Bangladesh Journal of Veterinary and Animal Sciences
Journal home page: www.bjvas.com
pISSN 2227-6416
eISSN 2709-2542

Research article

Production performance and heritability value of different traits of quail under intensive rearing conditions

Mrinmoy Bhowmik[1] and Md. Kabirul Islam Khan[2*]

[1]Department of Microbiology and Veterinary Public Health, Chattogram Veterinary and Animal Sciences University, Khulshi, Chattogram- 4225, Bangladesh
[2]Department of Genetics and Animal Breeding, Chattogram Veterinary and Animal Sciences University, Khulshi, Chattogram- 4225, Bangladesh

A R T I C L E I N F O

Article history:

Received: 05/08/2021

Accepted: 23/02/2022

Keywords:

Heritability, regression, quail, parent, offspring

[*]*Corresponding author:*
Cell: +88 01732986741
E-mail: kkhan@cvasu.ac.bd

A B S T R A C T

A study was conducted to know the production performance and heritability value of the different traits of Japanese quail. A total of 72 quails were reared in an intensive condition in each parent and offspring generation. The number of eggs produced by the quails was counted from the onset of laying up to 10 weeks and live weight was measured weekly up to 12 weeks of age of the quails. A total of 200 eggs from each generation of the quails were collected at 14-18 weeks of age to assess the external and internal characteristics of the eggs. The heritability value of the traits was estimated using the parent-offspring regression method. The egg production per quail per day of parent and offspring generation from the onset of laying to 10 weeks was 0.60 and 0.61, respectively, and up to a year of egg production a quail laid about 219 to 224 eggs. The average live weight in the parent and the offspring generations up to 12 weeks of age was 132.10 g ± 23.129 and 130.02 g ± 21.546, respectively. The live weight gains of the quails showed an increasing trend with age both in the parent and the offspring generations with a weekly growth rate of 16.95 g and 17.19 g up to 12 weeks of age and after 12 weeks the growth was retarded. Both the external and internal characteristics of the eggs of the quails were numerically higher in the parent generation than in the offspring generation. The heritability value of all traits showed positive except yolk width. It was also found that the heritability value of live weight was higher than the other traits. The results indicated that the traits can be included in the selection index to improve quail production.

To cite this paper: *M. Bhowmik and M. K. I. Khan, 2021. Production performance and heritability value of different traits of quail under intensive rearing conditions. Bangladesh Journal of Veterinary and Animal Sciences, 9(2):23-29.*

1. INTRODUCTION

In fiscal year 2019-2020, the production of total meat and egg was 7.67 million metric tons and 17.36 billion against the demand of 7.44 million metric tons and 17.66 billion, respectively in Bangladesh (DLS, 2020). There was a surplus in meat production, but deficit in egg production in Bangladesh (DLS, 2020). Per capita protein intake was only 36.80g per day against the requirements of 56g per day (BBS, 2020). The lack of adequate production of animal protein is a major factor for poor dietary nutrient inadequacy and undernutrition in mothers and young children of Bangladesh (FAO and WHO, 2014). Among the animal protein sources, quail meat and egg can be a good source to fulfill the demand as quail meat and egg contain more protein than chicken (Ali, 2019; Ioniţă et al., 2011). In addition, quail eggs are good sources of folate, vitamin B_{12}, pantothenic acid, iron, phosphorus, riboflavin and selenium (Kalsum at al., 2012) and in regard to meat quality (pH, color, and texture), quail meat is similar to broiler meat (Narinc et al., 2013).

Quail has some advantages such as faster growth, early sexual maturity, high rate of egg production, short generation interval (3-4 generations a year), small floor space demand (200-250 and 150-200 cm^2, respectively in litter and cage system), less feed requirements (20-25 g/adult bird/day), short incubation period of hatching eggs, less feed cost, and less susceptibility to common chicken diseases (Khan and Akter, 2019; Aygun and Sert, 2013; Jatoi et al., 2013, Faitarone et al., 2005). With proper care, hens lay 200 eggs in their first year of lay. Life expectancy of quail is only 2 to 2½ years. The internal and external egg quality traits of Japanese quail's were also observed by Khan and Akter (2019) and Yılmaz et al. (2011).

