An Official Journal of Bangladesh Livestock Research Institute (BLRI)
Bangladesh Journal of Livestock Research
Journal Homepage: https://www.banglajol.info/index.php/BJLR
ISSN 1022-3851

# Laying performance of 5th generation of BLRI improved native duck

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## Abstract

This research was aimed to improve the egg production performances and to estimate the selection response of fifth generation ($G_5$) of deshi white (Rupali) and white breasted black (Nageswari) duck genotypes through an individual selection program. All the ducks were reared in an open sided duck house. Diet containing 17.5% CP and 2750 Kcal ME/kg and fresh water provided twice daily in the morning and evening. Individual egg production was recorded from each duck. After 40 weeks of age, female ducks were selected on the basis of selection index and selection differences, selection intensity and responses were also measured. Egg weight, egg production and feed intake were recorded and FCR, egg mass was calculated. All recorded data were analyzed by SAS and differences were determined by DMRT. The selection criteria of fifth generation ($G_5$) of both duck genotypes were studied. As a result of selection, age at sexual maturity (day), egg weight (g) and egg production % were expected to improve by -1.63d, 0.60g, 1.01% and -0.85day, 0.39g, 0.47% for Rupali and Nageswari ducks, respectively. Egg mass was significantly ($p<0.05$) higher in Rupali (40.24g) than Nageswari (37.55g) duck whereas, egg weight was not significantly differ in both genotypes. Egg production in Rupali and Nageswari duck was 65.41% and 62.74%, respectively. Rupali ducks were significantly ($p<0.05$) consumed more feed (134.54 g) than Nagesswari ducks (126.23 g). The FCR was significantly ($p<0.05$) better in Rupali (3.34) than Nageswari (3.61) ducks. The egg quality results showed that egg shell thickness of Rupali duck was significantly ($p<0.05$) higher than Nageswari. Higher values for albumen width ($p<0.05$) was also found in Rupali (65.03mm) than Nageswari (59.11mm) duck egg. On the other hand shape index, albumen index, yolk index and haugh unit were not found significantly different in both genotypes but the yolk color score of Nageswari found highest score than Rupali duck egg. Proximate composition of eggs was not significantly different of both duck genotypes. Based on the results it is revealed that Rupali duck was better in terms of egg weight, egg mass and egg production, but starting lay egg is earlier in Nageswari than Rupali duck.

**Key words:** Selection, Improvement, Rupali, Nageswari, Native ducks

Bang. J. Livs. Res. Vol. 27 (1&2), 2020: P. 15-23. https://doi.org/10.3329/bjlr.v27i1.55166

## Introduction

Duck production in Bangladesh is largely a traditional enterprise. This native poultry species is threatened for existence due to lack

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of scientific breeding and management practices in Bangladesh. Duck population has been estimated at 57.52 million occupying second position in Bangladesh (DLS, 2019) and therefore duck eggs play an important role in family income as well as household nutrition. In Bangladesh, most of the duck populations are native like Pati (Deshi), Nageswari, Sythetmete, Cinahanh which have been well adapted to local climate and are considered to be dual purpose. Now a days, existing breeding system is done randomly without control. Over the years, the random crossbreeding with exotic breeds leads to gradual disappearance of pure native duck and there is a risk of extinction this germplasm in near future. Therefore efforts should be directed towards the implementation of appropriate breeding system especially in duck rearing centers. Duck breeding is very important for maintaining line purity as well as to improve the genetic make-up of the local stock. This will also help to improve the productivity. With the view, Bangladesh Livestock Research Institute (BLRI) preserved and improved two native duck genotypes namely deshi white (Rupali) and Desi black (Nageswari). Desi white duck has dominant white plumage color at all body and desi black has a white breasted black body. Nageswari is believed to have originated in the Sylhet district (Zaman. *et al*., 2005) and desi white are widely distributed throughout the country named as Rupali (FAO, 2004). Genetic quality improvement through selective breeding is the common methods applied (Al-Nasser *et al*., 2007). Therefore, the ongoing research program was designed to know the laying performance and egg quality of 5$^{th}$ generation of Rupali and Nageswari duck under intensive management condition.

