SAARC J. Agric., 21(1): 253-263 (2023) *DOI: https://doi.org/10.3329/sja.v21i1.66244*

GROWTH PERFORMANCE, EGG QUALITY AND SELECTION INTENSITY OF 6TH GENERATION OF BLRI IMPROVED NATIVE DUCK GENOTYPES

H. Khatun[1*], S. Sultana[1], S. Faruque[1], M.S.K. Sarker[1]
M.M.R. Manu[1] and M.Z. Ali[2]

[1]Poultry Production Research Division, Bangladesh Livestock Research Institute Savar, Bangladesh.
[2]Animal Health Research Division, Bangladesh Livestock Research Institute Savar, Bangladesh.

Abstract

This research was taken to improve the performance of native duck. Two native duck varieties, Rupali and Nageswari of 6th generation were selected aiming to increase their laying performances. A total of 540 ducklings of both genotypes were hatched and brooded in brooder house. Male and female ducks were separated and marked with wing band at 12 weeks of age. At 40 weeks of age, a total of 300 ducks of both genotype were selected on the basis of selection index comprising the parameters of age at first egg, body weight at first egg, egg production % and egg weight. The individual with the higher total score was selected for breeding purposes. Selected male and female ratio were 1:5 using natural mating. The selection intensity and expected selection responses of selection criteria of two duck genotypes were estimated. Selection responses for ASM (day), egg weight (g) and egg production rate was -1.84, 1.08 g and 0.45 in case of Rupali and -1.66, 1.35 and 0.73 for Nageswari, respectively. Egg production % was numerically higher in Rupali (60.12%) than Nageswari (58.41%). Egg weight (EW) and feed intake were significantly differences between two native ducks where both higher values were found in Rupali (EW 64.83g and feed intake 134g) than Nageswary. Egg shape index was significantly higher in Rupali (76%) than Nageswari (75%) duck. In conclusion, Rupali ducks showed better production performance and it is suggested that selective breeding of duck may have significant impact on the development of native duck.

Keywords: Conservation, Improvement, Performance, Native duck, Genotype

[*] Corresponding author: hkr.7519@gmail.com

Received: 18.1.2023 *Accepted: 21.06.2023*

INTRODUCTION

The livestock as a subsector of agriculture contributing 1.9% of total gross domestic production (GDP) of Bangladesh and total 63845 million number of ducks directly impacted (DLS, 2023) on livestock production. Native ducks have been raised in Bangladesh for centuries for meat or eggs, hence ducks are one of the most important commodities among other livestock. Traditional duck farming has been practiced for centuries (Parvez et al., 2020). Ducks are herded in rice fields, canals, and rivers to obtain their feed. Native ducks have great potential, but they have a low appreciation compared to exotic breeds. There is a general assumption that exotic breeds are better (Ali et al., 2021; Ali, 2018; Hossen et al., 2019). Due to this, indiscriminate breeding and the associated risk of losing some of the genetic potential of local breeds cannot be avoided. Numerous studies indicate that exotics are not always better than local breeds (Ali, 2020; Ali and Islam, 2021; Rahman et al., 2018; Paul et al., 2017). A native duck is a genetic resource that contributes to the biodiversity of our nation and preserves its genetic diversity. The performance of our native ducks has been improved in order to meet the increasing demand for meat and eggs. Bangladesh Livestock Research Institute (BLRI) has been selecting two native duck genotypes, BLRI duck 1 (Rupali) and (Nageswari) for generations. Rupali has dominant white plumage throughout its body, whereas Nageswari has a white breasted black body. The local Nageswari variety originated in the Sylhet district (Zaman et al., 2005), while the Rupali variety is widely distributed throughout the country (FAO, 2004). In order to raise ducks successfully, breed quality is an important factor-particularly egg production. Substantial improvement in egg production has been achieved through application of quantitative genetics methods but further improvement in egg number has to be done through traditional selection traits (Luc, 1996). There is an ongoing research program in this area. Thus, the purpose of the study was to determine the performance of 6th generation Rupali and Nageswari ducks under intensive management conditions.

