The Journal of Animal & Plant Sciences, 23(1): 2013, Page: 7-13
ISSN: 1018-7081

EFFECT OF DIFFERENT BODY WEIGHT CATEGORIES ON THE PRODUCTIVE PERFORMANCE OF FOUR CLOSE-BRED FLOCKS OF JAPANESE QUAILS (*Coturnix coturnix japonica*)

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ABSTRACT

A study was conducted to investigate the effect of different body weight categories on productive performance of four close-bred flocks of Japanese quails maintained at Avian Research and Training Centre, University of Veterinary and Animal Sciences, Lahore. For this purpose, a total of 432 adult (12 weeks-old) quails, comprising 108 males and 324 females were randomly divided into 108 experimental units, comprising one male and three females each. These experimental units were randomly assigned to 12 treatment groups having 4 close-bred flocks x 3 female body weights (heavy 300-350g, medium 250-300g and small 200-250g) with randomized complete block design in factorial arrangements having 9 replicates in each treatment. Significant differences were observed in mean body weight and egg weight among imported and all local flocks. Mean egg production percent, egg number, egg mass (g/bird) and FCR (g/egg) differed non-significantly among different close-bred flocks. With respect to body size categories, a significant ($p<0.05$) difference was observed in their mean body weight, egg number, egg weight and FCR (g/egg). However egg mass (g)/bird were found to be non-significant. Interaction between flocks and body sizes was significant in respect of all the above parameters. The average weekly body weight, egg weight and feed conversion ratio (g/g egg mass) in imported flock remained on higher side than that of local flocks. The heavy weight category birds had maximum body weight and egg weight followed by that of medium and small size groups. The average weekly egg production percent/bird, egg number and egg mass g/bird in the local-3 flock remained higher than that of imported, local-1 and 2 flocks. The small weight category birds had maximum egg production percent, egg number and egg mass g/bird than that of heavy and medium size. The average weekly FCR (g/egg) in local-1 flock remained on higher side than in the imported, local-2 and 3 flocks. The heavy weight category birds had maximum FCR (g/egg) than those from medium and small size birds.

Key words: Body weight, egg production (egg number, egg weight, egg mass g/bird) and FCR/egg.

INTRODUCTION

Japanese quail (*Coturnix coturnix japonica*) are now kept for both the egg and meat production (Cain and Cawley 2000) being robust, disease resistant, easy to maintain with less requirement of space and equipment (Anonymous 1991; Tikk and Tikk 1993; Baumgartner 1994; Yildirim and Yetisir 1998; Minvielle 2004). The female quail starts egg production at an average 6 weeks of age and continuously lay for at least one year. Furthermore the quail is efficient converter of feed, with each egg a female deposits an edible package of 8 percent of her own body weight as compared to 3 percent in case of chicken (Martin *et al.* 1998). Japanese quail has been reported to be the most appropriate avian species to be used for all type of poultry research work (Minvielle 2004).

Quail farming was introduced in Pakistan in early 1970 with the introduction of exotic breeding stock of Japanese quails. However, quail production has remained as one of the neglected components of poultry sector in the country (Anonymous 1990). Very little research work has been conducted on its breeding, incubation, housing, nutritional requirements, feeding, management and disease control aspects in Pakistan. Almost 4 decades back a breeding stock of hybrid Japanese quails was imported in Pakistan with good genetic potential having better egg production performance, egg quality parameters and hatching traits compared to local quail. But unfortunately due to continuous inbreeding, since that time, genetic potential of the imported quail might have deteriorated. Simultaneously no serious attempt has been made to improve the genetic potential of our local native quails. Keeping this in view, 4 different close-bred (three local and one imported) of Japanese quails have been maintained at Avian Research and Training Centre, UVAS, Lahore, for improving their productive and growth potentials. The research findings reported in this paper are part of Ph.D. research work by the major author undertaken to study effect of parental body size on the productive performance of Japanese quails.

