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QUAIL BREEDER'S PRODUCTION PERFORMANCE IN RESPONSE TO SELECTION FOR HIGHER THREE WEEKS BODY WEIGHT

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ABSTRACT

The present study was executed to compare breeder performance parameters (feed intake, Age at 1st egg, egg weight, hen day & hen house production %, FCR /kg and/dozen eggs) in mass selected (MS), pedigree based selected (PS) and random bred controls (RBC), in three consecutive generations of Japanese quail. In generation1 (G1), 11000 quail chicks were randomly distributed into 22 sub-groups. After 3 weeks, birds were weighed and sexed; the higher body weight birds were selected as the parents of next generation. Out of 22 groups, first group was maintained with fully pedigree record, in second group birds were picked randomly without following any selection procedure, rest 20 groups were subjected to mass selection. Pedigree selection significantly improved egg weight, egg mass and FCR/ kg egg mass in higher body weight selected birds with the advancement in generations. Hence, it can be concluded that short term selection for higher 3-week body weight in quails exhibited little or no deterioration, rather improved subsequent production performance with the advancement of generations.

Key words: Selection, Japanese quail, age at 1st egg, egg production performance, Egg mass, FCR/kg egg mass

INTRODUCTION

Selection significantly improves production traits in Japanese quail. Proper selection and breeding techniques coupled with improvements in the environmental and managerial conditions can help improving overall egg production (Chahil *et al.,* 1975). Significantly higher egg production was observed in selected lines of Japanese quail as compared to control groups (Aboul-Hassan, 2001a). However it is a well-known fact that selection for higher body weight is negatively correlated with production performance, leading to the relatively poor egg production (Nath *et al.,*2011). Selection for higher 6-week body weight in Japanese quail (Aboul-Hassan *et al.,* 1999) reduced the average egg number (10 week) per bird from 64.3 to 57.1 which may be consequent effect of increased body weight (Hassan *et al.,* 2008). Egg weight was also found to be positively affected by selection for higher live body weight in Japanese quail due to increase in size of ova and increased albumen secretion (Altinel *et al.,* 1996)and was mainly dependent on the bird type (Afanasiev, 1991). Variation in egg size and weight largely depends upon the breed and strain, from one strain to the other and from one individual to another, as a consequence, extensive variation in egg weight may be observed within a flock (Shoukat *et al.,* 1988).

Feed consumption is reported to be affected by the variations in body weight (Nazligul *et al.,*2001). Higher egg production and improved feed conversion ratio is reported in light weight categories followed by medium and heavy chickens (Lacin *et al.,* 2008).Higher daily and cumulative feed intake in selected birds may be due to their body size as well as increased egg weight as a result of selection for body weight (Hassan *et al.,* 2008).

Though, a number of researchers have investigated the effect of selection for higher body weight on overall egg production performance in breeding stocks of broiler and layer chickens, yet such systematic genetic studies on Japanese quails are still lacking. Keeping in view the above discussion, an experiment was conducted with the main objectives to identify the possible changes in breeder quail's production performance as a subsequent effect of different selection strategies for higher 3-week body weight in three successive generations.

MATERIALS AND METHODS

The present study was executed at Avian Research and Training Centre, University of Veterinary and Animal Sciences, Lahore to investigate breeder production parameters pertaining to feed intake, Age at 1st egg, egg weight, hen day &hen house production %, FCR /kg and /dozen eggs in mass selected (MS), pedigree based selected (PS) and random bred controls (RBC) in three generations (G1, G2 and G3) of Japanese quail. In G1, 11000 quail chicks were randomly distributed into 22 sub-groups. After 3 weeks, birds were weighed and sexed; the higher body weight birds were selected as the parents of next generation. Out of these 22 sub-groups, first group was maintained with fully pedigree record, in second group birds were picked randomly without following any selection procedure, rest 20 groups were subjected to mass selection. The same procedure was repeated in the next two generations.