The heritability value of a trait measures, by the strengths of inheritance of that trait, that is, whether it is or not likely to pass on to the next generation or not. Heritability values of live weight at different ages and egg quality traits were estimated by Akbas et al. (2004) and Daikwo et al. (2013), respectively. The estimates of genetic parameters, like heritability, genetic and phenotypic correlations are necessary to construct a selection index and predict response to selection. This genetic study on quail enables breeders to design suitable genetic improvement programme. Therefore, the present study was conducted with the following objectives (i) to know the performance of Japanese quail under intensive farming conditions; and (ii) to estimate the heritability value of the different traits of quail.

2. MATERIALS AND METHODS

Study area

The study was conducted on a quail farm, at Dagonbhuiya in Feni, Bangladesh from October 2019 to March 2020. The study area has a latitude of 23°01'N, longitude 91°39'E and elevation of 12 m. The average daily maximum temperature was between 24ºC and 27ºC during day time and at night it cooled down to temperatures between 12ºC and 15ºC during the study period.

Husbandry

A total of 72 Japanese quails were reared at a sex ratio of 1: 4 (male: female) both in parent and offspring generation. The chicks were brooded artificially up to three weeks of age. Then, the birds were shifted to the cages, as the quails were reared under a cage rearing system in an open house. Sex was determined either by observing plumage color or vent observation. During the first three weeks, the lighting was 24 hours, and then the lighting regime was set as 16 hours' light and remaining 8 hours dark. Birds were allowed to access *ad libitum* feed and water. They were fed with commercial diet Golden Poultry Boiler Starter™ (2950 kcal ME/kg, 24.7% CP and 3% Ca) for 35 days and thereafter commercial feed Fresh Layer Layer (Mash) 1™ (2800 kcal ME/kg, 24.7% CP and 3.5% Ca) were given. To produce offspring from parent generation, eggs were collected from 12-16 weeks of age and the eggs were incubated in an electronic incubator.

Measurements

The live weight of quail was measured at weekly interval up to 12 weeks of age and recorded. Live weight of quail was measured early in the morning before feeding using an electronic balance (0.1g least count). The egg was collected twice daily from the onset until 70 days of laying (from 6 to 15 weeks); after collection, the number of the eggs produced was recorded in a data sheet. The egg production per quail per day was calculated by dividing number of egg production by number of quail on that particular day. Then the number of daily egg production was converted to yearly calculation.

For the egg quality study, a total of 200 eggs from each generation of quails were collected from 14-18 weeks of age for the assessment of both external and internal characteristics. Deformed eggs like soft-shelled, cracked and small eggs were not used in the study. To measure the weights (egg weight, shell weight, yolk weight, and albumen weight), a digital weighing balance (Digiscale™, Germany) with 0.01g accuracy was used. A slide caliper (Tricle Brand™, China) sensitive to 0.01mm was used for measuring the length and width of the egg. Shell thickness was measured in the equatorial region of the egg using a micrometer (Tricle Brand™, China) sensitive to 0.01 mm. Yolk height, thick albumen height and thin albumen height were calculated using a tripod micrometer (Sunshine™, India).

The egg shape index was determined for these measurements according to the following formula as given by Reddy et al. (1979).

Shape Index (%) = (Egg width (cm) / Egg length (cm)) × 100 ---- (1)

The Haugh unit values were calculated for individual eggs using the following formula given by Haugh (1937),

Haugh Unit (%) = 100 log (Albumen height (mm) +7.5 –1.7×Egg weight (g)$^{0.37}$) – (2)

Estimation of heritability

The linear regression equation Y = a + bx, (where, Y is the value of the traits, x is the ages of female quail, and a (constant) and b (regression co-efficient)) was used to estimate the heritability of traits. The heritability of the traits of quail was estimated using the regression of offspring on sire/dam and $h^2 = 2b$, where, h^2 is the heritability value of the traits and b is the regression co-efficient.

Statistical analysis

The following statistical model was used to obtain the least square means for each parameter, goodness of fit (R^2) the regression model parameters using PROC GLM of SAS (SAS, 2010). The model is given as:

$Y_{ij} = \mu + A_i + e_{ij}$

Where, Y_{ij} is the values of the trait, μ is the overall mean, A_i is the effect of age and e_{ij} is the residual effect, distributed as N (0 σ^2).

