources purpose (Hassan, 2011). Japanese quail, the smallest farmed avian species is getting more importance for commercial egg and meat production. It has marked advantages such as fast growth, early sexual maturity, high rate of egg production, short generation interval and short incubation period. The average age at onset of laying for Japanese quail is 6-8 weeks (Sarabmeet *et al*., 2008). With proper care, quail hens can lay up to 280-300 eggs in their first year. In order to establish a breeding

program, it is essential to estimate genetic parameters for improving the traits. Approximately 4 decades ago, quail were recognized as a valuable animal model for research because of their early sexual maturity, short generation interval, high rate of egg production, low maintenance cost associated with their small body size, and resistance to diseases (Yalcin *et al*., 1995 and Oguz and Minvielle, 2001). More recently, quail have become an important source of meat and eggs for human consumption (Kayang *et al*., 2004). Japanese quail represents important species for commercial production of egg and meat because of its unique traits such as fast growth and high rate of egg production (Sarabmeet *et al*., 2008).

The advantages of Japanese quail, which have been widely used for biological and genetic studies are because of this bird has a small body size, easily handled, a large number of birds can be kept in a limited space, sexual maturation is rapidly accomplished, turnover of generations is rapid, high egg production and many offspring can be available from certain number of parents (Hassan, 2011 and Hassan, 2013). Growth is the most important trait for evaluating different livestock species, especially in meat producing animals and birds. Growth traits such as body weight and body weight gain are affected by genetic and non- genetic factors and the phenomenon of growth is usually measured by observing differences in body weight recorded at different ages and/or body weight gain obtained during different growth periods (Chambers, 1993). Growth traits in the Japanese quail have been estimated by more than a few researchers (EL- Full *et al*., 2001, Almeida *et al*., 2002, Abdel- Fattah *et al*., 2006).

The energy and protein requirements as well as the efficiency of feed utilisation are still poorly documented, especially for quails. Generally, the energy and protein requirement for this category of poultry were considered to be similar to those of other poultry species, especially hens (Scholtz *et al.*, 2009).

The nutritional requirements of metabolizable energy (ME) and crude protein (CP) for quails have been published (Vohra and Roudybush, 1971; Sakurai, 1981; Ri *et al*., 2005); however, the reported values are limited and contradictory. For instance, as the interest in the study of Japanese quail developed, the maintenance of intensive quail populations on diets containing about28% CP was adopted (Woodard *et al*, 1965); however, later studies indicated that Coturnix can be reared on 25-26% CP- diets during the first weeks (Weber and Reid, 1967; Svacha *et al*, 1970). Dietary content can be reduced to 20% after 3 weeks of age (Gropp and Zucker, 1968). Like other species the energy is the principal nutritional component of the diets, which determines the quail performance. The ME requirements of quails are variable depending on a number of factors including body weight gain, amino acid balance, feed efficiency, breed, house condition and stocking density. Sakurai (1981) obtained

optimum performance with 58 kcal ME/day in a smaller species. Comparing the energy utilization by quails and broiler chickens, Begin (1968) did not find any clear difference in feed: gain ratio between low or high energy diets (2200 and3400 kcal ME/ kg), concluding that quails can utilize the diets with varying energy contents similar to broilers. On the other hand, dietary CP requirement of Japanese quail is relatively high and depends on body weight gain, breed, age, diet composition and environmental condition. Woodard *et al* (1965), suggested a dietary protein level of 28% for intensively- raised quails, while Whyte *et al*., (2000) suggested a dietary protein level of 18-24% for better performance.

The objective of the current study was to compare between Black and Brown quail performance under Sudan conditions.

Materials and methods

Study area: This experiment was carried out in the Animal Production Research Centre at Kuku, Khartoum North, Khartoum State, Sudan, during (April to July 2016). Minimum and maximum temperatures outside the poultry unit were 26.1˚C and 40˚C respectively.

Birds and diets: A total of 123 (Black=93 and Brown =30) comprising 22 full-sibs families of Japanese quail were used in this experiment. The nutrient requirements of the birds was calculated according to (NRC.1994) recommendations, however, protein contents and metabolizable energy level was calculated to be 26% and 2914 kcal/kg for the starter and grower provided in the period from one to 45 day old. Additionally protein contents and metabolizable energy level was calculated to be 22 % and 2835 kcal/kg respectively for the breeder diets as recommended for quail under Sudan conditions by Hamed *et a.l*, 2016. The starter and grower diet was provided until the sexual maturity followed by breeder diet up to the end of the experiment (week 10). The main sources of protein and metabolizable energy were Groundnut cake and Sorghum.