## Materials and Methods

**Collection, feeding and management of duck**

A total of 200 layer pullet were taken for the experiment purpose. All the ducks were reared in an open sided duck house and providing 16h photoperiod with 12 h sunlight and 4 h artificial lights during laying period.

Table 1: Nutrient composition of ration supplied to layer ducks

| Nutrients | Laying (20-72 weeks) |
|---|---|
| ME(Kcal/kg) | 2750 |
| CP (%) | 17.5 |
| Lysine (%) | 0.88 |
| Methionine (%) | 0.36 |
| Calcium (%) | 3.00 |
| Available Phosphorus (%) | 0.52 |

Vitamin- mineral premix was added at a rate of 0.5 kg per 100 kg feed.

**Data recorded**

Ducks were individually weighed and feed consumption were recorded weekly up to 16 weeks of age. Adult body weights were measured before egg laying cycle started and then, were recorded monthly interval up to 72 weeks of age. Feed conversion ratio (FCR) and egg mass (g/duck/day) were calculated. The male and female were separated and marked with wing band after 12 weeks of age. Individual egg production was recorded by caging each duck early in the morning. Egg weight (g) data were recorded fortnightly.

**Egg quality measurement**

A total of 60 fresh eggs were collected from the Rupali and Nageswari duck at 40 weeks of age to investigate external and internal egg quality. The egg quality characteristics included egg length, egg width, shape index, egg breaking strength, membrane thickness, shell thickness, albumen index, yolk index, yolk color score, albumin width, albumen length and Haugh unit (HU). Appropriate instruments and formula were used to measure above mentioned quality characteristics.

**Proximate analysis of egg**

The freshly laid eggs of Rupali and Nageswari ducks were collected from the experimental shed. Dry matter (DM), crude protein (CP), ether extract (EE) and total ash (TA) content of eggs were determined following the principles of AOAC (2005).

**Selection criteria of ducks**

At 40 weeks of age, a total of 200 ducks were selected on the basis of Selection Index (comprising age at first egg, day; body weight at first egg, g; egg production % and egg weight, g) and individual culling. Selection Index was computed by the following equation:

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

Where, $x_1$, $x_2$,…….$x_n$ represent the phenotypic value for the trait

$b_1$,$b_2$,…….$b_n$ 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.

Along with the females 40 males were also selected and were mated with a mating ratio of 1:5.

**Estimation of selection response**

Expected selection response in two genotypes for egg production, egg weight and age at sexual maturity was estimated for the 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

**Statistical analysis**

All data were analyzed in SAS (1990) and significant mean differences were separated using Duncan Multiple Range Test (Duncan, 1955).

## Results and Discussion

The egg production performance of Rupali and Nageswari duck under intensive management conditions are presented in Table 2. Duck-day egg production was found

to be 65.41% and 62.74% and average annual egg production was 238.76 and 229.03 no. for Rupali and Nageswari duck, respectively. This result is in agreement with the findings of Valavan *et al*., (2009) who reported average annual egg production to be 200-220 in Nageswari duck under intensive management. Khatun *et al*., (2012) found 50.67±1.5 and 55.40 ± 2.36 % egg production rate up to 52 weeks of age in Rupali and Nageswari duck which is relatively lower than the present study. Ketarendan Prasetyo (2000) reported that the annual egg production of confined ducks was 55.6%, and this results less than the present findings.

In Rupali and Nageswari duck, egg weight was 67.12 g and in 65.40 g, respectively. These results are close to those reported in Brown Tsaiya ducks weighing 64.2 g and 67.8 g at 210 and 280 days of age, respectively. However, higher egg weight also reported by Sharma *et al*., (2002) in Nageswari duck (62.45g) and Mahanta *et al*. (2009) in Chara-chamballi duck (71.6g) of Assam. Egg mass production was significantly ($p<0.05$) higher in Rupali (40.24g) than Nageswari (37.55g) duck. Bhuiyan *et al*. (2017) found 32.40 ± 2.29 egg mass production in Nageswari duck. Islam *et al*. (2015) reported much lower egg mass production in deshi duck (31.69). These results revealed that Rupali and Nageswari duck is comparable with exotic duck breeds. Daily feed consumption of Rupali and Nageswari duck during laying period was 134.54 and 126.23 g/d respectively and showed significant difference ($p<0.05$). Higher amount feed consumption was reported in deshi duck (178 g/d) Huque, *et al*. (2001) and in Nageswari duck (154.85 g/b/d) Bhuiyan *et al*. (2017). Significant ($p<0.05$) difference was found in feed conversion ratios during laying period (3.34 *vs* 3.61) in Rupali and Nageswari, respectively. Bhuiyan *et al*. (2017) found higher feed conversion of 4.63 in Nageswari duck.