Management and Housing: From 5th week onwards all the experimental birds were maintained in multi-deck cages specially made for separate breeding of Japanese quail, placed in a properly ventilated octagonal shape quail house measuring "33×12×9 cubic feet", under standard management conditions. Fresh and clean drinking water was provided round the clock through automatic nipple drinkers. The birds were fed quail breeder ration (CP 20% and ME 2900 K Cal/Kg) in measured quantity, as per recommendations of NRC (1994).

Parameters studied: In the present experiment following parameters were studied:

a) Age at 1st egg: - It was the chronological age when a female laid her 1st egg
b) First egg weight: - It was recorded with the help of an electric weighing balance capable of measuring up to 0.1g precision.
c) Eggs till 20th week:- It was the total number of eggs produced till the end of 20th week
d) Egg production %: - In this regard hen day and hen housed egg production % were calculated.
e) Average feed intake: - It was calculated by averaging total feed intake per replicate. For this purpose, measured quantity of feed was offered and then residue was taken after 24 hours to calculate actual feed intake.
f) Cumulative feed intake (6th to 20th week): - It was calculated simply by adding the daily feed intake till 20 weeks.
g) Average egg weight: - It was calculated by averaging total egg weight per replicate
h) Total egg mass: - Total egg mass was calculated by adding the weights of all eggs obtained from a replicate
i) FCR / dozen eggs: - It was calculated by measuring total feed required to produce one dozen egg
j) FCR / kg egg mass:- It was also calculated by measuring total feed required to produce one kg egg mass

Statistical Analysis: Data were analyzed according to Completely Randomized Design (CRD) under factorial arrangements (Steel *et al.,* 1997) using GLM procedures. Means were compared through Duncan's (1955) multiple range test with the help of SAS 9.1 for windows (SAS, 2004) assuming following statistical model:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ijk}$$

Where,

Y_{ijk} = Dependent variable

μ = Overall Population mean

α_i = First factor effect (Generations i= 3)

β_j = Second factor effect (Selection methods j = 3)

$(\alpha\beta)_{ij}$= interaction effect

ε_{ijk} = Residual effect

RESULTS AND DISCUSSION

Average daily and Cumulative (6-20 weeks) feed intake: In the present experiment, significant differences (P≤0.05) were observed in average daily and cumulative feed intake among 3 successive generations and selection groups (table 1). G-3 showed significantly higher average daily (31.28±0.322g) and cumulative feed intake (3065.77±31.605g), than that of G-1[(29.78±0.383g), (2919.26±37.597g)]. While comparing different selection methods it was observed that pedigree based selected birds showed significantly higher average daily (30.99±0.310g) and cumulative (3037.18±30.449g) feed intake to that of random bred control group [(29.89±0.423), (2929.22±41.516)]. Selection methods in interaction with generations increased the feed intake to highest level in mass selected birds in G-3 as maximum daily (32.10±0.347g) and cumulative (3145.80±34.022g).This might be attributed to intensive selection process, resulting in higher body weight as a response to selection (Hussain *et al.,* 2013), thus requiring more feed. Feed consumption is reported to be affected by the variations in body weight in Japanese quails (Nazligul *et al.,* 2001). This can also be due to genetic variance in the populations. Leeson *et al.* (1997) also found significant differences in feed intake among different strains of chicken. Considerable differences in feed intake were observed in different breeds of chicken due to the differences in the genetic background of the breeds (Akhtar *et al.,* 2007). It was further reported that feed intake of broiler breeders increased due to increase in body weight (Hassan *et al.,* 2008).

Age at first egg: In the present study significant differences (P≤0.05) were observed in age at first egg among different generations with the maximum number of days for G-2 (46.85±0.766 days) (table 1). Mass selection in interaction with G2 took the maximum (47.75±1.339 days) number of days to reach the age at first egg and the minimum (43.20±0.716 days) in pedigree based birds of G3. It might be attributed to the genetic make-up of the birds, their overall body conditions and the seasonal variations in day length because the onset of egg production is considered a combined factor of chronological age, overall body condition and day length (Krapu, 1981;Reddish *et al.,* 1993).

