Journal of Animal Breeding and Genomics
pISSN:1226-5543 eISSN:2586-4297
JABG. 2020 December, 4(4):73-81
https://doi.org/10.12972/jabng.20200007
RESEARCH ARTICLE
OPEN ACCESS

Morphometric, productive and reproductive performances of Japanese quail(*Coturnix japonica*) in Sylhet city of Bangladesh

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ABSTRACT

Objectives: This study was undertaken on Japanese quails to evaluate their productive and reproductive performance in Sylhet Sadar Upazilla, Sylhet. **Materials and Methods:** Total 942 quails and 250 eggs of different private farms of Sylhet Sadar Upazilla were observed and studied. The traits studied include body weight, morphological traits, and reproductive traits. **Results:** Results showed that, mean hatch weight and mature body weight (20 weeks) of Japanese quails were 5.74±1.14gm and 170.02±5.85gm respectively. At adult age (12 weeks) mean shank length, body length, wing length and breast girth were 3.91±0.16, 18.05±1.02, 15.20±0.95, 7.30±0.12cm respectively. Mean age at sexual maturity, was 54.06±1.78 days while weight of first egg and average egg weight were 7.72±0.18 and 12.72±1.95gm respectively. Hen-day egg production and Hen-housed egg production were 5.64±1.41% and 11.49±4.96%, respectively. Percentage mean fertility was 78.40±4.05 while that of the percentage mean hatchability of eggs was 63.59±5.08. Percentage mean reproductive capacity was 70.28±3.53 and mean embryonic mortality was 26.82±2.94%. **Conclusions:** It was concluded that given the productive and reproductive estimates, Japanese quail can serve as an alternate livestock species that can ameliorate shortage of protein intake in environment studied.

Keywords: Japanese quail, Morphometric, Productive,Reproductuive, Sylhet

INTRODUCTION

Poultry is one of the major animal protein sources in Bangladesh of which quail has being an important poultry species, can contribute efficiently in increasing egg and meat production in poultry production sector. Quail production has a significant contribution to household economics, food security and improving the nutritional status of rural poor, especially in developing countries like Bangladesh. Quail eggs contain 13 percent proteins compared to 11 percent in chicken eggs. The most essential amino acid (EAA) of quail egg whites are leucine (1139.0 mg/100g), valine (869.5 mg/100g) and lysine (790.0 mg/100g) (Tunsaringkarnet al. 2013).

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Received: 30 November, 2020, **Revised:** 15 December, 2020, **Accepted:** 23 December, 2020

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Quail farming is becoming an in-demand enterprise in Bangladesh because of relatively better profit margins. Japanese quails are considered to be the right stuff for meat production due to faster growth, short generation interval, better egg production, and high resistance to diseases (Ahmad, 2014). This amazing bird finds its true economic and commercial value in its egg production, as domesticated lines of the Japanese quail can lay up to 290 to 300 eggs in their first year of lay (Jatoi et al., 2015). It has the potential to gain 160 to 170 grams body weight at the age of 4 week (Akram et al., 2012).Production of livestock species with short generation interval could be a viable option in ameliorating shortage of protein among the populace in developing countries (NVRI, 1994; Muthukumar and Dev Roy, 2005).

However, In Bangladesh, quail is not yet popular because of some unique characteristics such as; sensitive bird, cannibalism rate is very high; management is uncommon in the farmer level, high chick mortality, egg production peculiarity, low body and egg weight. But day by day the situation is changing.

Therefore, this study aims for understanding of the morphologic, productive and reproductive performances of Japanese quail in Bangladesh.

MATERIALS AND METHODS

Study area and population

The study was conducted from November 2019 to December 2019, at several farms of Sylhet Sadar Upazilla, Sylhet. A total number of 942 quails were observed and 250 eggs were observed.