MATERIALS AND METHODS

The present study of 31 weeks duration was conducted to evaluate the productive performance of 4 close-bred flocks of Japanese quails with different body weights, at Avian Research and Training Centre, University of Veterinary and Animal Sciences, Lahore, Pakistan. The birds were randomly divided into 108 experimental units (replicates comprising one male and three females of each) which were randomly assigned to 12 treatment groups having 4 close-bred flocks (imported, local 1, local 2, and local 3) x 3 female body weight with randomized complete block design in factorial arrangements having 9 replicates in each treatment. The body weight categories of heavy, medium and small quails of both the sexes have been presented in Table 1.

Table 1. Different body weight categories (g)

Body weights	♂	♀
Heavy	270-315g	300-350g
Medium	225-270g	250-300g
Small	180-225g	200 -250g

The experimental birds were tagged for their proper identification and maintained in specially remodeled individual compartments each measuring 30x20x15 cm in French made multi-deck cages (equipped with separate nipple drinkers) placed in one of the well ventilated octagonal shape quail houses measuring 10.05x3.65x2.74 meter. The maximum and minimum temperature of the quail house was recorded daily which ranged from 24^{0C} to 32^{0C}. Natural day light was provided to the birds at the start of the experiment and then light hours were increased by half an hour weekly till 16 hours light per day. Fresh and clean drinking water was provided at all the times through automatic nipple drinkers. The birds were fed *ad libitum* a balanced quail breeder ration according to NRC standards (1994), containing Metabolizable energy 2900 kcal/kg, crude protein 20%, calcium 3% and available phosphorus 0.4%. The data on body weight, egg production (egg number, egg weight, egg mass g/bird) and FCR/egg were recorded to study the response of different parental body size from different close bred flocks on productive performance of Japanese quails through-out the study.

Statistical Analysis: The data thus collected were analyzed using ANOVA techniques (Steel *et al.* 1997) with Randomized Complete Block Design (RCBD) under factorial arrangement for further interpretation using general linear model (GLM) procedures (SAS 9.1, 2002-03) portable software, assuming the following mathematical model:

$Y_{ij} = \mu + S_i + W_j + \varepsilon_{ij}$

Where,

Y = each observation

μ = Population mean

S_i = Number of flocks treated as blocks (i = 4)

W_j = Weight categories treated as treatments (j = 3)

ε_{ij} = Random error associated with i flocks and j weight categories

The comparison of means was made using Duncan's Multiple Range (DMR) test (Duncan 1955).

RESULTS AND DISCUSSION

1. Body weight (g): In the present study, the imported flock of Japanese quails attained significantly ($p<0.05$) higher body weight than all local flocks (Table 2). These findings are in line with those of Vali *et al.* (2005) who reported significant body weight variation in two quail strains at 35, 42 and 49 days of age. The variation in body weight of different close-bred flocks of Japanese quails recorded during this study could be attributed to difference in genetic makeup of these flocks. The variation in body weight of close bred flocks of chickens has been attributed to difference in genetic makeup of flocks maintained in different areas and ecological regions (Hafez 1963; Marks 1971; Sefton and Siegel 1974; Shamma 1981; Darden and Marks 1988). Similarly

Table-2 Mean body weight (g) in 4 close-bred laying flocks of Japanese quails with different body weight categories during 31 weeks

*CBF Categories	Imported	Local-1	Local-2	Local-3	Mean
		**BW (Mean ± ***SE; g)			
Heavy	$316.75±7.35^{a}$	$303.75±5.19^{b}$	$300.58±5.25^{b}$	$299.64±2.86^{b}$	$305.18±2.74^{E}$
Medium	$284.55±2.97^{c}$	$276.55±2.92^{cd}$	$275.17±2.78^{cd}$	$269.53±2.93^{d}$	$276.45±1.52^{F}$
Small	$251.53±2.85^{e}$	$247.22±2.60^{e}$	$242.23±2.66^{e}$	$245.26±2.68^{e}$	$246.56±1.37^{G}$
Mean	$284.28±4.06^{A}$	$275.84±3.35^{B}$	$272.66±3.42^{b}$	$271.48±2.96^{B}$	