The mean differences were compared using least significant difference (LSD) (Steel et al., 1997) at 5% level of significance.

3. RESULTS AND DISCUSSION

The average egg production (no) per quail per day in parent and offspring generation from the onset to 10 weeks of laying is shown in Figure 1. The Figure 1 indicates that the egg production per quail per day of parent and offspring generation from 6 to 15 weeks of laying period was 0.60 and 0.61 per quail/day, respectively. It is indicated that for 10 weeks, a quail laid 42.0 to 43.0 eggs and up to a year of egg production, a quail can lay about 219 to 224 eggs. The egg production of quail up to 10 weeks of age was higher than the result of Dauda et al. (2014), Faruq et al. (2018) and Khan and Akter (2019). This difference may be attributed to ambient temperature, relative humidity and photoperiod provided for the quail hens.

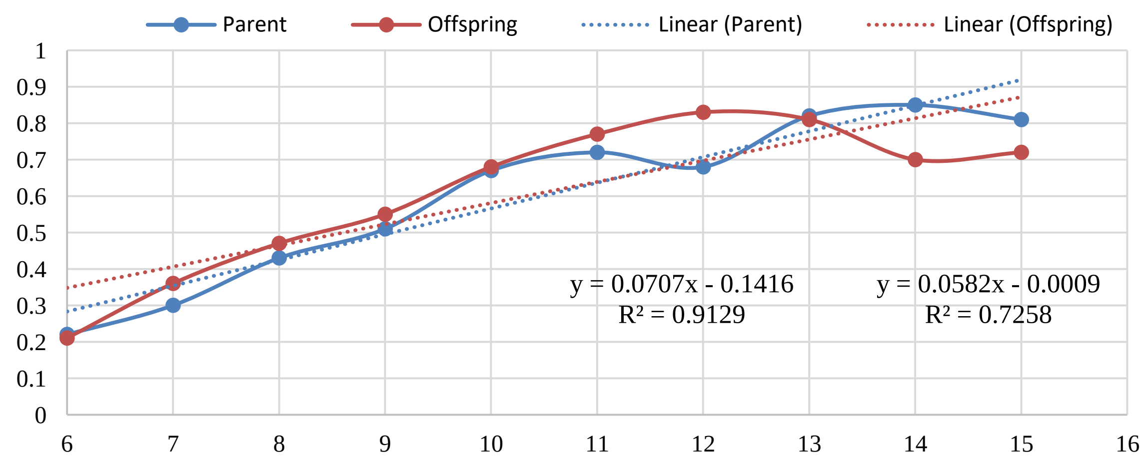
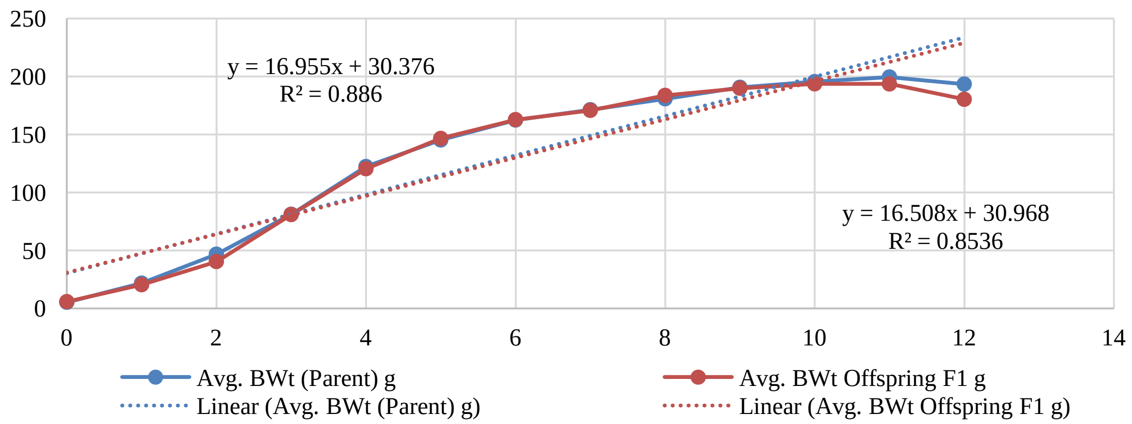


Figure 1. Egg production of parent and offspring generation from onset to 10 weeks of laying

The average body weight in parent and offspring generation up to 12 weeks of age was 132.10g ± 23.129 and 130.02g ± 21.546, respectively. Figure 2 shows the average body weight gain of quail from first to twelve weeks of age. The average body weight gains of quail showed an increasing trend with age both in parent and offspring generations and the weekly growth rate of 16.95g and 17.19g respectively was recorded up to 12 weeks of age and after 12 weeks the growth was retarded. Average live weight up to 11 weeks was similar with the result of Rahman et al. (2016). In contrast, Jatoi et al. (2015) found lower average live weight than the present result.