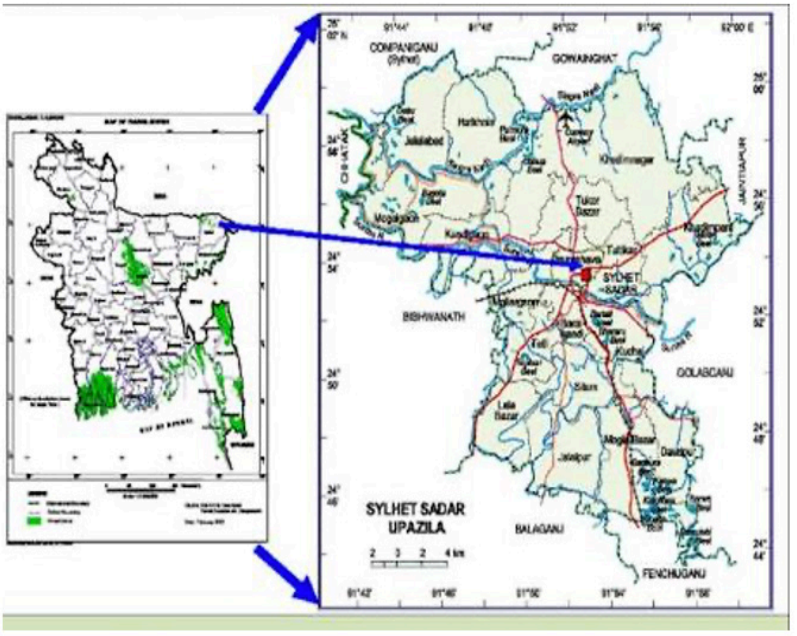

Figure 1. Map of Sylhet Sadar Upazilla.

Body Weight

Live body weights were measured using sensitive electronic scale and at hatching and then at 4th, 8th, 12th and 20th weeks of age.

Linear Body Measurement

The linear body measurements such as body length, shank length, wing lengths and breast girth were measured at 12 weeks using measuring tape.

Age at First Egg (AFE)

This is the age at which quails lay their first egg. Age at first egg is the age at which quail attain sexual maturity.

Body Weight at First Egg (BWFE)

This is the weight of the hen when the first egg was laid.

Weight of First Egg (WFE)

The weight of 40 first egg for each quail hen was taken using sensitive electronic scale.

Egg Number

The total numbers of eggs production per birds per batch were recorded.

Egg Weight

The weights of 210 eggs were taken in grams of 20 weeks and determine average egg weight.

Fertility

Fertility was determined based on total eggs set

Percentage fertility was expressed as = $\frac{\text{Number of fertile egg}}{\text{Total egg laid}} \times 100$

Hatchability

This was expressed on the basis of fertile eggs and total eggs set.

Percent hatchability based on fertile egg = $\frac{\text{Number of hatched chicks}}{\text{Total fertile eggs}} \times 100$

Percent hatchability base on total egg set,

Reproductive capacity = $\frac{\text{Number of hatched chicks}}{\text{Total fertile eggs}} \times 100$

Embryonic Mortality:

This is the fertile egg that does not develop fully to normal chicks. Those that shortly after being developed were considered early embryo mortality while others that developed fully but could not hatched were termed late embryo mortality.

Percent embryonic mortality = $\frac{\text{Number of dead embryo}}{\text{Total number of fertile egg}} \times 100$

Hen Housed Egg Production

$$\text{HHEP} = \frac{\text{Total egg laid}}{\text{No.of birds housed} \times \text{No.of days since the birds housed}} \times 100$$

Hen Day Egg production

$$\text{HDAP} = \frac{\text{Total egg laid}}{\text{No.of birds housed} \times \text{No.of days since the bird lay egg}} \times 100$$

Statistical analysis

The data obtained were stored and coded accordingly using Microsoft Excel-2016. The data were exported from MS Excel- 2016 to Stata 15.0 statistical software for analysis.

RESULTS

Table1 shows the summary statistics of linear body parameters of Japanese quails. It was evident of mean shank length, body length, wing length and breast girth at adult age. Mean values for shank length, body length, wing length and breast girth at maturity (12 weeks) were 3.91±0.16, 18.05±1.02, 15.20±0.95, 7.30±0.12 cm.