MATERIALS AND METHODS

Experimental ducks

A total of 550 ducklings of Rupali and Nageswari were used to evaluate the productive and reproductive performances at 6th generation (G6). Ducklings were leg banded at day old age and were individually weighed and transferred into the brooder. After 4th week of age they were reared in floor under intensive management condition. All the birds were reared in a natural-ventilated duck house and providing 16h photoperiod with 12h sunlight and 4h artificial lights. Each pen was equipped with an individual feeder and drinker. Adult duck were housed in an open sided shed with concrete floor and maintained through family mating system. The male and female were separated after 12 weeks of age. At 40 weeks of age, on the basis of selection criteria (egg at first lay, egg production and egg weight), 30 males and 150

females were selected both Rupali and Nageswari genotypes and the desirable mating ratio was 1:5 in an intensive pen. Egg production data of individual duck were recorded keeping them individual coop during egg laying period that is from evening to 8 am.

Feeding management

Starter ration was fed from hatching to 8th week, grower ration from 9th to 16th week and layer ration thereafter. The diet composition is given in Table 1.

Table 1. Composition of feed supplied during study

Type	Moisture %	ME (Kcal/kg)	CP%	CF%	Ca%	Available P%
Layer starter	10	2900	19.50	4.75	1.00	0.5
Layer grower	10	2950	16	4.75	1.50	0.46
Layer layer	10	2900	17	4.60	3.50	0.42

Feed and water were given *ad libitum*. Each pen was equipped with an individual feeder and drinker. Water also provided *ad libitum* twice daily in the morning and evening. Feeders were cleaned twice in a week and drinkers were cleaned every day. Leftover of the feed was measured every day in the morning.

Lighting management

All the birds were reared in a natural-ventilated open-sided house. Lighting schedule in grower house was set to 14-hour light and 10-hour dark cycle. At the beginning of 14 week the length of photoperiod was successively increased and from 16 week of age a 16L: 8D light program was applied, where providing 16h photoperiod with 12h sunlight and 4 h artificial lights on between 06.00 and 22.00h. Light intensity at the height of bird's eye was about 30 lux. The management conditions were kept identical as far as possible for all the hatches.

Vaccination

Duck plague and duck cholera vaccines were given to the Rupali and Nageswari ducks as per schedule (Table 2). Medication was given as per recommendation. Proper bio-security and hygienic management was taken for better healthy birds.

Table 2. Vaccination schedule of Rupali and Nageswari ducks

Age (day)	Name of Vaccine	Route	Dose/Duck
First dose 21d	Duck Plague	Inject thigh muscle	0.5 cc/bird
Second dose 36 d	Duck Plague	Inject thigh muscle	0.5 cc/bird
Repeat each 6 months interval	Duck Plague	Inject thigh muscle	1 cc/bird
First dose 56 d	Duck Cholera	Inject Subcutaneous	0.5 cc/bird
Second dose 71 d	Duck Cholera	Inject Subcutaneous	0.5 cc/bird
Repeat each 6 months interval	Duck Cholera	Inject Subcutaneous	1 cc/bird

Data recorded

Ducks were individually weighed weekly to determine the mean population weight. Body weight, feed consumption and feed conversion ratio (FCR) were measured weekly up to 12 weeks of age. The male and female were separated and marked with wing band after 12 weeks of age. Individual egg production was measured by caging each duck in the evening, taking it out of the cage early in the morning and recording the characteristics of the eggs laid. Body weights were measured before egg laying cycle started. The age at first egg and body weight of first egg were recorded

Egg quality measured

The external traits were recorded for each egg are- egg weight, egg length or vertical diameter, egg width or horizontal diameter, shape index which was defined as the ratio of the length on the width measured to the nearest 0.1 mm, egg shell thickness. Broken eggs were not used. Egg weight was measured to the nearest 0.01 g while the shell thickness was measured with a precision of 0.01 mm using a Vernier caliper. The egg shape index was calculated for each egg using the formula of Reddy et al. (1979). The albumen index was measured according to Heiman and Carver (1936) formula. The yolk index was calculated according to Wesley and Stadelman (1959) formula. Yolk color was determined by comparing with the Roche Yolk Color (RYC) Fan (RYC, F. Hoffman-la Roche and Ltd., Switzerland) depending on visual comparison according to Vuilleumier (1969) and Haugh Unit (HU) was calculated using the formula suggested by Haugh (1937).