Housing and management: The experiment was carried out at the poultry unit consists of an open sided building. The dimensions of each cage were 0.50×0.50 m^2. The poultry house was dry cleaned washed and disinfected before arrival of birds. Feeders and drinkers were thoroughly cleaned, washed and disinfected at the beginning of the experiment. Wood shaving was used as litter. Drinkers were daily clean and filled with fresh water. Birds were offered feed and water *ad libitum* throughout the experimental period. No information about vaccination program for quail in Sudan, hence no vaccination was implemented.

Measurements: The hatched chick weight was taken at the hatchery, before transferred to the farm. The weekly live body weight and the provided and remained feed per replicates were recorded using sensitive electronic balance. Consequently, Body weight gain (BWG), feed intake (FI) and feed conversion ratio (FCR) were calculated. Protein efficiency ratio (PER) and Energy

efficiency ratio (EER) were obtained according the following equations:

Feed conversion ratio (FCR): Feed conversion ratio (FCR) was calculated by dividing the amount of feed consumed by body weight gain (g feed/ g gain).

Protein efficiency ratio (PER): = weight gain/ protein intake (Kamran *et al*., 2008).

Energy efficiency ratio (EER): = (weight gain×100)/energy intake (Kamran *et al*., 2008).

Liveability %: was determined by calculating the difference in birds number at the initiation and termination of each week until week 10.

Statistical analysis: The data was subjected to analysis of independent samples T-test using SPSS software program, version 16 (2007). The means and standard error were calculated.

Results and Discussion

Feed intake (FI): The mean values of feed intake of Japanese quail are shown in Table 1. The result showed that feed intake of Japanese quail was not significantly affected by colour (P>0.05). The overall mean feed intake during experiment ranged between 18.12 to 83.44 g in black strain whereas in Brown strain ranges between 17.60 to 81.05 g. This result disagree with those of Tuleun *et al*., (2009) who found that average daily feed intake ranged between7.49 to 8.17g and Hamed *et al*., (2016) who found that average daily feed intake ranged between 9.5 to 10.5. It might be due to different in season. While Sakunthaladevi *et al*., (2012) reported that Black strain birds consume more feed and gain higher body weight gain from 1-6 weeks of age as compared to Brown strain.

Table 1: Effect of Japanese quail colour on feed intake and body weight

Period/weeks	Feed intake (g/bird/week)				P. value	bird weight (g/bird/week)				P. value
	n	Black	n	Brown		n	Black	n	Brown	
Week1	93	18.12 ± 0.51	30	17.60±0.32	0.39	93	14.14± 0.35	30	13.47±0.41	0.31
Week2	93	35.27±0.56	30	36.47±1.05	0.30	93	28.98 ±0.82	30	30.57±1.23	0.33
Week3	93	56.45±0.41	30	54.62±0.94	0.08	93	55.62±1.39	30	57.50±2.47	0.51
Week4	90	67.28±1.00	30	65.41±1.84	0.36	90	76.37±1.50	30	78.70±2.72	0.44
Week5	90	76.61±1.10	30	74.88±2.22	0.45	90	108.81±2.03	30	110.40 ± 3.85	0.70
Week6	88	81.34±0.87	28	78.31±2.22	0.21	88	136.61±2.32	28	136.43±4.35	0.97

Week7	84	82.77±0.82	28	79.65±2.20	0.19	84	157.06±2.39	28	157.93±4.46	0.86
Week8	80	82.79±0.83	26	81.17±2.14	0.49	80	178.88±2.34	26	176.43±4.74	0.62
Week9	78	82.58±0.79	26	81.05±2.08	0.50	78	194.90±2.44	26	194.23±4.47	0.89
Week10	73	83.44±0.79	23	81.26±2.14	0.35	73	208.71±2.72	23	210.48±5.03	0.75

Body weight (BW): The mean values of body weight of Japanese quail (Table 1) revealed there was no significance different (P>0.05) between the two quail strain. Moreover the live body weight was ranged between 14.14 to 208.71 g and 13.47 to 210.48 in Black strain and Brown strain respectively. This result could be due to the similarity in feed intake of both black and brown quail. The body weight at hatch obtained in this study is in agreement with Abdel- Fattah (2006) and Abdel- Tawab (2006) who reported values that ranged between 6.0 and 9.3g. This finding was differ than those of Rahman *et al*. (2010) and Islam *et al*. (2011) who reported that body weight at different ages were significantly influenced by different types of colour mutants or varieties of quails.