Table 1. Summary statistics of linear body measurement (cm) of Japanese quail reared in Sylhet Sadar Upazilla.

Parameters	Number of observation	Average length(cm)	Standard Deviation	Minimum length(cm)	Maximum length(cm)
Shank length	190	3.91	0.16	3.53	4.38
Body length	190	18.05	1.02	15.55	21.67
Wing length	190	15.20	0.95	13.09	17.67
Breast girth	190	7.30	0.12	6.99	7.58

The mean values and their standard deviation of the mean for body weight at various ages are shown in Table 2. It was evident that regardless of sex, the mean body weight remarkably increased as the quail advanced in age. Body weight at hatch, 4th, 8th, 12th and 20th weeks of age averaged 5.74±1.10, 93.02±4.28, 140.35±6.14, 150.92±5.59, 170.02±5.85 grams respectively.

Table 2. Summary statistics of body weight of Japanese quail at different age.

Age	Number of observation	Average Body weight(g)	Standard Deviation	Minimum weight(g)	Maximum weight(g)
Weight at hatch	200	5.74	1.10	4.64	6.84
4th week weight	186	93.02	4.28	85.87	101.32
8th week weight	192	140.35	6.14	130.57	150.49
12th week weight	190	150.92	5.59	140.33	160.22
20th week weight	174	170.02	5.85	162.37	182.07

The mean performance of reproductive traits of Japanese quails in the population studied is presented in Table 4. The average percentage fertility (%), reproductive capacity (%) , hatchability (%), embryo mortality (%), and egg number per hen, age at first egg lay and egg weight were 78.40±4.05%, 70.28±3.53%, 63.59±5.08%, 26.82±2.94% and 0.83±0.04 54.06±1.78, 7.72±0.18 respectively. Mature egg weight was 12.72±1.95 gm (Table 3 and 4).

Table 3. Reproductive performance of Japanese quail raised in Sylhet Sadar Upazilla.

Flock size	Batch size	fertile egg	set in Incubator	hatch	No of dead embryo	Fertility	Reproductive capacity	Hatchability	Embryonic mortality	Egg number per hen
250	200	156	140	99	41	78.00	70.71	63.46	26.28	0.80
220	170	130	120	87	33	76.47	72.5	66.92	25.38	0.78
170	135	104	90	61	29	77.03	67.78	58.65	27.88	0.79
175	150	116	100	72	28	77.33	72	62.06	24.13	0.85
160	140	121	110	71	39	86.42	64.55	58.67	32.23	0.88
190	165	124	120	89	31	75.15	74.17	71.77	25.00	0.87

Table 4. Reproductive performance of Japanese quail raised in Sylhet Sadar Upazilla.

Parameters	Observations	Mean	Standard deviation	Minimum	Maximum
Fertility %)	6	78.40	4.05	75.15	86.43
Reproductive capacity (%)	6	70.28	3.53	64.55	74.17
Hatchability (%)	6	63.59	5.08	58.65	71.77
Embryonic mortality (%)	6	26.82	2.94	24.14	32.23
Egg number per hen	6	0.83	0.04	0.77	0.87
Age at first egg lay(day)	40	54.06	1.78	50.73	56.98
Egg weight at first-lay(gm)	40	7.72	0.18	7.41	7.96
Egg weight at maturity(gm)	210	12.72	1.95	9.42	16.22

The hen housed egg production and hen day egg production are shown on Table 6. Total observations were 6 batch(Table 5) and Mean hen day egg production and hen housed egg production were 5.64±1.41% and 11.49±4.96% respectively.

Table 5. Some egg laying parameters of Japanese quails in Sylhet Sadar Upazilla.

Flock size	Batch size	No of days since housed	No of days since hen laid	hen housed egg production	hen day egg production
250	200	18	11	4.45	7.27
220	170	20	13	3.86	5.94
170	135	14	7	5.67	11.34
175	150	16	9	5.36	9.52
160	140	12	5	7.29	17.50
190	165	12	5	7.24	17.37

Table 6. Hen day Egg production and Hen Housed Egg production of Japanese qauil reared in Sylhet Sadar Upazilla.