Selection criteria

Sexing was done at 12^{th} week and thereafter both the sexes were kept separately in growing pens. After separation of sexes, one male duck and five female duck were set for breeding purpose and marked with wing band to identify them. At 40 weeks of age, a total of 150 ducks were selected of each on the basis of selection Index comprising the parameters of age at first egg (day), body weight at first egg (g), egg production (%) and egg weight (g).

The selection Index was computed by the following equation:

Selection Index (I) = $b_1x_1 + b_2x_2 + \ldots\ldots\ldots\ldots + b_nx_n$

Where, $x_1, x_2, \ldots\ldots x_n$ represent the phenotypic value for the trait

$b_1, b_2, \ldots\ldots b_n$ denote the relative weight given to each of the trait

The total score was obtained from above calculation is a selection index. The individual with the higher total score was selected for breeding purposes. Both index selection and independent culling levels were used to select duck. Male drakes selected with female ducks that were produced by different sire. Forty males were selected and the desirable mating ratio was 1:5 in an intensive pen.

Prediction of expected selection response

Expected selection response in two types of native duck genotype for egg production, egg weight and age at sexual maturity was estimated for foundation stock using the following equation (Falconer, 1981)

$R = ½ h^2 \times Sr$

Where,

R= Expected response in mass selection

h^2= Heritability of egg production, body weight, egg weight and age at sexual maturity

Sr= Selection differential for duck

Selection Intensity

i= Selection differential/Standard deviation of population mean

Statistical analysis

All recorded data were analyzed by t-test.

Results and Discussion

The mean body weight, weight gain, feed intake, and feed conversion ratio (FCR) of Rupali and Nageswari ducks from 0-12 weeks of age are shown in Table 3. There were no significant differences in the performance of the duck genotypes in terms of live body weight, body weight gain, feed intake, and feed conversion.

Table 3. Growth performances between Rupali and Nageswari ducks from 0-12 weeks of age

Parameters	Age (Weeks)	Rupali	Nageswari	SEM	Level of significance
Body weight (g)	DOC	39	37.47	2.43	NS
	4	421.16	397.53	3.71	NS
	8	917	884.5	6.561	NS
Mean	12	1270	1200.5	9.36	
WG (g)	0-4	382.16	359.53	3.532	NS
	5-8	495.85	486.97	4.317	NS
	9-12	353.01	316	4.143	NS
Mean	0-12	1231.1	1162	10.671	
FI (g)	0-4	645.87	478.85	8.971	NS

Parameters	Age (Weeks)	Rupali	Nageswari	SEM	Level of significance
	5-8	1165.25	1131.97	9.184	NS
	9-12	1291.19	1241.6	14.714	NS
Mean	0-12	3002.31	2852.42	21.542	
FCR	0-4	1.69	1.331	0.943	NS
(Feed: Gain)	5-8	2.3	2.325	0.982	NS
	9-12	3.657	3.929	1.182	NS
Mean	0-12	2.44	2.454	1.012	

BW: Body weight; WG: Weight gain; FI: Feed Intake; FCR: Feed Conversion Ratio; DOC: day old chicks

Rupali and Nageswari ducks weighed 39g and 37.47g, 917g and 884.5g, and 1270g and 1200.5g at day old, 8th and 12th weeks, respectively. Islam et al. (2014) reported mean day-old body weights of 40.10g and 36.24g which were similar to the present study. The 8th week body weight was found to be lower, while the 12th week body weight was found to be 100g higher than the present study. From 0 to 12 weeks of age, Rupali gained 1231.10g and Nageswari gained 1162g. Up to 12 weeks, Rupali and Nageswari ducks consumed 3002.31g and 2852.42g of feed, respectively. In the 0-4, 5-8, and 9-12 weeks, Rupali's FCR was 1.69, 2.3, and 3.65, while Nageswari's was 1.33, 2.3, and 3.9. Up to 12 weeks, Rupali had a mean FCR of 2.44, while Nageswari had a mean FCR of 2.45.