Body weight gain (WG): The results of weight gain (Table 2) wasn't affected by Japanese quail strain (P>0.05) this result could be due to the likeness in feed intake and genetics of both quail strains. Furthermore the mean values of weight gain ranged from 7.42 to 32.44 g/week. This results were disagreed with those of Tuleun *et al*., (2009) who found that average daily weight gain (g) ranged between 1.58 to 1.78g, it might be attributed to different in environmental condition. As well Sakunthala *et al*., (2012), reported that weekly body weight gain from 1 to 4 weeks of age was more in Black strain as compared to Brown strain, whereas during the 5th and 6th week, the Brown strain birds showed higher weight gain over the values of Black strain.

Feed conversion ratio (FCR): The mean values for feed conversion ratio up to 10 weeks age are shown in Table (2). The overall mean of feed conversion ratio was ranged from 2.36 to 6.99 for Black strain and 2.36 to 5.87 for Brown strain, this results somewhat similar to those reported by Tuleun *et al*., (2009) and Sakunthala *et al*., (2012) they were found that FCR ranged from 4.35 to 5.09 and 1.70 to 6.30 respectively. Generally, several studies reported that feed conversion ratio for quails was poor compared to broilers chicken (Emiola *et al*., 2003; Weber and Reid, 1967; Haruna *et al*., 1997; and Sobamiwa and Longe, 1998).

: Effect of Japanese quail colour on weight gain and Feed conversion ratio**2Table**

Period/weeks	weight gain (g/bird/week)				P. value	Feed conversion ratio				P. value
	n	Black	N	Brown		N	Black	n	Brown	
Week1	93	7.42±0.32	30	6.83±0.41	0.26	93	2.68±0.09	30	3.15±0.46	0.32
Week2	93	14.84±0.66	30	17.10±1.11	0.09	93	2.86±0.15	30	2.39±0.15	0.03
Week3	93	26.53±0.85	30	26.93±1.71	0.82	93	2.42±0.12	30	2.36±0.22	0.79
Week4	90	20.74±0.90	30	21.20±1.81	0.81	90	4.12±0.29	30	5.36±1.28	0.35
Week5	90	32.44±1.22	30	31.70±1.85	0.75	90	2.86±0.19	30	2.74±0.25	0.75
Week6	88	27.28±0.74	28	26.89±1.56	0.81	88	3.22±0.12	28	3.60±0.63	0.37
Week7	84	19.50 ±0.86	28	21.50±1.53	0.26	84	6.42±1.10	28	4.36±0.41	0.27
Week8	80	20.24±0.84	26	18.76±1.34	0.38	80	5.10±0.41	26	5.03±0.49	0.96
Week9	78	16.40±0.85	26	17.81±1.50	0.41	78	6.99±0.71	26	5.87±0.80	0.40
Week10	73	14.64±0.75	23	17.78±2.41	0.10	73	8.54±1.26	23	14.55±5.35	0.28

Protein efficiency ratio (PER) and energy efficiency ratio (EER): The results of protein efficiency ratio (PER) and energy efficiency ratio (EER) are presented in Table 3 and it was observed that quail strain had no significant effect (P>0.05) on PER and EER, high protein efficiency ratio was observed in week 1 to week 6 it was ranged between 1.42 to 2.15 and1.55 to 2.24 for black and brown strain respectively. While lowest protein efficiency ratio observed in week 7 to 10 for black and brown strain ranged between 0.79 to1.12 and 1.00 to 1.23 respectively. This might be due to change in crude protein level in both used diets and age of quail. This finding was in line with those of Genchev *et al*. (2005) and Tuleun *et al*. (2009) who showed that the PER were changed with age of quails, also it was similar with those of Erener *et al*. (2002) who found that PER ranged from 1.20-1.29. As well high energy efficiency ratio was observed in week 1 to week 6 for black and brown strain it ranged between 2.64 to 3.99 and 2.87 to 4.15 respectively. While lowest EER observed in week 7 to 10 for black and brown strain ranged between1.47 to 2.07 and 1.85 to 2.28 respectively.

