EFFECTS OF DIVERGENT SELECTION FOR 35-DAY BODY WEIGHT ON FERTILITY AND HATCHABILITY OF JAPANESE QUAIL

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ABSTRACT
A study was conducted to determine the effect of divergent selection for 35-day body weight on fertility and hatchability, egg weight loss, and hatch weight of Japanese quail eggs. Eggs for incubation were obtained from a total of 1,500 chicks obtained from the National Veterinary Research Institute in Vom, Plateau State as the base population from which 'High Line'and 'Low Line' were established based on individual body weight at 35-days of age.A random sample of the base population was maintained as the Control Line. Random mating was made within Line at the ratio of one male to three females and eggs were collected for incubation to propagate subsequent generations using the same selection procedure. Data obtained over five generations of selection were analysed within and between Lines using One-way Analysis of Variance procedure.Percentage fertility of incubated eggs showed no significant (P>0.05) differences among experimental lines in all generations except generation four. Over the five generations of selection, the Low weight lines had the highest fertility (86.07%) Percent hatchability over the five generations of selections in the three lines showed no significant (P<0.05) differences though the High body weight line had the highest mean value (44.37%). Mean hatchability of fertile eggs for the five generations of selection was highest in the High Body Weight line (53.18%) though not significantly (P>0.05) higher than the Control (50.86%), and the Low line (43.49%). Hatch weight increased with progress in selection. At the end of five generations, mean hatch weight differed significantly (P<0.05). Mean values were 6.42g, 6.08g and 5.79g for the High Control and the Low lines respectively. Chick: Egg weight ratios were not significantly (P>0.05) affected in all generations, though there was an increase with progress in selection in the High line.
Keywords: High weight line, Low weight line, Control, selection.

INTRODUCTION
Japanese quails have been employed as a pilot animal in quantitative genetic studies because of its short generation interval and lesser resource requirement (Anthony *et al*., 1996). Devi *et al* (2010) have reported genetic selection as a powerful means of increasing body weight and rate of gain in the Japanese quail. Selection experiments with quails have examined the role of selection environment on short- and long-term selection responses (Marks, 1996). Experimental researches have established that body weight of Japanese quail responded quickly to selection (Caron and Minvielle, 1990; Marks, 1993) and many selection experiments for body weight in the Japanese quail have demonstrated significant genetic improvement. An important attributes of parent stock performance are fertility and hatchability.Selections for increased growth rate in the avian species have been reported to result in depressed egg production, fertility and hatchability of the birds (Marks, 1979; Siegel and Dunnington, 1985). Selection for traits beside reproductive fitness often results in a negative correlation between the selected trait and reproductive fitness, this negative correlation has been shown to be true between growth rate and reproductive traits such as female fertility and egg traits (Bunan and Pym, 1991).In the Japanese quail, wide differences have been reported for fertility and hatchability values and these differences have been attributed to the amount of water loss during incubation and other environmental differences (Vasconcelos*et al*., 2008).Nazligul*et al*. (2001) had reported the proportional increase of fertility and the hatchability of fertile eggs with egg weight. Higher hatchability in heavier birds than in medium and light weight birds have also been reported (Ipek*et al*., 2004).Information on the

effect of selection for body weight on fertility and hatchability traits of Japanese quail is lacking in the sub-Saharan environment especially as reports have shown the performance of the birds in this area to be lower than that of their counterparts in other places. The study therefore examines the effect of short term divergent selection for 35-day body weight on fertility and hatchability of Japanese quail in Nigeria.

MATERIALS AND METHODS

The experiment was conducted at the Poultry unit of the Department of Animal Production, Faculty of agriculture, University of Ilorin. All experiments were implemented in accordance with Institutional guidelines on the care and use of animals for scientific studies, and in compliance with generally accepted rules of best practice worldwide.

Origin and Management of Experimental Birds

A total of 1,500 day-old Japanese quail chicks obtained from a random-bred population maintained at the National Veterinary Research Institute (NVRI), Vom, Plateau state, Nigeria served as the base population. Chicks were weighed on arrival and transferred into electrically-heated brooder pens. All chicks received a starter ration of 24% Crude Protein and 2800Kcal/kg of metabolizable energy and breeder rations of 19% Crude Protein and 2700Kcal/kg of metabolizable energy as recommended by the NVRI. Feed and water were provided *ad libitum* throughout the experimental period.At 35 days of age, 1,331 birds were wing-tagged, visually-sexed by plumage colour and weighed. Selection was based on individual body weight at 35 days of age. High (H) and Low (L) 35-day body weight (BW) lines were established based on individual body weight at that age. The H Line consisted of all individual birds having body weight greater than one standard deviation above the population mean weight (Pop mean + 1σ) while all individuals which had body weight less than one standard deviation below the population mean (Pop mean -1σ) were designated as the Low line. A random sample of the base population was maintained as the Control (C) Line for estimating environmental effects and genetic improvements. Selection was not changed at any time during the experiment in the two selected lines. The selected populations and the Control line were grown inter-mingled in order that temperature, humidity, light intensity and other variables would be as similar as possible among populations.