Table 4 shows the differential selection, selection intensity, and selection response in the sixth generation (G6) of Rupali and Nageswari ducks. After selection, Rupali and Nageswari ducks reached sexual maturity at 144.40 and 142.64 days, respectively. In Rupali and Nageswari ducks, ASM was reduced by 4 and 2 days, respectively. This study was better than Khatun et al. (2020), who reported ASMs of Rupali and Nageswari ducks at 150 and 155 days, respectively. In Rupali and Nageswari, the selection differentials were -4.62 and -1.65; 2.17 and 2.70; 3.02 and 4.88, respectively. The intensity of selection for ASM, egg weight and egg production were -0.36 and -0.13; 0.32 and 0.23; 1.23 and 0.45 for Rupali and Nageswari ducks as well.

Table 4. Selection differential, selection intensity and selection responses in 6th generation (G_6) of Rupali and Nageswari ducks

Genotype	Traits	Before selection	After selection	Selection differential	Selection intensity	Selection responses
Rupali	ASM (d)	149.02	144.40	-4.62	-0.36	-1.84
	EW(g)	55.36	57.54	2.17	0.38	1.08
	BW(g)	1705.75	1758.63	52.87	0.38	26.43
	EP %)	60.69	63.71	3.02	0.45	0.45
Nageswari	ASM(d)	144.29	142.64	-1.65	-0.64	-1.66
	EW(g)	52.07	54.78	2.70	0.69	1.35
	BW(g)	1606.89	1683.96	77.06	0.74	38.53
	EP %)	58.40	63.29	4.88	0.80	0.73

ASM: Age at sexual maturity, BW: Body weight, EW: Egg weight, EP: Egg production, EM: Egg Mass

As reported by Khatun et al. (2020), the intensity of selection for Rupali and Nageswari ducks were -0.12, -0.13, 0.32, 0.23, and 1.23, 0.45, respectively, in 5th generation. As a result of selection, age at sexual maturity was expected to decrease by 1.84 and 1.66 days in Rupali and Nageswari ducks, where egg weight was expected to increase by 1.08g and 1.35g and egg production % was also expected to increase by 0.45 and 0.73 for Rupali and Nageswari ducks as well.

The egg production performances of two strains of BLRI-1 (Rupali) and BLRI-2 (Nageswari) at 24-40 weeks of age are shown in comparison in Table 5 below:

Table 5. Egg production performances between Rupali and Nageswari at the age of 24-40 weeks of age.

Parameters	Rupali	Nageswari	SEM	Level of significance
Egg production %	60.12	58.41	1.03	NS
Egg weight (g)	64.83^{a}	61.30^{b}	0.61	**
Egg mass (g/d)	39.00^{a}	35.81^{b}	0.77	*
Feed Intake (g)	134^{a}	130.38^{b}	0.64	**
FCR	3.46	3.75	0.08	NS

FCR= Feed conversion ratio; Means on the row with different superscripts are statistically significant; **= ($P<0.01$); *= $P<0.05$

The egg mass production (g/b/day) of Rupali ducks (39.00g) was significantly higher than that of Nageswari ducks (35.81g). According to Khatun et al. (2020), Rupali and

Nageswari ducks produced 40.24 and 37.55 eggs per duck in G5, which is slightly higher than the present results. A study by Bhuiyan et al. (2018) determined that Nageswari ducks produce 32.40g of eggs per bird per day. A study by Islam et al. (2014) reported that Deshi duck eggs produced 31.69g of eggs per bird per day, which is lower than the present study. There was a highly significant difference in egg weights between genotypes ($P<0.001$). The egg weights of Rupali and Nageswari ducks were 64.83g and 61.30g, respectively (Table 5). For laying traits, our results are similar to those reported for Brown Tsaiya ducks with egg weights of 64.2g and 67.8g at 210 and 280 day of age, respectively. Sharma et al. (2002) reported higher egg weight in Nageswari ducks (62.45g) and Mahanta et al. (2009) reported higher egg weights in Chara-chamballi ducks (71.6g) of Assam. But Khatun et al. (2020) found that in G_5 there was no significant difference in egg weight among the genotypes. The average feed consumption of the Rupali and Nageswari ducks was 134.00 and 130.38 (g/bird/d), respectively, and highly significant differences were found between the genotypes ($p<0.001$). BLRI (2001) reported higher feed consumption in deshi ducks (178 g/b/d), whereas Bhuiyan et al. (2018) reported higher feed intake in Nageswari ducks (154.85 + 2.27 g/b/d). During the lying period, the feed conversion ratios were 3.46 for Rupali ducks and 3.75 for Nageswari ducks, and no significant differences were detected ($P>0.05$). Bhuiyan et al. (2018) found the feed conversion efficiency in Nageswari ducks was 4.63± 0.21, which is more than the current observation.