*CBF = Close-bred flocks **BW= Body weight ***SE = Standard error many other workers also described the significant effect of genetic group on body weight of chicken (Mohammed *et al.* 2005; Devi and Reddy 2005; Chatterjee *et al.* 2007). In the previous studies it has been reported that the mean body weight differed significantly among different local and imported flocks of Japanese quails. The body weight of male and female quails in imported flock was significantly ($p<0.05$) higher than those of local quails (Rehman 2006 and Akram *et al.* 2008). It has also been observed that body weight from day-old to 20 weeks of age was significantly higher in selected lines than the control un-selected line (Chaudhary *et al.* 2009). The significant ($p<0.01$) effects of strains and generations on body weight of Japanese quails at different ages have been reported (Mohammed *et al.* 2006) indicating that selection could increase body weight in Japanese quails (Varkoohi *et al.* 2010).

2. Egg production

i. Cumulative egg number: In the present study, the mean cumulative egg number/bird was not significantly different among all the local and imported flocks of Japanese quails (Table 3). These results are in agreement with those of Leeson *et al.* (1997) and Hocking *et al.* (2003) who could not detect difference ($p>0.05$) in egg production between different strains of chicken. Similarly, Rehman (2006) reported non-significant difference in egg production among different local and imported stocks of Japanese quails. On the contrary some workers indicated that egg production has been shown to be affected by breed, body size, feed, season and breeder age (North and Bell 1990; Ipek and Sahan 2004). The higher growth-selected strain of broiler breeder exhibited poorer egg production than all the other strains (Wolanski *et al.* 2007). The higher egg production in exotic Rhode Island Red breed than the local breeds was attributed to its better genetic potential (Sazzad 1992; Akhtar *et al.* 2007). The genetic ability for egg production of the Manchurian gold breed was higher as compared to the Pharaoh Quail breed up to the age of 150 days (Genchev and Kabakchiev 2009). Contrary to the findings of the present study Hanan (2010) reported highly significant differences in egg number and egg production percent in Japanese quails. Variation in the results of both the studies could be attributed to difference in strains used in both the studies.

The results of the present study indicated significant ($p<0.05$) difference in the mean egg production of different body size quails during the entire experimental period. The maximum egg production was recorded in the small weight category and minimum in the heavy size birds (Table 3). Similar findings have also been observed (North and Bell 1990; Ipek and Sahan 2004) in poultry birds. The interaction between flocks and body size was not significant. These findings are in quite agreement with those of Nestor and Bacon (1982) indicating that egg production decreased in heavy size and increased in low body weight strains of Japanese quail. The similar findings have been reported in chickens by Renden and McDaniel (1984); Leeson *et al.* (1997); in Lohmann hens Lacin *et al.* (2008); in selected strains of broiler breeders Wolanski *et al.* (2007) and in quails Aboul-Hassan (2001). On the contrary El-Sagheer and Hassanein (2006) reported that the medium and heavy size strains of chicken had significantly ($p<0.05$) higher egg production than those of light strains.

The low egg production in heavy quails in comparison to small quails recorded in this study could be due to less number of mature ovarian follicles in heavy quails. Similar view point has been held by Wilson and Cunningham (1984); Palmer and Bahr (1992) who attributed that difference in heavy and older chicken in egg production than the lighter and younger birds has been due to physiological changes leading to slow growth of ovarian follicles.

ii. Egg weight (g): In the present study, the weekly mean egg weight in the imported flock of Japanese quails was significantly ($p<0.05$) higher than all the local flocks during the entire experimental period. The maximum mean egg weight was recorded in imported quail and minimum in local-3 flock (Table 3). The similar findings indicating the highest egg weight in exotic Rhode Island Red than in local Lyallpur Silver Black breed have been reported (Akhtar *et al.* 2007). The size and weight of an egg not only depends upon the breed and strain but also it varied to great extent from one individual to another as a result of these factors wide variation in egg weight may be present within a flock (Shoukat *et al.* 1988). The similar findings have been reported by El-Fiky *et al.* (2000); Aboul-Hassan (2001). Juliank and Christians (2002) stated that egg size increases with advancement of age in birds. With reference to contribution of male on the egg weight, no detectable effect of male on the egg weight of their mates has been observed (Moss and Watson 1999). Altan *et al.* (1998) stated that selection of quails for live body weight influenced egg weight due to increase in size of ova produced in the ovaries of females.