Table 3: Effect of Japanese quail colour on Protein efficiency ratio and Energy efficiency ratio

Period/weeks	Protein efficiency ratio				P. value	Energy efficiency ratio				P. value
	n	Black	n	Brown		n	Black	n	Brown	

Week1	93	1.84±0.05	30	1.76±0.10	0.49	93	3.41±0.10	30	3.27±0.19	0.49
Week2	93	1.90±0.08	30	2.14±0.14	0.13	93	3.52±0.14	30	3.97±0.26	0.13
Week3	93	2.15±0.07	30	2.24±0.14	0.56	93	3.99±0.13	30	4.15±0.25	0.56
Week4	90	1.42±0.06	30	1.55±1.14	0.42	90	2.64±0.12	30	2.87±0.26	0.43
Week5	90	1.98±0.08	30	1.94±0.12	0.80	90	3.68±0.16	30	3.60±0.22	0.80
Week6	88	1.55±0.05	28	1.58±0.12	0.52	88	2.87±0.10	28	2.94±0.22	0.76
Week7	84	1.08±0.05	28	1.23±0.10	0.53	84	2.01±0.10	28	2.28±0.18	0.22
Week8	80	1.12±0.05	26	1.07±0.10	0.39	80	2.07±0.12	26	1.99±0.18	0.85
Week9	78	0.91±0.05	26	1.02±0.10	0.45	78	1.69±0.10	26	1.89±0.19	0.18
Week10	75	0.79±0.05	25	1.00±0.14	0.18	75	147±0.09	25	1.85±0.26	0.21

Age at first egg (AFE) and body weight at first egg (BWFE): The results of (AFE) and (BWFE) are showed in Table (4). Age at first egg was determined as 9.91 week in black strain and 9.79 week in brown strain, the quail strain had not influenced ($P<0.05$) both (AFE) and (BWFE). The result was not similar to Sakunthaladevi *et al*., (2011), Padmakumar *et al*., (2000) and Momoh *et al*., (2014), who found that the ages at first egg was 7.67 week a, 8.21 and 7.78 week respectively, as well Bahie El-Dean *et al*., (2008) reported age at sexual maturity in Japanese quail females (weeks) were 6.14, 7.15 and 8.84 for early age at sexual maturity group, medium and late groups; respectively. The overall mean of mature weight observed for Black strain was 208.82 g and 212.25 g in brown strain. The weight at first egg had not affected by quail strain, this result was disagreed with those of Sakunthaladevi *et al*., (2011) in Japanese quails.

Table 4: Effect of Japanese quail strain on mature age and mature weight

	Bird colour	P. value

	n	Black	n	Brown	
Mature age (week)	67	9.91 ± 0.15	24	9.79± 0.19	0.662
Mature weight(g)	67	208.82 ± 2.96	24	212.25 ± 5.72	0.570

Liveability %: The mean liveability of percentage of Japanese quails was recorded in Table (5). The strain had significant effect (P<0.01) on the liveability. The highest liveability value (100.00 %) was observed in brown strain in weeks 1 to 4, Shamna (2008) reported a similar mean liveability % ranging from 97.90 to 100.00 from 1 to 6 week of age in Japanese quails. while black strain liveability % ranged from 57.09 to 97.85 in the whole experimental period.

Table 5: Effect of Japanese quail strain on liveability

Period/weeks	Liveability %				P. value
	n	Black	N	Brown	
Week1	93	100.00 ± 0.00	30	100.00 ± 0.00	0.422
Week2	93	100.00 ± 0.00	30	100.00 ±0.00	0.040
Week3	93	100.00 ± 0.00	30	100.00 ±0.00	0.005
Week4	90	96.77 ±1.18	30	100.00 ±0.00	0.005
Week5	90	96.77 ±1.18	30	100.00 ± 0.00	0.898
Week6	88	92.86±1.91	28	93.33 ± 2.48	0.898
Week7	84	85.0 4± 3.04	28	93.33 ± 2.48	0.706
Week8	80	82.89 ± 3.17	26	86.67 ± 3.03	0.392
Week9	78	77.132 ± 3.44	26	80.00 ± 3.87	0.606
Week10	73	78.49	23	76.67	0.000

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