A comparison between the egg quality parameters of Rupali and Nageswari ducks is presented in Table 6 below.

Table 6. Comparative egg quality parameter measurements of Rupali and Nageswari at 30 weeks of age.

Parameters	Rupali	Nageswari	SEM	Level of significance
Egg				
weight (g)	66.70	64.93	0.770	NS
Length (mm)	58.98	58.8	0.287	NS
Width (mm)	45.13	44.12	0.296	*
Albumen				
Height (mm)	9.94	9.50	0.38	NS
Width (mm)	57.94	62.0	1.95	NS
Length (mm)	82.31	85.88	1.49	NS
Yolk				
color	8.46	8.77	0.165	NS
Height (mm)	18.88	18.51	0.171	NS

Parameters	Rupali	Nageswari	SEM	Level of significance
Width (mm)	45.12	43.5	0.700	NS
Weight (g)	21.022	20.2	0.690	NS
Shell				
Weight (g)	8.73	8.422	0.24	NS
Thickness (mm)	0.60	0.62	0.01	NS
Shape index	76.60[a]	75.11[b]	0.345	*
Albumen index%	10.10	9.23	0.449	NS
Yolk index%	41.94	42.71	0.871	NS
Haugh unit	96.95	95.56	1.666	NS

Means on the row with different superscripts are statistically significant; **= (P<0.01); *= P<0.05, NS= Not Significant

At the age of 30 weeks, Rupali and Nageswari ducks were tested for their egg quality characteristics. This shape index was highly significant (P<0.01) between the genotypes, with Rupali having a higher value than Nageswari ducks indicating that Rupali is more robust. Both genotypes did not differ significantly in any of the other parameters of external and internal characteristics of egg quality. On the other hand, contrary results emerge regarding the generation five (G5) of the population. In their research, Halima et al. (2020) reported that there was a significant difference in albumen width, yolk color, and shell thickness between Rapali and Nageswari genotypes at generation five (G5).

CONCLUSION

Rupali ducks produced better eggs in terms of weight, mass, and number than Nageswari duck genotypes. It was also found that the Nageswari genotype reached maturity earlier and consumed less feed than the Rupali genotype. However, both genotypes showed similar egg quality parameters and feed conversion ratios. These findings suggest that selective breeding may contribute to the improvement of production performance of native ducks.

REFERENCES

Ali, M.Z. and Islam, M.M. (2021). Characterization of β-lactamase and quinolone resistant Clostridium perfringens recovered from broiler chickens with necrotic enteritis in Bangladesh. *Iranian Journal of Veterinary Research*, 22(1): 48-58.

Ali, M.Z., Hasan, M. and Giasuddin, M. (2021). Potential risk factors of avian influenza virus infection in asymptomatic commercial chicken flocks in selected areas of Bangladesh during 2019. *Journal of Advanced Veterinary and Animal Research*, 8(1): 51-57.

Ali, M.Z. (2018). The seroprevalence study of Reticuloendotheliosis virus infection in chicken in Bangladesh. *Egyptian Journal of Veterinary Sciences*, 49(2):179-186.

Ali, M.Z. (2020). Common respiratory diseases of poultry in Bangladesh: A review. *SAARC Journal of Agriculture*, 18(1): 1-11.

Bhuiyan, M.S.A., Mostary, D.S., Ali, M.S., Hussain, M.M. and Ferdaus, A.J.M. (2017). Performances of Nageswari duck of Bangladesh under intensive management condition. *Bangladesh Journal of Animal Science*, 46(3): 198-205.