Parameters	Observations	Mean	Standard deviation	Minimum	Maximum
Hen housed egg production (%)	6	5.64	1.41	3.86	7.29
Hen day egg production (%)	6	11.49	4.96	5.94	17.5

DISCUSSION

As expected, body weight in Japanese quails increased as the birds advanced in age. Body weight at hatch obtained in this study is almost similar with the findings of Aboul-Seoud (2008) and Ojo et al. (2011) who reported values that ranged between 4.78 and 6.60g for both sexes in random bred populations. Body weight at 4th weeks of age was lower than those reported by (El-Full et al., 2001; Abdel-Fattah, 2006; AbdelTawab, 2006 and Daikwo, 2011). The observed differences when compared with these earlier studies could be due to differences in the climate and managerial conditions under which different flocks were reared. Also, due to selection for increased body weight and possible differences in genetic make-up of the different flocks, body weight at different ages could differ for different population.

The percentage fertility (78.40±4.05%) recorded in this study is within the range of 66.7-85.8% reported by Sachdev et al. (1985) but greater than 72.92% reported by Wilson et al. (1961). However, it is lower than 85.41% reported by Daikwo (2011) but higher than the values documented by Mark, 1980; AboulHassan et al., 1999 and Kurshid et al., 2004. Fertility of 78.40% would suggest that Japanese quails are fertile enough and could, therefore, be utilized efficiently in meat and egg production enterprise.

Percentage hatchability 63.59±5.08 reported in this study does not agreed with the findings of Chahil et al. (1975) who obtained a wider range of 65.0 to 88.9% for 10 weeks old Japanese quails and El-Fikyet al. (1996) who reported a range of 68.2-78.5% during 3 consecutive generations. This hatchability value is not similar to 71.52% reported by Daikwo (2011). However percentage hatchability of present report is similar with Lower values of hatchability (50.8 and 67.6%) were reported by Mark (1979) and Kurshid et al. (2004). The percent reproductive capacity (hatchability based on total egg set) of 70.28±3.53 observed in this study is above the value reported by Kurshid et al. (2004) who reported 55.14% as the percent hatchability base on total egg set and also higher than 58% and 61.31±1.93 reported by Farooq et al. (2001) and Daikwo (2011), respectively. Reproductive capacity is of more practical important to the farmer than hatchability. Medium hatchability in the present study could be due to medium fertility than that reported by Kurshid et al., 2004.

Embryonic mortality 26.82±2.94 is higher than the finding of El-Fiky et al. (1996) who reported between 16.50 and 22.20% for late embryonic mortality. Daikwo (2011) reported higher (18.59±1.85%) early and lower (9.89±1.31) late embryonic mortality. The variations observed could be due to the differences in pre-incubation storage, holding period, mating ratio and incubators used.

The 7.72±0.18 reported for weight of first egg in this study is similar to 7.12±0.06g obtained by Daikwo (2011) but lower than the values of 8.99-9.72 and 9.33 reported by (El-Full, 2001 and Screenivasaiah and Joshi, 1988). Age at first egg 54.06±1.78 is obtained in this study falls within the range of 45.3-58.9 days reported by Mark (1979) and 50.94-61.22 days reported by El-Deen et al. (2008) and El-Full (2001) respectively. Sezer et al. (2006) documented that, Japanese quails lay her first egg at an early age of 45.82±0.22 days. However, Thomas and Ahuja (1988) and Daikwo (2011) reported that the age at sexual maturity was 48.9-49.6 and 47.01±0.22 days, respectively in Japanese quail. Age at first egg can be very variable because it is affected by feeding and management practices. Early age at first egg can be very advantageous because selection for it could lead to reduced generation interval but for commercial egg production it might lead to many small eggs which may not find a ready market. However, if early age at first egg is accompanied by a corresponding increase in body weight then the egg size could also increase.