Table 2: Laying performances of Rupali and Nageswari ducks

| Parameters | Rupali | Nageswari | SEM | P value |
|---|---|---|---|---|
| Duck day egg production (no.) | 238.76 | 229.03 | 4.17 | 0.094 |
| Egg Production (%) | 65.41 | 62.74 | 0.918 | 0.117 |
| Average egg weight (g) | 67.12 | 65.40 | 0.572 | 0.103 |
| Egg mass (g/d) | 40.24 | 37.55 | 0.363 | 0.042* |
| Average feed intake(g/d) | 134.54 | 126.23 | 0.398 | 0.039* |
| Feed Conversion Ratio (Feed intake/egg mass) | 3.34 | 3.61 | 0.384 | 0.043* |

Table 3: External and internal egg quality characteristics of Rupali and Nageswari ducks

| Parameters | Rupali | Nageswari | SEM | P-value |
|---|---|---|---|---|
| Egg weight (g) | 66.93 | 63.68 | 1.227 | 0.216 |
| Length (mm) | 58.34 | 58.90 | 0.608 | 0.699 |
| Width(mm) | 45.65 | 44.35 | 0.371 | 0.068 |
| Albumen length (mm) | 88.44 | 86.28 | 1.200 | 0.429 |
| Albumen width (mm) | 65.03 | 59.11 | 1.572 | 0.035* |
| Yolk width (mm) | 23.60 | 22.00 | 0.445 | 0.053 |
| Yolk height (mm) | 18.24 | 18.44 | 0.131 | 0.518 |
| Yolk color | 8.00 | 9.00 | 0.223 | 0.0001*** |
| Shell thickness (mm) | 0.51 | 0.44 | 0.015 | 0.0001*** |
| Membrane thickness (mm) | 0.28 | 0.27 | 0.020 | 0.891 |
| Shape index (%) | 78.36 | 75.56 | 0.833 | 0.085 |
| Albumen index (%) | 11.05 | 11.76 | 0.351 | 0.369 |
| Yolk index (%) | 38.89 | 39.93 | 0.339 | 0.136 |
| Haugh unit | 90.17 | 90.85 | 0.587 | 0.620 |

Findings on external and internal egg quality characteristics of Rupali and Nageswari ducks are presented in Table 3. Egg shell thickness of Rupali and Nageswari duck was 0.51 and 0.44 mm, respectively those are significant ($p<0.05$) different from each other. This finding was in agreement with that of Khatun *et al*. (2012) who reported shell thickness of 0.61 and 0.41mm in Rupali and Nageswari duck, respectively. The similar result on egg shell thickness might be a breed characteristic features of Rupali and Nageswari ducks as revealed by the findings of present and earlier studies. Higher ($p<0.05$) albumen width was noted in Rupali duck but the higher yolk color score was found in Nageswari. The present finding on yolk colour score of Nageswari coincides the result Bhuiyan *et al*. (2017). Carotenoid contents in feed may affect the color of the yolk (Dzikria *et al*., 2019). On the other hand, shape index, albumen index, yolk index and haugh unit were not differ significantly in both genotypes.

**Proximate components of eggs**

No differences were found in moisture, dry matter, fat and ash contents between Rupali and Nageswari duck albumens (Table 4). The DM content of egg albumen found in the present experiment is in agreement with the findings of Chaiyasit *et al*. (2019), Prasad (2000) and Das (1999). Higher percentage of albumen dry matter may be explained by the fact that large eggs tend to have a higher proportion of albumen (Marion *et al*. 1964).The CP content (11.68% in Rupali and 11.35% in Nageswari duck albumen) was much lower than the values reported by Chaiyasit *et al*. (2019) (12.15±0.10%).