Egg Collection, Storage, Incubation and Selection in Subsequent Generations

Random mating was maintained at a ratio of one male to three females in the appropriate body weight direction to propagate the first filial generation. From the different Lines, eggs were collected daily, weighed and incubated weekly after storing at room temperature of 12 – 15^{0}C. Eggs were incubated in separate trays based on the selection line using a natural draught kerosene incubator. Eggs were incubated at 37.5^{0}C and at an accurate percentage of relative humidity for 17 days. During incubation, eggs were turned manually three times daily until the 14th day. At the end of the incubation period, all unhatched eggs were checked for fertility. Fertility, hatchability of incubated eggs and hatchability of fertile eggs were then calculated. Percent fertility was obtained from the equation = (Number of fertilized eggs / total number of eggs placed in the incubator) X 100. Hatchability of egg set was calculated in percentages as (Number of hatched chicks / Total number of Eggs Set) X 100. Hatchability of fertile eggs was obtained as (Number of hatched chicks / Number of fertilized eggs placed in Incubator) X 100.

Chick Weight to Egg Weight ratio was obtained from the equation: Average weight of chicks /Average weight of egg setx 100.

All data obtained were analysed within and between Lines using the One-Way Analysis of Variance procedure of SPSS Version 16 (IBM SPSS, 2008). Any significant differences among means were separated by use of the Duncan's Multiple Range procedure option in SPSS 16 (SPSS IBM). Means were calculated within and between lines for all measured variables.

RESULTS AND DISCUSSION

Table 1 shows the fertility and hatchability characteristics in five generations of Japanese quails selected divergently for 35- day body weight. The result on fertility of eggs set in all experimental lines showed fertility rates in

Japanese quails to be high ranging from 70.32 to 91.30%. This falls within the range reported by Sadeghi*et al.* (2013) who also reported high percentage fertility (71 - 88%) in quails divergently selected for 4-week body weight over nine generations. Ojo*et al.* (2012) had earlier reported high percent fertility of 79.4 and 73.5 in large and medium-sized Japanese quail eggs. Khaldari*et al.* (2010), on the other hand, reported a lower fertility rate of 67% in five generations of selection for increasing six week body weight. The non-significant effect in percent fertility among lines was similar to the report of Nestor (1977) who found no significant effect in percent fertility of eggs in turkey selected for 16-week body weight. The higher fertility observed in the Low body weight lines agrees with the reports of Marks (1979), Siegel and Dunnington (1985) and Bunan and Pym (1991) that selection for increased growth rate in the avian species do result in depressed fertility of the birds. Anthony *et al.* (1996) have also indicated the negative effect of selection on fitness traits, including egg number and fertility.

Sadeghi*et al.* (2013) had reported percent hatchability of 55.42, 65.93 and 62.13 in the High weight, Control and Low weight Lines respectively with differences being significant among lines. Lower hatchability can be observed in a flock, when embryonic mortality is higher and fertility is lower. Khurshid*et al.* (2004) gave reasons for variation in embryonic mortality to be due to poor egg holding period, imbalanced nutrition, stressful conditions the parent flock was exposed to, or any other fault in incubation and hatching requirements/equipment. Higher hatchability recorded in the High weight birds over the random bred Control and the Low weight birds is in line with the report of Ipek*et al.* (2004) who also observed higher hatchability in heavier birds than in the medium and the light weight birds. Selection for High body weight in this study was found to improve percent hatchability of total eggs significantly and hatchability of fertile eggs. This is in contrast to the reports of Sadeghi*et al.* (2013) and Marks (1996) who both reported that hatchability percent in selected lines were significantly lower than in Control lines. Egg weight was reported by Altan*et al.* (1995) to be critical to hatchability. Narahari*et al.* (1988) corroborated this and postulated that hatchability is directly proportional to egg weight. Better hatchability observed in the High body weight line in this study could therefore have resulted from the heavier eggs set for incubation.

Table 2 shows the effect of divergent selection for 35-day body weight on egg to hatch weight ratio of Japanese quail. The value for hatch weight reported in this study ranged between 5.44g and 6.66g and is similar to the results of Lepore and Marks (1971) who reported an estimate of 6.0g of body weight in both sexes at hatch. Marks (1995) however reported a range of 6.3g and 6.6g for body weight at hatch through random-bred population of Japanese quails. The significantly larger egg weight selected for incubation in the High weight birds than the Low and the random bred Control Lines also resulted in significantly larger hatchling weight of chicks. This agrees with the results of Farooq*et al.* (2001) and Petek*et al.* (2003) who both reported positive interrelation between egg weight and hatchling weight. Thus, smaller eggs would normally produce smaller chicks while bigger eggs would produce larger chicks. The ratio of the hatching chick weight to the weight of the egg set ranged from 61.59 to 72.03% and was similar to the value estimated by Wilson (1991), Murad*et al.* (2001) and Khurshid*et al.* (2004). These authors have reported a range of 62-76% for hatchling chick weight to weight of eggs set. The weight of chick as a percent of egg weight has been reported to be fairly constant across species, for instanceAyorinde*et al.*(1994) reported a value of 72.42 % in guinea fowl, while Murad*et al.* (2001) and Khurshid*et al.* (2004) separately reported 67.3% and 68.2% in Fayoumi chickens and Japanese quails, respectively. The non-significance of these values in all experimental lines also showed that weight loss during incubation was proportionate to egg size.