Hen-day and Hen-housed egg production of this study is 5.64±1.41% and 11.49±4.96% which is lower than 25.77% and 17.57% reported by G. Dauda et al(2014). This could be due to strains differences, feeding, climate and management. Percentage hen-day and hen-housed egg production are fairly high and could ensure adequate supply of eggs to consumers. High hen-day shows the effectiveness of production while hen house indicated good management.

CONCLUSION

The study has given a general idea about the productive and reproductive performance of Japanese quails at Sylhet Sadar Upazilla, Sylhet. It was conducted during the period of November 2019 to December 2019 and aimed to know the productive and reproductive performance of Japanese quails at Sylhet Sadar Upazilla. Different productive and reproductive performances were studied. Age at first egg laying was found to be 54.06±1.78 days. The average weight of egg at first laying was 7.72±0.18 gm and average egg weight was 12.72±1.95 gm. However the hatchability (63.59±5.08%) and fertility (78.40±4.05%) was not so high may be due to poor management system or lack of awareness among the farmers. From the interpretation of analyzed data and obtained results, it may be concluded that the productive and reproductive characteristics of Japanese quails is good enough. The performance of Japanese quail is very useful fulfill the protein demand in Sylhet Sadar Upazilla. However, by developing the management and rearing system, Quail farming can be made an outstanding source to meet the increasing protein demand of our country.

REFERENCES

Abdel-Fattah, M. H. (2006). Selection for Increased Body Weight and Growth Rate in Japanese Quail. Ph. D Thesis, Fac.Agric. Fayoum Univ., Egypt 153 pp.

Abdel-Fattah, M. H., El-Full, E. A., Farahat, G. S., Hataba, N. A. and Khalifa, M. A. (2006). Inheritance of Body Weight, Growth Rate and some Fitness Traits in Japanese Quail. Egypt Poult. Sci. J., 26(3): 1195-1215.

Abdel-Tawab, S. K. (2006). The Effects of Selection for Egg Weight on some Productive Traits in Japanese Quails.M. Sc. Thesis Fac. of Agric., Al-Azhar Univ. Cairo, Egypt.127 pp.

Aboul-Hassan, M. A. (2001). Crossbreeding Effects on some Growth and Egg Production Traits among two Strains of Japanese Quail.Al-Azhar J. of Agric. Res., 34:41-57.

Aboul-Hassan, M. A., El-Fiky, F. A. and Attalah, G. E. Y. (1999). Selection for Growth Traits in Japanese Quail. 2-Correlated response.Al-Azhar J. for Agric. Res., 29:55-70.

Aboul-Seoud, D. I. M. (2008). Divergent Selection for Growth and Egg Production Traits in Japanese Quail. Ph. D. Thesis, Fac. of Agrc. AlAzhar Univ.Egypt . 159 pp.

Ahmad, S. 2014. Effect of selection for higher 4 week body weight in 4 closebred stocks and three age groups of Japanese quail in 4th generation. M.Phil Diss. Univ. Vet. Anim. Sci. Lahore, Pakistan.

Akram, M., J. Hussain, A. W. Sahota, S. Ahmad, A. S. Jatoi, A. Ali, and M. Dawood. 2012. Genetic gain in 4 week body weight through mass selection in 4 close-bred stocks of Japanese quail. Book of Abstract. 32nd Cong. Zool. Lahore, Pakistan. (Abstr.) This amazing bird can produce 290-300 eggs in their first year of lay (Jatoi et al., 2015). It has the capability of producing 160-170 grams body weight at the age of 4 weeks (Akram et al., 2012).

Chahil, P. S., Johanson, W. A. and Schilling, P. E. (1975). Combining ability in a Diallel Cross of three Lines of Coturnixcoturnix japonica. Poult. Sci. J., 54:1844-1849

Daikwo, I. S. (2011). Genetic Studies on Japanese Quail (Coturnixcoturnix japonica) in a tropical environment. Ph.D. Thesis, College of Ani.Sc.Univ. Agric. Makurdi, Nigeria. 167pp

Das SC, SD Chowdhury, MA Khatun, M Nishibori, N Isobe and Y Yoshimura (2008). Poultry production profile and expected future projection in Bangladesh. World's Poultry Science Journal 64(1):99–118.