Department of Livestock Services. (2023). Livestock economy at a glance. https://dls.portal.gov.bd/sites/default/files/files/dls.portal.gov.bd/page/ee5f4621_fa3a_40ac_8bd9_898fb8ee4700/2022-07-18-03-43-37d18965a6458cda3c542ab146480962.pdf

Duncan, D.B. (1955). Multiple range and multiple F tests. Biometrics, 11: 1-41.

Falconer, D.S. (1981). Introduction to quantitative genetics. 2nd ed. John Wiley and Sons, New York.

FAO. (2004). First Report on the State of the World's Animal Genetic Resources (AnGR), Bangladesh. Pp: 40.

Haque, Q.M.E., Islam, M.N., Hossain, M.J. and Sarker, M.S.K. (2001). A report of Selection and Improvement of native duck. Worked at Bangladesh Livestock Research Institute. Financed by IDA: Credit No: 2815-BD. Agricultural Research Management Project, Bangladesh Agricultural Research Council, Farmgate, Dhaka, Bangladesh.

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

Hossen, A., Rahman, M.H., Ali, M.Z., Yousuf, M.A., Hassan, M.Z. and Giasuddin, M. (2019). Investigation of duck plague virus in hoar areas of Bangladesh. *Bangladesh Journal of Livestock Research*, 26(1-2):73-78.

Islam, M.S., Khatun, H., Islam, M.N., Faruque, S. and Sarker, M.S.K. (2014). Study on the productive and reproductive performances of BLRI-1 and BLRI-2 ducks in Bangladesh. The Agriculturists, 12:10-14.

Khatun, H., Sultana, S., Faruque, S., Sumon, M.R.A., Sarker, M.S.K. and Sarker, N.R. (2020). Laying performance of 5th generation of BLRI improved native duck. *Bangladesh Journal of Livestock Research*, 27: 15-23.

Luc, K.M., Miyoshi, S., Suzuki, M. and Mitsumoto, T. (1996). Heritablity estimates of some clutch traits in the laying hen. *Japanese Poultry Science*, 33(1): 23-28.

Mahanta, J.D., Raj, J., Sapcota, D. and Jalaludeen, A. (2009, November). Certain performance traits of Chara-chamballi ducks of Kelara under range condition in Assam. In Proceeding of IV world waterfowl conference held at Thrissur, Kerala, India, 11-13.

Parvez, S., Miah, M.Y. and Khan, M.H. (2020). Smallholder duck farming: a potential source of livelihood in haor women in Bangladesh. *Asian Journal of Medical and Biological Research*, 6(1): 73-80.

Paul, P., Akther, S., Ali, M.Z., Banu, H., Khan, M.S.R. and Khatun, M.M. (2017). Isolation, identification and antibiogram study of Salmonella spp. from poultry farm environment. *International Journal of Animal Biology*, 3(2): 5-11.

Rahman, M.M., Uddin, M.K., Hassan, M.Z., Rahman, M.M., Ali, M.Z., Rahman, M.L., Akter, M.R. and Rahman, M.M. (2018). Seroprevalence study of infectious laryngotracheitis virus antibody of commercial layer in Gazipur Districts of Bangladesh. *Asian Journal of Medical and Biological Research*, 4(1):1-6.

Reddy, P.M., Reddy, V.R., Reddy, C.V. and Rao, P.S.P. (1979). Egg weight, shape index and hatachability in Khaki Campbell duck eggs. *Indian Journal of Poultry Science*, 14: 26-31.

Sharma, S.S., Zaman, G., Goswami, R.N., Roy, T.C. and Mahanta, J.D. (2002). Physical characteristics of Nageswari duck eggs of Assam. *Indian Journal of Animal Science*, 72: 1177-1178.

Vuilleumier, J.P. (1969). The 'Roche Yolk Colour Fan '-An Instrument for Measuring Yolk Colour. *Poultry Science*, 48(3): 767-779.

Wesley, R.L. and Stadelman, W.J. (1959). Measurements of interior egg quality. *Poultry Science*, 38(2): 474-481.

Zaman, G., Goswami, R.N., Aziz, A., Nahardeka, N., Roy, T.C. and Mahanta, J.D. (2005). Farming system of Nageswari ducks in North-Eastern India (Assam). *World's Poultry Science Journal*, 61(4): 687-693.