The EE content is almost similar to the findings of Rahman *et al*. (2010). The content of inorganic elements are higher than those reported by Rahman *et al*., (2010). There was no difference in DM contents of egg yolk between two duck genotypes. Similarly, CP contents are in agreement with the findings of Mountney and Parkhurst (2001); Stadelman and Cotterill (2002). EE content of egg yolk is much lower than the findings of Rahman *et al*., (2010).

Table 4: Proximate composition of Rupali and Nageswari duck eggs

| Parameters (%) | Albumen | | | Yolk | | |
|---|---|---|---|---|---|---|
| | Rupali duck | Nageswari duck | P-Value | Rupali duck | Nageswari duck | P-Value |
| Moisture | 85 | 85.66 | 0.32 | 44.46 | 43.16 | 0.18 |
| DM | 13.4 | 13.46 | 0.93 | 55.53 | 56.83 | 0.18 |
| CP | 11.68 | 11.35 | 0.65 | 17.20 | 18.12 | 0.24 |
| EE | 0.18 | 0.11 | 0.65 | 10.76 | 14.62 | 0.49 |
| Ash | 1.01 | 0.85 | 0.31 | 2.20 | 2.41 | 0.38 |

DM= Dry matter, CP= Crude protein, EE= Ether extract

Table 5: Selection differential, selection intensity and selection responses in fifth generation ($G^5$) of Rupali and Nageswari ducks

| Genotype | Traits | Before selection | After selection | Selection differential **(S)** | Selection intensity **(i)** | Heritability ($h^2$) | Selection responses **®** |
|---|---|---|---|---|---|---|---|
| Rupali | ASM (d) | 157.23 | 155.66 | -1.57 | -0.12 | 0.4 | -1.63 |
| | EW(g) | 57.96 | 59.16 | 1.20 | 0.32 | 0.5 | 0.60 |
| | BW(g) | 1412.60 | 1452.58 | 39.98 | 0.46 | 0.5 | 19.99 |
| | EP %) | 44.60 | 51.36 | 6.76 | 1.23 | 0.15 | 1.01 |
| Nageswari | ASM(d) | 152.63 | 150.50 | -2.13 | -0.13 | 0.4 | -0.85 |
| | EW(g) | 54.28 | 55.06 | 0.78 | 0.23 | 0.5 | 0.39 |
| | BW(g) | 1346.58 | 1345.78 | -0.80 | -0.01 | 0.5 | -0.40 |
| | EP (%) | 41.75 | 44.86 | 3.11 | 0.45 | 0.15 | 0.47 |

ASM-Age at sexual maturity, BW-Body weight, EW- egg weight, EP-Egg production

Selection differential, selection intensity and selection responses in fifth generation ($G^5$) of Rupali and Nageswari ducks are shown in Table 5. After selection, age at sexual maturity of Rupali and Nageswari ducks were 155.66 and 150.50 days, respectively. The findings of the present study were slightly lower than the result of Khatun and Islam (2010) who reported that foundation stock of Rupali and Nageswari duck came to sexual maturity at 166 and 164 days, respectively. Selection differential of age at sexual maturity, egg weight and egg production for Rupali and Nageswari were -1.57 vs. -2.13; 1.2 vs. 0.78; 6.76 vs. 3.11, respectively. The intensity of selection for ASM, egg weight and egg production were -0.12 vs. -0.13; 0.32 vs. 0.23; 1.23 vs. 0.45 for Rupali and Nageswari duck, respectively. Sarker *et al*., (2018) reported that in fourth generation the intensity of selection for ASM, egg weight and egg production were -0.44 vs. -0.31; 0.32 vs. 0.22; 0.95 vs. 0.44 for Rupali and Nageswari duck, respectively. Heritability for body weight and egg weight was 0.5 and for ASM and egg production were 0.4 and 0.15. As a result of selection, age at sexual maturity was expected to decrease -1.63 day and -0.85 day in Rupali and Nageswari ducks respectively where egg weight was expected to increase by 0.60 g and 0.39g and egg production % was also expected to increase by 1.01% and 0.47% for Rupali and Nageswari ducks respectively.

## Conclusion

These findings revealed that among the native duck genotypes Rupali duck was better in terms of egg weight, egg mass and egg production. But Nageswari genotype was also found reaching maturity earlier than Rupali genotype and this findings give us more attention for continuing the duck breeding research for developing suitable egg type native duck genotypes in Bangladesh.

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