Egbeyale LT, HO Fatoki and OA Adeyemi (2013).Effect of egg weight and oviposition time onhatchability and post hatch performance of Japanese quail (Coturnix coturnix japonica).Nigerian Journal of Animal Production 40(1):102–110.

El-Deen, M. B., El-Tahawy, W. S., Attia, Y. A. and Meky, M. A. (2008). Inheritance of Age at Sexual Maturity and its Relationship with some Production Traits of Japanese Quails.Egypt Poult. Sci. J., 28(4): 1217-1232

El-Fiky, F. A., Aboul-Hassan, M. A. and Shoukry, H. M. S. (1996). Effects of Intensive Inbreeding on some Productive Traits in Japanese Quail. Fayoum J. Agric. Res. Dev., 34: 189-202.

El-Full, E. A. (2001). Genetic Analysis of Hatched Egg Weight, Body Weight at different Ages and Reproductive Performance with their Relationships in Japanese Quail. Egypt. Poult. Sci. J., 21(11):291-304.

El-Full, E.A., Ali, A. A., El-Fattah, A. and Khalifa, M. A. (2001). Inheriatance of some Growth Characteristics of Japanese Quail. Egypt poult. Sci. J., 21(3):719-739.

F.A.O. (1991). Guidelines for Slaughtering, Meat Cutting and further Processing. FAO Animal Production and health paper No. 91. Rome, Italy. 170 pp.

Farooq, M., Aneela, K., Durrani, F. R., Muqarrab, A. K., Chand, C. and Kurshid, A. (2001). Egg Shell Weight, Hatching and Reproductive Performance of Broiler Japanese Quails.Sarhad J. Agric., 17 (3): 289293.

G. Dauda, O. M. Momoh, N. I. Dim and D. M. Ogah(2014). Growth, Production and Reproductive Performance of Japanese Quails (Coturnix Japonica) in Humid. Egypt. Poult. Sci. Vol (34) (II): (381-395).

Hassan E. Elkomy, Ayman E. Taha*, Heba A. Basha, Magda I. Abo-Samaha, Mohamed M. Shara. GROWTH AND REPRODUCTION PERFORMANCE OF JAPANESE QUAILS (Coturnix coturnix japonica) UNDER VARIOUS ENVIRONMENTS OF LIGHT COLORS 2019.

Islam MS, S Faruque, H Khatun and MN Islam (2014). Comparative production performances ofdifferent types of quail (Coturnix coturnix japonica). The Agriculturists 12(2): 151-155.

Jatoi, A. S., A. W. Sahota, M. Akram, K. Javed, M. H. Jaspal, S. Mehmood, J. Hussain, H. M. Ishaq, and E. Bughio. 2015. Egg quality characteristics as influencedby differentbody sizes in four close-bred flocks of Japanese quails (coturnix coturnix japonica). J. Anim. Plant Sci. 25:921–926.

Mark, H. L. (1979). Changes in Unselected Traits accompanying Long-term Selection for four-week Body Weight in Japanese Quail. Poult. Sc. J., 58:269-274.

Mark, H. L. (1980). Revere Selection in a Japanese Quail Line previously selected for 4-week Body Weight. Poult. Sci. J., 59:1149-1154.

Minvielle F, E Hirigoyen and M Boulay (1999). Associated effects of the roux plumage colormutation on growth, carcass traits, egg production, and reproduction of Japanese quail

Muthukumar, S. P. and Dev Roy, A. K. (2005). Alternate Poultry Production in India. An overview. Copyright 2005–06 Sadana Publishers and Distributors. All right reserve http://www.dairyyearbook.com/poul try news 1.aspx

Nasar A, A Rahman, N Hoque, AK Talukder and ZC Das (2016). A survey of Japanese quail (Coturnix coturnix japonica) farming in selected areas of Bangladesh. Veterinary World 9(9):940-947

NVRI (1994). Farmer Training and Quail Production and Health management. National Veterinary Research Institute, Vom Nigeria. 44 pp.