The results of this study indicated significant ($p<0.05$) difference in the mean egg weight in quails of different weight categories. The maximum mean egg weight was recorded in the heavy weight category quails and minimum in the small size birds (Table 3). The similar findings have been reported by Hagger (1994) and Leeson *et al.* (1997) indicating that egg weight increase was associated with increase in body weight and age of the breeder. These findings are also in quite conformity with those of El-Sagheer and Hassanein (2006); Kirikci *et al.* (2007) who observed that heavy eggs were obtained from the heavy birds and the light eggs were produced by the small size birds. It has further been indicated that a positive correlation exists between body weight and egg weight (Siegel 1962; Festing and Nordskog 1967; Kinney (1969). Therefore a compromise between body weight reduction and maintenance of acceptable egg weight is needed (Nordskog and Briggs 1968; Hocking *et al.* 1987). These results are fully substantiated by those of Afanasiev (1991) who observed that egg weight in Japanese quails is largely dependent on the type of birds, being 8-10g in the egg type (small size), 10-11g in the combined type (medium size) and-12-16g for the broiler type (heavy size). Hanan (2010) reported highly significant ($p<0.05$) differences in egg weight in Japanese quails at different ages. Lacin *et al.* (2008) also pointed out that egg weight was lower in the group with low body weight than those of medium and heavy hens, respectively.

iii. Egg mass (g/bird): In the present study, the mean egg mass (g/bird) in all the close-bred flocks of Japanese quails was not significantly different which appeared to be due to not significant difference in egg production among these flocks (Table 3). These results are in line with those of Sahota and Bhatti (2003) who reported that black, dark brown and light brown varieties of Desi chicken differed non-significantly in egg mass. Similarly, in another study conducted by Rehman (2006) who reported that the mean egg mass (g/bird) showed non-significant difference among different local and imported stocks of Japanese quails, however, egg mass of local and imported stocks increased with advancement of age from 6th to 12th weeks. In the present study, with respect to body size categories, a not significant difference in mean egg mass was also noted, however, interaction between flocks and body size showed significant ($p<0.05$) difference. On the contrary, Nazligul *et al.* (2001) reported that egg mass was affected by both age and body weight in quails.

Table 3 Mean cumulative egg number/bird, weekly egg weight (g) and egg mass (g/bird) in 4 close-bred laying flocks of Japanese quails with different body weight categories during 31 weeks

*CBF Categories	Imported	Local-1	Local-2	Local-3	Mean
		***EN (Mean ± **SE; #)			
Heavy	$121.31±13.06^{c}$	$136.67±8.28^{abc}$	$126.37±9.90^{c}$	$138.94±7.90^{abc}$	$130.82±4.93^{F}$
Medium	$139.76±8.13^{abc}$	$136.61±4.99^{abc}$	$135.20±7.99^{abc}$	$153.02±8.23^{a}$	$141.14±3.76^{EF}$
Small	$152.67±3.87^{a}$	$155.63±4.30^{a}$	$146.78±7.86^{bc}$	$150.80±6.28^{ab}$	$151.46±2.82^{E}$
Mean	137.91±5.67	142.96±3.81	136.11±5.06	147.58±4.34	
		****EW (Mean ± **SE; g)			
Heavy	$12.96±0.08^{a}$	$12.81±0.07^{ab}$	$12.810.07±^{ab}$	$12.72±0.10^{b}$	$12.82±0.04^{E}$
Medium	$12.33±0.04^{c}$	$12.23±0.12^{c}$	$12.35±0.04^{c}$	$12.25±0.07^{c}$	$12.29±0.03_{F}$
Small	$11.80±0.06^{d}$	$11.63±0.05^{d}$	$11.61±0.05^{d}$	$11.63±0.04^{d}$	$11.67±0.02^{G}$
Mean	$12.36±0.10^{A}$	$12.22±0.10^{B}$	$12.26±0.10^{AB}$	$12.20±0.09^{B}$	
		*****EM (Mean ± **SE; g)			
Heavy	$50.95 ± 5.34^{b}$	$56.73 ± 3.26^{ab}$	$52.44 ± 4.04^{ab}$	$57.92 ± 3.10^{ab}$	54.51 ±1.99
Medium	$56.20 ± 3.22^{ab}$	$54.82 ± 1.93^{ab}$	$54.99 ± 3.28^{ab}$	$61.88 ± 3.25^{a}$	56.97 ±1.50
Small	$58.52 ± 1.61^{ab}$	$59.48 ± 1.87^{ab}$	$56.08 ± 2.88^{ab}$	$56.92 ± 2.26^{ab}$	57.75 ±1.08
Mean	55.22 ± 2.15	57.01 ± 1.40	54.50 ± 1.93	58.91 ± 1.66	