CONCLUSION

The results of this study revealed that selection for increased 35-day body weight improves hatchability, hatch weight and chick to egg weight ratio of Japanese quail. Fertility was however optimum in the Low body Weight. This can be of help to breeders in decision making for selection programmes in the Japanese quail.

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Table 1: Effect of Divergent Selection for 35-Day Body Weight on Incubation Characteristics (%) of Japanese Quail Eggs

	Fertility			Hatchability of Eggs Set			Hatchability of Fertile Eggs		
Gen	**High**	**Control**	**Low**	**High**	**Control**	**Low**	**High**	**Control**	**Low**
1	88.08±2.70^{x}	90.10±2.19	91.30±1.27	37.73±6.05^{x}	44.44±1.98^{yz}	37.13±7.80	42.95±7.77^{x}	48.00±2.46^{y}	40.59±8.04
2	70.32±4.55^{y}	71.87±17.47	82.07±9.97	35.51±7.27^{x}	34.83±7.76^{x}	30.27±3.62	51.01±13.24^{y}	49.72±4.05^{y}	36.90±1.51
3	89.66±2.25^{y}	88.41±2.42	84.07±6.77	42.79±7.64^{x}	39.18±2.26^{xy}	42.75±14.75	47.78±8.73^{xy}	36.82±6.05^{x}	49.62±13.41
4	85.51±0.51^{b,y}	76.47±0.50^{c}	88.34±1.38^{a}	44.75±3.82^{ab,x}	50.65±1.31^{a,z}	41.94±3.71^{b}	52.37±4.78^{b,y}	66.24±2.14^{a,z}	47.56±4.94^{b}
5	85.73±5.52^{y}	85.99±1.13	84.56±4.39	61.05±13.44^{a,y}	46.11±4.66^{ab,yz}	36.33±6.47^{b}	71.79±18.25^{a,z}	53.55±4.71^{b,y}	42.79±5.78^{b}
mean	83.86±7.80	82.57±9.99	86.07±5.98	44.37±11.64	43.04±6.76	37.68±8.44	53.18±14.12	50.86±10.43	43.49±8.14

$^{a-c}$Means in the same row having different superscripts differ significantly ($P<0.05$)
$^{x-z}$Means in the same column having different superscripts differ significantly ($P<0.05$)
Gen- Generations

Table 2: Effect of Divergent Selection for 35-Day Body Weight on Hatch: Egg Weight Ratio of Japanese Quail

	Egg Weight (g)			Hatch Weight (g)			Hatch: Egg Weight Ratio		
Gen	High	Control	Low	High	Control	Low	High	Control	Low
1	9.34±0.16^{a,x}	8.83±0.06^{b}	8.77±0.14^{b}	6.11±0.09^{a}	5.44±0.03^{b,x}	5.84±0.30^{a,xy}	65.42±1.58	61.61±0.11	66.59±4.47
2	9.86±0.07^{a,z}	8.87±0.09^{b}	8.97±0.21^{b}	6.44±0.27^{a}	5.83±0.03^{b,y}	5.88±0.30^{b,xy}	65.31±2.38	65.73±0.58	65.55±4.01
3	9.73±0.22^{a,yz}	8.96±0.30^{b}	8.44±0.18^{c}	6.47±0.09^{a}	6.45±0.03^{a,z}	5.55±0.07^{b,x}	66.50±2.46	71.99±2.06	65.76±0.74
4	9.48±0.06^{a,xy}	9.42±0.39^{a}	8.83±0.25^{b}	6.43±0.21^{a}	6.36±0.16^{a,z}	5.55±0.23^{b,x}	67.83±2.27	67.52±3.80	62.85±2.12
5	9.67±0.16^{a,yz}	9.21±0.11^{b}	8.95±0.29^{b}	6.66±0.23^{a}	6.31±0.22^{ab,z}	6.15±0.20^{b,y}	68.87±1.35	68.51±2.79	68.72±2.51
mean	9.62±0.23^{a}	9.06±0.30^{b}	8.79±0.27^{c}	6.42±0.25^{a}	6.08±0.41^{b}	5.79±0.31^{c}	66.74±2.27	67.12±4.06	65.87±3.27

$^{a-c}$Means in the same row having different superscripts differ significantly ($P<0.05$)
$^{x-z}$Means in the same column having different superscripts differ significantly ($P<0.05$)