First egg weight as well as average egg weight: Among different selection methods significantly (P≤0.05) higher first egg weight (10.58±0.132g) was observed in pedigree based selected birds than those of random bred control group (table 1). In the overall interaction between different selection methods and generations, pedigree based selected birds in G3 showed the highest (10.75±0.216g) first egg weight whereas, RBC of G2 remained the lowest (9.90±0.216g). Regarding average egg weight, G-3 showed the highest average egg weight (12.76±0.126g), followed by G-2 (12.13±0.134g) and G-1 (12.76±0.126g). Among different selection methods, pedigree based selected birds showed significantly higher (12.46±0.135g) average egg weight than that of random bred controls (11.39±0.117g) (table 2). The progressive increase in the 1st egg weight as well as average egg weight might be attributed to higher body weight of the birds in generation three in response to selection for improved growth rate. In some other experiments it was observed that selection for 4 week body weight increased egg and hatch weight (Anthony *et al.,* 1989, 1996). It might also be attributed to selection accuracy in pedigree based selected birds that helped exploiting the maximum potential in terms of body weight (Hussain *et al.,* 2013) proving that egg weight is a direct factor of body weight. Similar findings were also reported by Altan *et al.* (1998) who indicated that selection of quails for live body weight influenced egg weight due to increase in size of ova produced in the ovaries of females. Kosba *et al.* (2003) also performed selection for higher 6 week body weight over 17 generations and reported that the selected and control lines were essentially identical in the base and first generation of selection for the average egg weight, thereafter, the selected line laid significantly (P≤0.01) larger eggs than the control.

Cumulative eggs/ female plus Hen day and Hen housed egg production %: Significantly (P≤0.05) higher hen day as well as total egg number/ female till 20th week was observed in G-2, than that of G-3, while Hen housed egg production % differed non-significantly among different generations (table 2). However, selection methods could not show any significant differences regarding cumulative egg number, Hen day and Hen housed egg production %. Generations in interaction with selection methods also yielded non-significant differences. Decrease in egg number from G2 to G3 may be due to increase in body weight controlled by genotype as both are in inversely co-related (Oluyemi and Roberts, 1979; Harms *et al.,* 1982). However, G1 might not have expressed its effect due to some uncontrolled factors as egg production is reported to be influenced mainly bygenetic back ground, body size, quality of feed, season and breeder age (North and Bell, 1990;Ipek and Sahan, 2004). Regarding body weight, up selection lowered rate of egg production more than down selection with the possible explanation that the genes for high egg production may become lost when selection is directed exclusively towards body size or egg size (Michael *et al.,* 1967). A decrease in egg production due to selection for 4-week body weight over 10 generations was recorded by Darden and Marks (1988). Some other scientists also observed (Hanan, 2010) significant differences in egg number and egg production % in different groups of Japanese quails on the basis of their body weight variations.

Total egg mass: In the present experiment, significant differences (P≤0.05) were observed regarding total egg mass among three successive generations and selection methods (table 3). G-3 showed the maximum value (794.15±20.231g) of egg mass, whereas the lowest (726.86±20.654g) was observed in G-1.Among different selection methods pedigree based selected birds showed the highest (794.32±18.558g) total egg mass, while the lowest (719.59±18.637g) was recorded in random bred birds. In the interaction between different selection methods and generations, mass selected birds in G-3 exhibited the highest total egg mass (828.05±22.323g), while the lowest (706.13±36.962g) was observed in random bred birds of G-1. Egg mass is a factor of egg number and egg weight, hence higher values of total egg mass in selected groups might be due to the higher egg weights in high body weight selected birds as the generations progressed. Nazligul*et al.* (2001) also reported that the egg mass in quail is influenced by body weight. The estimates of 485.3 and 463.9g of egg mass after ten weeks of laying among selected and control lines after three generations of selection for increased egg production have also been reported (Aboul–Hassan, 2001b).