The mean with standard error of different traits of the parent and offspring generation of quail is shown in Table 1. The results showed that live weight of quail, egg weight, egg length, egg width, shell weight, yolk weight, albumen weight, thin albumen height and shape index were higher in parent generation than the offspring generation (Table 1). Whereas, egg production (no.) /quail/day, shell thickness, yolk height, thick albumen height and Haugh unit were found higher in offspring generation than the parent generation (Table 1). Significant difference ($P < 0.05$) was observed in the egg length and yolk weight between parent and offspring generation.

Figure 2. Body weight (g) of parent and offspring generation upto 12 weeks of age



On the other hand, lower yolk and albumen weight than the current study was observed by Abd Salman Abu Tabeekh (2011). Yolk height of parent and offspring generation was close to the result of Kul and Seker (2004). The average albumen height of Abd Salman Abu Tabeekh (2011) and Hrnčár et al. (2014) which ranges from 3.30 to 4.82 mm was close to the result of the current study. In contrast, Chimezie et al. (2017) found lower yolk and albumen height than the current study. Haugh unit of parent and offspring generation was similar with Ayorinde (1987). However, Chimezie et al. (2017) found 79.81% Haugh unit in quail which was lower than the current study. The causes of difference of external and internal egg quality traits with above mentioned researchers may be due to the different number of the sample size, age, plumage color, breed, environment and management practices. Sarı et al. (2012) reported that layer age and plumage color had an effect on external and internal qualities of egg.

In Table 2, the estimated heritability values of different traits of quail is presented. The heritability values of all traits showed positive except yolk width, which was negative. The table 2 shows that the heritability values of live weight were estimated higher than the other traits. Usually, the heritability values of live weight are higher than other productive traits, which range from 0.31 to 0.61 (Daikwo et al., 2013 and Sezer, 2007); similarly, in this study higher values were observed that might be due to the use of the regression method for heritability estimation.

Table 1. Mean with standard error of different traits of parent and offspring generation of quail

Traits	Parent generation	Offspring generation	SEM	P-value
Egg production (no.) /quail/day	0.60 ± 0.030	0.61 ± 0.027	0.086	0.927
Body weight at 12 weeks of age (g/ bird)	132.10 ± 21.149	130.02 ± 21.646	24.294	0.943
Egg weight (g)	10.91^a ± 0.294	10.09^b ± 0.181	5.047	0.016
Egg length (cm)	3.25 ± 0.065	3.18 ± 0.076	1.456	0.469
Egg width (cm)	2.59 ± 0.063	2.48 ± 0.055	1.170	0.715
Shell weight (g)	1.46 ± 0.063	1.35 ± 0.054	0.609	0.076
Shell thickness (mm)	0.31 ± 0.008	0.31 ± 0.019	0.109	0.987
Yolk weight (g)	4.04^a ± 0.129	3.30^b ± 0.096	1.806	0.026
Albumen weight (g)	5.11 ± 0.218	4.85 ± 0.130	2.265	0.234
Yolk height (mm)	10.14 ± 0.100	10.46 ± 0.143	4.753	1.754
Thick albumen height (mm)	4.58 ± 0.112	4.64 ± 0.168	1.917	0.853
Thin albumen height (mm)	3.16 ± 0.143	3.04 ± 0.104	1.346	0.981
Haugh unit (%)	90.08 ± 0.646	91.27 ± 0.841	43.158	0.548
Shape index (%)	79.94 ± 2.140	79.00 ± 2.721	33.883	0.231

SEM= Standard error of mean; $^{a\,b}$ Means with different superscript differed at 5% level of significance