Ojo, V., Josiah, B. O. and Adeyinka, K. L. (2011). Effect of Egg Weight on Hatching Weight in the Japanese Quail. Pp. 28-31 In: Proceedings of the 35th Annual Conference of Genetics Society of Nigeria 10th – 14th October, 2011. Ahmadu Bello University, Zaria.

Pizzolante CC, ABG Faltarone, EA Garcia, ESPB Saldanha, AP Deodato, MR Sherer, AA Mendes, C Mori and K Pelicia(2006). Production performance and egg quality of quails (Coturnix japonica) during several periods of the day.RevistaBrasileira de CiênciaAvícola 8(3): 149-152

Rahman ANMA, MN Hoque, AK Talukder and ZC Das (2016).A survey of Japanese quail (Coturnixcoturnix japonica) farming in selected areas of Bangladesh.Veterinary World 9(9): 940-947.

Rahman MS, KMG Rasul and MN Islam (2010).Comparison of the productive and reproductive performance of different color mutants of Japanese quails (Coturnix japonica) Dhaka, Bangladesh. Proceedings of the Annual Research Review Workshop BLRI, Savarpp: 50–56.

Rahman MS, KMG Rasul and MN Islam (2010).Comparison of the productive and reproductive performance of different color mutants of Japanese quails (Coturnix japonica) Dhaka, Bangladesh. Proceedings of the Annual Research Review Workshop BLRI, Savarpp: 50–56.

Razee, A.S.M. Mahbub, M.Y. Miah, M.R. Hasnath, M.K. Hasan, M.N. Uddin and S.A. Belal. Performance of Japanese Quails (Coturnix coturnix japonica) on Floor and Cage Rearing System in Sylhet, Bangladesh: Comparative Study. Iranian Journal of Applied Animal Science (2016) 6(4) 931-936.

Redoy MRA, AAS Shuvo and and M Al-Mamun (2017). A review on present status, problems and prospects of quail farming in Bangladesh. Bangladesh Journal of Animal science 2017. 46 (2): 109-120.

Redoy MRA, AAS Shuvo and and M Al-Mamun(2017). A review on present status, problems and prospects of quail farming in Bangladesh. Bangladesh Journal of Animal Science 46 (2):109-120

Sachdev, A. K., Ahuja, S. D., Thomas, P. C. and Agarwal, S. K. (1985). Effects of Egg Weight and Duration of Storage on the Weight Loss, Fertility and Hatchability Traits in Japanese Quail. Indian J. Poult. Sci., 20: 19-22.

Screenivasaiah, P. V. and Joshi, H. B. (1988). Influence of Hatching Season on Egg Production Characteristics in Japanese Quail. Indian J. Poult. Sci., 23: 62-65.

Sezer, M., Berberoglu, E. and Ulutas, Z. (2006). Genetic Association between Sexual Maturity and weekly Live Weights in Layingtype Japanese Quail. South Africa J. Anim. Sci., 36(2):142-148

Siddiqui SA and MAS Mondal (1996).Economics of Japanese quail farming in Dhaka metropolitan city.Bangladesh Journal of Agricultural Economics,19 (1-2):71–84.

Sultan AJ, AS Waheed, M Akram, K Javed, J Hussain, S Mehmood and MJ Hayat (2013).Hatchingtraits as influenced by different body weight categories in four close-bred flocks of Japanesequails (Coturnixcoturnix japonica). Pakistan Journal of Zoology45(5):1215–1220.

Thomas, P. C. and Ahuja, S. D. (1988). Improvement of Broiler Quails of Cari through Selective Breeding. Poultry guide, 25(10): 45-47.

Tunsaring T, K Tungjaroencha, W Siriwong (2013). Nutrient benefits of quail (CoturnixCoturnixJaponica) eggs. International Journal of Scientific and Research Publications 3(5): 2250-3153

Wilson, W., Ursnia, O., Abott, K. and Abplanalp, H. (1961). Evaluation of Japanese Quail as pilot Animal for Poultry Breeding. Poult. Sci. J., 40:651-657.