FCR/dozen eggs and / kg egg mass: FCR/kg egg mass was significantly improved (3.71±0.122) for mass selected birds of G-2 than (4.40±0.291) random bred birds of G-1 (table 3). It might be attributed to the optimum feed intake against a large amount of egg mass produced by mass selected birds of G-2 due to higher egg weight in birds selected for higher body weight (Altinel *et al.,* 1996). Feed intake of smaller birds remained consistently lower during laying period but resulted in loss of egg size (Leeson *et al.,* 1997) hence reduced total egg mass. The higher estimates of daily egg mass in selected birds (8.53 and 9.22g/day) to those of (8.18 and 8.90g/day) unselected control lines were also reported by El-Fiky (2005). However, feed/ dozen could not express any difference neither under generations nor selection methods either alone or in their interaction. Rehman (2006) also reported non-significant differences in feed/dozen eggs among different closebred stocks of Japanese quail.

Table 1. Comparison between different generations of Japanese quail regarding average daily feed intake, total feed intake, age at 1st egg and 1st egg weight (Mean ± SE).

	Average daily feed intake	Cumulative feed intake 6^{th}-20^{th}week	1^{st} egg weight	Age at 1^{st} egg
	--------------------(g)--------------------			---(days)---
Comparison between different generations				
Generation 1	29.78±0.383^{b}	2919.26±37.597^{b}	10.18±0.143	45.15±0.350^{b}
Generation 2	30.45±0.343^{ab}	2984.10±33.709^{ab}	10.28±0.140	46.85±0.766^{a}
Generation 3	31.28±0.322^{a}	3065.77±31.605^{a}	10.43±0.158	44.70±0.612^{b}
Comparison between different selection methods				
Mass	30.64±0.319^{ab}	3003.72±31.267^{ab}	10.30±0.166^{ab}	45.68±0.636
Pedigree	30.99±0.310^{a}	3037.18±30.449^{a}	10.58±0.132^{a}	44.71±0.619
Random-bred	29.89±0.423^{b}	2929.22±41.516^{b}	10.01±0.133^{b}	46.30±0.564
Overall interaction between different generations and selection groups				
G1 × Mass	29.42±0.645^{d}	2883.16±63.234^{d}	10.15±0.254^{ab}	45.10±0.644^{abc}
G1 × Pedigree	30.02±0.695^{bcd}	2942.45±68.144^{bcd}	10.35±0.246^{ab}	44.05±0.609^{bc}
G1 × Random-bred	29.92±0.678^{bcd}	2932.16±66.488^{bcd}	10.05±0.234^{ab}	46.30±0.476^{abc}
G2 × Mass	30.40±0.466^{abcd}	2979.20±45.745^{abcd}	10.30±0.281^{ab}	47.75±1.339^{a}
G2 × Pedigree	31.40±0.350^{abc}	3077.20±34.391^{abc}	10.65±0.208^{ab}	46.90±1.516^{ab}
G2 × Random bred	29.55±0.819^{cd}	2895.90±80.271^{cd}	9.90±0.216^{b}	45.90±1.137^{abc}
G3 × Mass	32.10±0.347^{a}	3145.80±34.022^{a}	10.45±0.336^{ab}	44.20±1.099^{bc}
G3 × Pedigree	31.55±0.467^{ab}	3091.90±45.787^{ab}	10.75±0.216^{a}	43.20±0.716^{c}
G3 × Random bred	30.20±0.727^{bcd}	2959.60±71.309^{bcd}	10.10±0.250^{ab}	46.70±1.196^{ab}

Different alphabets on means in a column show significant differences at P≤0.05

Table 2. Comparison between different generations of Japanese quail regarding total eggs/female, Hen day%, Hen house % and Average egg weight (Mean ± SE).