Table 2. Heritability value (h^2) of different traits of quail

Traits	h^2
Egg production	0.29
Body weight	0.66
Egg weight	0.38
Egg length	0.19
Egg width	0.28
Egg shell weight	0.08
Shell thickness	0.26
Yolk weight	0.32
Albumen weight	0.31
Yolk height	0.07
Yolk width	-0.03
Albumen height	0.14
Albumin width	0.11
Haugh unit	0.30
Shape index	0.22

The egg shape index showed moderate heritability and this result was lower than the result of Sezer (2007). Low heritability estimates for egg width, egg shell weight, and thin albumen height indicate that these traits at this age are to a very large extent are influenced by the environmental factors and the use of the regression method for estimation. The low heritability of a trait indicates less genetic variability relative to phenotypic variability among the quails. The implication of this is that selection for traits of interest may not result in any appreciable improvement. This finding was lower than the results of Daikwo et al. (2013) and Sezer (2007). On the other hand, the heritability estimates for egg production and other egg characteristic traits were similar to the values of Daikwo et al. (2013). The causes of variation of heritability values might be due to the sample size, breed, management procedure and environmental factors, as well as the use of estimation method.

4. CONCLUSION

Based on the results, it has been revealed that the values of the production and egg quality traits did not differ significantly between the parent and the offspring generation except for a number of traits. The heritability values estimated in this study are very important and could be included in the genetic improvement programme of quail. Confidently, more correct values could be obtained if additional data were to be collected and added to the current analysis.

ACKNOWLEDGEMENT

The authors are grateful to the authority of Chattogram Veterinary and Animal Sciences University for providing permission to conduct this study and use the labs during this study. Special thanks to the owner of Arif Hatchery and Poultry Farm, Feni, Bangladesh for his support and co-operation during the conduction of the study.

REFERENCES

Abd Salman Abu Tabeekh, M. 2011. Evaluation of some external and internal egg quality traits of quails reared in Basrah city. Basrah Journal of Veterinary Research, 10: 78–84.

Akbas, Y., Takma, C. and Yaylak, E. 2004. Genetic parameters for quail body weights using a random regression model. South African Journal of Animal Science, 34: 104–109.

Ali, M.A. 2019. A comparative study on nutritional value of quail and chicken eggs. Journal of Research Fields Specific Education, 2019: 39–56.

Aygun, A. and Sert, D. 2013. Effects of prestorage application of propolis and storage time on eggshell microbial activity, hatchability, and chick performance in Japanese quail (Coturnix coturnix japonica) eggs. Poultry Science, 92: 3330–3337.

Ayorinde, K. 1987. Physical and chemical characteristics of the eggs of four indigenous guinea fowls (Numida meleagris galeata, pallas) in Nigeria. Niger. Journal of Animal Production, 14: 125–128.

BBS, 2020. Monthly statistical bulletin - Bangladesh. Bangladesh Bureau of Statistics, Statistics & Informatics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, P: XXI.

Chimezie, V. O., Fayeye, T. R., Ayorinde, K. L. and Adebunmi, A. 2017. Phenotypic correlations between egg weight and some egg quality traits in three varieties of Japanese quail (Coturnix coturnix japonica). Journal of Agrisearch. 17: 44–53.

Daikwo, S. I., Dim, N. I. and Momoh, O. M. 2013. Inheritance of egg quality traits in the Japanese quail. International Journal of Poultry Science, 12: 153–156.

Dauda, G., Momoh, O. M., Dim, N. I. and Ogah, D. M. 2014. Growth, production and reproductive performance of Japanese quails (Coturnix coturnix japonica) in humid environment. Egyptian Poultry Science Journal, 34: 381–395.

DLS, 2020. Livetock economy at a Glance. Livestock Economy Section, Department of Livestock Services, Government of the People's Republic of Bangladesh.

Faitarone, A., Pavan, A., Mori, C., Batista, L., Oliveira, R., Garcia, E., Pizzolante, C., Mendes, A. and Sherer, M. 2005. Economic traits and performance of Italian quails reared at different cage stocking densities. Brazilian Journal of Poultry Science, 7: 19–22.

FAO and WHO. 2014. Country nutrition paper Bangladesh. International conference on nutrition 21 years later. P: 16.