Different alphabets on means in a row show significant differences at $p<0.05$
*CBF = Close-bred flocks **SE = Standard error ***EN = Egg number ****EW = Egg weight *****EM = Egg mass

3. Feed conversion ratio-FCR (g feed/egg): The results of this study show that the mean feed conversion ratio (g feed/egg) in all the four close-bred flocks of Japanese quails was not significantly different (Table 4). These results are in agreement with those of Rehman (2006) who indicated non-significant difference in FCR (g feed/egg) between different local and imported flocks of Japanese quails. Feed consumption is a variable phenomenon influenced by several factors such as strain of the bird, energy content of the diet, ambient temperature, floor density, hygienic conditions and rearing environments. As with growing pullet, feed conversion is the best when the hen is young, it then gradually decreases with age (Kingori *et al.* 2003). The findings of the present study did not agree with those of Varkoohi *et al.* (2010) who reported 18.4 percent cumulative genetic improvement in FCR or 6.1 percent improvement per generation of quails through selection. Similarly, Jaroni *et al.* (1999) observed strain difference in feed efficiency. Feed consumption was reported to be higher in the exotic Fayoumi birds than that of local Lyallpur Silver Black (Akhtar *et al.* 2007).

In the present study, a significant ($p<0.05$) difference was observed in the mean FCR (g feed/egg) in quail parents with different body weight. The maximum mean FCR (g feed/egg) was recorded in the heavy weight category and minimum in the small size birds. The interaction between flocks and body size was also significant (Table 4). The better FCR (g feed/egg) in small size quails during this study could be attributed to less feed requirement of these birds. These findings are in line with those of Leeson *et al.* (1997) who observed that the smaller birds consistently ate less feed throughout laying regardless of the strain. Feed consumption increased as body weight increased because heavy birds consume more feed. Similar findings reported in Hi-sex brown strain of chicken by El-Sagheer and Hassanein (2006); in Pheasant (Aydin and Bilgehan 2007) and in Lohmann laying hens (Lacin *et al.* 2008).

Table 4 Feed conversion ratio (g/egg) in 4 close-bred flocks of Japanese quails with different body weight categories during 31 weeks

*CBF Categories	Imported	Local-1	Local-2	Local-3	Mean
		**FCR g/egg (Mean ± ***SE; g)			
Heavy	$45.94{\pm}3.58_{abc}$	49.35 ± 2.91^{ab}	51 ± 2.32^{a}	$46.61{\pm}2.25^{abc}$	48.22 ± 1.39^{E}
Medium	$46.32{\pm}2.57^{abc}$	$47.92{\pm}1.57^{abc}$	$47.63{\pm}2.22^{abc}$	$42.61{\pm}2.85^{bc}$	46.12 ± 1.18^{E}
Small	$41.89 \pm 1.05_{c}$	41.13 ± 1.39^{c}	$44.01{\pm}2.11^{abc}$	$43.93{\pm}2.03^{abc}$	42.74 ± 0.84^{F}
Mean	44.72 ±1.50	46.13 ±1.34	47.54 ±1.35	44.38 ±1.37	

Different alphabets on means in a row show significant differences at p<0.05
*CBF = Close-bred flocks **FCR = Feed conversion ratio ***SE = Standard error

Acknowledgements: The authors thankfully acknowledge cooperation extended by Avian Research and Training (ART) Centre, Department of Poultry Production, University of Veterinary and Animal Sciences, Lahore, Pakistan, in providing research facilities during course of this study.

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