	Total Eggs/Female 6^{th} -20^{th}wk	Hen Day Egg Production	Hen Housed Egg Production	Average Egg Weight
	---(#)---	--------(%)--------		---(g)---
Comparison between different generations				
Generation 1	64.33±1.605^{ab}	67.93±1.749^{ab}	58.93±3.401	11.26±0.118^{c}
Generation 2	65.26±1.371^{a}	70.35±1.610^{a}	61.36±3.251	12.13±0.134^{b}
Generation 3	61.34±0.776^{b}	64.52±0.926^{b}	57.67±2.648	12.76±0.126^{a}
Comparison between different selection methods				
Mass	64.26±1.195	68.30±1.341	59.55±3.083	12.30±0.153^{a}
Pedigree	63.66±1.326	67.10±1.573	59.17±3.182	12.46±0.135^{a}
Random-bred	63.02±1.415	67.41±1.585	59.25±3.103	11.39±0.117^{b}
Overall interaction between different generations and groups				
G1 × Mass	65.66±2.798	69.36±3.125	57.60±6.279	11.05±0.223^{d}
G1 × Pedigree	63.89±2.653	66.75±2.944	60.00±5.298	11.65±0.181^{c}
G1 × Random-bred	63.46±2.999	67.69±3.144	59.19±6.249	11.10±0.190^{cd}
G2 × Mass	64.53±1.518	70.04±1.585	62.70±5.041	12.63±0.150^{b}
G2 × Pedigree	65.65±2.887	71.00±3.486	60.56±6.717	12.33±0.223^{b}
G2 × Random-bred	65.61±2.616	70.02±3.074	60.83±5.269	11.45±0.236^{cd}
G3 × Mass	62.59±1.708	65.51±1.964	58.36±4.790	13.24±0.116^{a}
G3 × Pedigree	61.45±0.743	63.54±0.872	56.94±4.434	13.41±0.075^{a}
G3 × Random-bred	59.99±1.403	64.53±1.810	57.72±4.760	11.63±0.172^{c}

Different alphabets on means in a column show significant differences at P≤0.05

Table 3. Comparison between different generations of Japanese quail regarding total egg mass, FCR/dozen eggs and FCR/kg egg mass (Mean ± SE).

	Total egg mass	FCR	
	---(g)---	Grams feed/ Dozen Eggs	Kg feed/kg egg mass
Comparison between different generations			
Generation 1	726.86±20.654[b]	567.92±17.853	4.24±0.149
Generation 2	794.15±20.231[a]	565.20±15.015	3.92±0.119
Generation 3	783.56±13.009[a]	605.52±10.334	3.97±0.081
Comparison between different selection methods			
Mass	790.64±17.251[a]	573.33±13.082	3.91±0.100
Pedigree	794.32±18.558[a]	588.21±13.998	3.96±0.113
Random-bred	719.59±18.637[b]	577.10±17.294	4.25±0.141
Overall interaction between different generations and selection groups			
G1 × Mass	726.40±35.710[bc]	548.69±30.256	4.16±0.239[ab]
G1 × Pedigree	748.06±35.864[abc]	573.29±28.506	4.14±0.252[ab]
G1 × Random-bred	706.13±36.962[c]	581.77±34.788	4.40±0.291[a]
G2 × Mass	817.49±25.885[ab]	559.40±14.254	3.71±0.122[b]
G2 × Pedigree	810.52±40.335[ab]	586.60±29.965	3.99±0.219[ab]
G2 × Random-bred	754.44±37.285[abc]	549.60±30.995	4.05±0.259[ab]
G3 × Mass	828.05±22.323[a]	611.92±18.848	3.85±0.125[ab]
G3 × Pedigree	824.40±11.008[a]	604.73±9.424	3.75±0.064[ab]
G3 × Random-bred	698.22±19.543[c]	599.93±23.388	4.31±0.179[ab]

Different alphabets on means in a column show significant differences at P≤0.05

Conclusions: The results presented in the above sections showed improvement in egg weight, egg mass and feed per kg egg mass in higher body weight selected birds. A little or no significant variation in the other breeder production performance traits suggest that short term selection for higher body weight can be successfully applied without compromising breeder production performance.

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