Faruq A. A., Sohel M. S. H., Podder S., Rakib T. M., Momin M. M. and Khan M. K. I. 2018. Correlation and regression of traits associated with age and sex of Japanese quail (Coturnix coturnix japonica). Bangladesh Journal of Veterinary and Animal Sciences, 6: 27–32.

Genchev, A. 2012. Quality and composition of Japanese quail eggs (coturnix japaonica). Trakia Journal of Science, 10: 91–101.

Haugh, R. R. 1937. The Haugh unit for measuring egg quality. U. S. Egg Poultry Magazine, 43: 552–555.

Hrnčár, C., Hanusová, E., Hanus, A. and Bujko, J. 2014. Effect of genotype on egg auality characteristics of Japanese quail (Coturnix japonica). Slovak Journal of Animal Science, 47: 6–11.

Ioniţă, L., Popescu-Micloşanu, E., Roibu, C. and Custură, I. 2011. Bibliographical study regarding the quails' meat quality in comparison to the chicken and duck meat. Lucrări Ştiinţifice 56: 224–229.

Islam, M. S., Faruque, S., Khatun, H. and Islam, M. N. 2015. Comparative production performances of different types of quail (Coturnix coturnix japonica). The Agriculturist, 12: 151–155.

Jatoi, A. S., Mehmood, S., Hussain, J., Ishaq, H. M., Abbas, Y. and Akram, M. 2015. Comparison of six-week growth performance in four different trains of Japanese quail (Coturnix coturnix japonica). Sarhad Journal of Agriculture, 31: 59–64.

Jatoi, A. S., Sahota, A.W., Akram, M., Javed, K., Hussain, J., Mehmood, S. and Jaspal, M. H. 2013. Response of different body weights on blood serum chemistry values in four close-bred flocks of adult Japanese quails (Coturnix coturnix japonica). Pakistan Journal of Zoology, 45: 1215–1220.

Kalsum, U., Soetanto, H., Achmanu. and Sjofjan, O. 2012. Influence of a probiotic containing Lactobacillus fermentum on the laying performance and egg quality of Japanese quails. International Journal of Poultry Science, 11: 311-315

Khan, M. K. I. and Akter, M. A. 2019. Performance of Japanese quail (Coturnix coturnix Japonica) subjected to selection through exchange of male. Scholar Journal of Agriculture and Veterinary Sciences, 6: 128–134.

Kul, S. and Seker, I. 2004. Phenotypic correlations between some external and internal egg quality traits in the Japanese quail (Coturnix coturnix japonica). International Journal of Poultry Science, 3: 400–405.

Narinc, D., Aksoy, T., Karaman, E., Aygun, A., Firat, M.Z. and Uslu, M. K. 2013. Japanese quail meat quality: Characteristics, heritabilities, and genetic correlations with some slaughter traits. Poultry Science, 92: 1735-1744.

Narinc, D., Aygun, A., Karaman, E. and Aksoy, T. 2015. Egg shell quality in Japanese quail: characteristics, heritabilities and genetic and phenotypic relationships. Animals, 9: 1091–1096.

Rahman, A. N. Md. A., Hoque, Md. N., Talukder, A.K. and Das, Z.C. 2016. A survey of Japanese quail (Coturnix coturnix japonica) farming in selected areas of Bangladesh. Veterinary World, 9: 940–947.

Reddy, P. M., Reddy, V. R., Reddy, C. V. and Rao, P. S. P. 1979. Egg weight, shape index and hatchability in khaki Campbell duck egg. Indian Journal of Poultry Science, 14: 26–31.

Sarı, M., Işık, S., Önk, K. and Kırmızıbayrak, T. 2012. Effects of layer age and different plumage colors on external and internal egg quality characteristics in Japanese quails (Coturnix coturnix japonica). Arch. Geflügelk. 76: 254–258.

Sezer, M. 2007. Heritability of exterior egg quality traits in Japanese quail. Journal of Applied Biological Science, 1: 37–40.

Steel, R. G. D., Torrie, J. H. and Dickey, J. D. 1997. Principles and Procedures of Statistics: A Biometrical Approach, 7th ed. McGraw-Hill Book Co., New York.

Yılmaz, A., Tepeli, C. and Cağlayan, T. 2011. External and internal egg quality characteristics in Japanese quails of different plumage color lines. Journal of Food Agriculture and Environment, 9: 375-379.