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Research Article

Comparative study on growth and carcass characteristics of three genotypes of duck for establishing a baseline population towards a meat type duck variety

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Abstract

Poultry meat and egg have a major contribution in human nutrition all over the world. Ducks in terms of meat and egg production occupy an important position next to chicken farming in Bangladesh. Present study was conducted to establish a baseline population forwarding a meat type duck variety in Bangladesh. For this novel purpose, day-old ducklings (n=60 each) of commercial three duck breeds Pekin (PK), Deshi Black (DB), and Nageswari (NG) were selected with three replications of 20 birds each were utilized to the study of ten weeks of rearing under intensive management system. All birds were supplied the same feed, vaccine, light, temperature with sufficient clean drinking water. During this period different parameters like their total body weight, body weight gain, feed conversion ratio (FCR), mortality and carcass characteristics were recorded for all the breeds. The results showed that final body weight (BW), Live weight gain (LWG) and carcass parameters are significantly ($p<0.05$) higher in PK compare to DB and NG, with significantly ($p<0.05$) lower FCR and mortality rate comparing with other two breeds. Although there is no significant ($p<0.05$) difference between DB and NG in case of FCR but other parameters like BW and LWG with carcass parameters DB is significantly ($p<0.05$) higher than NG with the inverse result in case of mortality. From this study it may concluded that PK and DB are better than NG in the sense of selection for next generation breeding.

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Introduction

Duck rearing becomes a profitable and demanding business for low laying areas of Bangladesh. The climatic conditions of Bangladesh are suitable for duck farming. For poor and landless people duck rising has become one of the ways of livelihood because of the fact that duck can exploit common natural feed resources. In rural poultry production and economy ducks play a remarkable contribution (Farrell and Stapleton, 1986). It is estimated that approximately 89 % of poor village households rear poultry (Islam et al., 2003). A study reported that about 30 percent of total poultry meat and egg consumption is duck meat and eggs, in our country (Islam el al., 2003).

Duck population has been estimated to be 61.746 million occupying around 17% of the total poultry population in Bangladesh (DLS, 2021). Currently, the prices of meat in terms of beef, mutton or native chicken are going beyond the buying capacity of the poor families. Increased production of duck meat can play a crucial role in solving this problem. Soggy, swampy river side, wet lands and sterile lands are unsuitable for chicken rearing but are suitable for duck rearing (Valavan et al., 2009). The geographic distribution and demographic pattern of duck population in Bangladesh revealed that land ecology has a strong impact on duck production systems (Khanum et al., 2005). Usually, every household keep some ducks in association with chicken throughout the country. Furthermore, in low land water bodies of the country are rich source of duck farming. Duck rearing is one of the promising ways to break out the poverty trap of poor small holder families and also considered as the most important source of income through self-employment for youth and ultra-poor distress rural women. Duck production is considered to be more advantageous over all poultry species, because it requires less care and management. About one-ninth of the total land of Bangladesh are considered low land comprising marshy lands, rivers, ponds, natural water bodies, haors and canals that could be easily utilized for duck rearing. Moreover, ducks are hardy and adapted to local climates and also relatively resistant to diseases (Holderread, 1990). In addition, ducks are excellent foragers and consume natural feed enough to cover most of the nutrient requirements. Furthermore, the scavenging sources and feeds of duck and chicken are different, therefore they are not considered as the competitor of each other for scavenging feeds.

Duck farming can serve a crucial role in low-lying areas of Bangladesh by generating money, nutritional fulfillment, and employment (Islam et al., 2003).

Non descriptive indigenous ducks in Bangladesh produces around 60–80 eggs per year on an average (Rahman et al., 2009). Egg production of Nageswari ducks was 120–150 eggs on an average per year per duck (Islam et al., 2002). In contrast, Deshi black ducks have genetic potential of egg production and it can produce 200 to 230 eggs per duck in a year (Sharma et al., 2003).

Ducks account for 11% of the commercial poultry business the indigenous ducks have been underutilized, and there has been less emphasis on enhancing native ducks through pedigree selection and breeding (Ukil and Islam, 1991). Although Bangladesh is rich in duck genotypes (Pati, Nageswari, Sylhet mete, Desi Black, and Deshi White), due to lack of public and/or private initiatives, the expansion of duck sub-sector is still in sub optimal level. However, there are scantily documented research studies so far that investigated the duck genetic resources, their improvement and conservation. Although there is some research work that has been performed by some researchers, there is still no such research work on the development of meat type duck variety or strain to make this sector profitable leading towards sustainable development of the rural economy. In Bangladesh, about 90 to 95% of the ducks reared by village farmers are non-descriptive type, which are not satisfactory in terms of meat production or growth performance. Moreover, the commercial duck farming is mainly consisted of purebred Pekin and/or Nageswari or Desi Black duck, from which a sustainable broiler duck variety could be possible to develop using a planned breeding program. Considering the above-mentioned facts, the present research has been proposed to focus on establishing a baseline population for systematic duck breeding toward developing a sustainable meat type duck variety.

Material and Methods

Collection of duckling

A total of 180-day old ducklings (60 PK, 60 DB, and 60 NG) were collected from Central duck breeding farm (CDBF), Narayanganj, Bangladesh.

Brooding and management of duck

Brooding was done for 10 weeks. Hover space was provided of 90 sq. cms. per ducklings under the brooder. A temperature of 32℃ was maintained during the first week. It was reduced by about 2℃ per week till it reaches 24℃ during the fifth week. From fifth to tenth week of rearing shed temperature was maintained between 24-26°C with the relative humidity (RH) of 70-75%. During brooding period (1-5th week) commercial starter feed was supplied to the birds in mash form that was containing 2650Kcal/Kg ME (Metabolizable Energy) and 22% CP (Crude Protein) with adlibitum water. The next 5 weeks (6th 10th week) birds were supplied commercial grower feed containing 2780 Kcal/Kg ME and 18.75% CP with the adequate clean drinking water. Nutrient composition of the duck is shown in the Table 1. The shed was cleaned regularly and water in the drinkers was supplied 6 to 7.5 cm (2 to 3") deep just sufficient to drink and not dip themselves. Ducks were routinely vaccinated against duck plague, avian influenza and duck cholera according to vaccination schedule Table 2. Strict bio-security measures and hygienic control were maintained to ensure healthy environment of duck during the experimental period.

Table 1: Nutrient composition of duck at the experiment

Nutirents	Starter (0-5 wks)	Grower (6-10 wks)
ME (Kcal/Kg)	2650	2780
CP%	22	18.75
CF%	5	3.5
Fat%	3	5.15
Ca%	2.75	3.5
Lysine%	0.85	0.7
Phosphorus%	0.5	0.5
Common salt%	0.25	0.25

Table 2: Practiced vaccination schedule in the study

Disease name	Dose of vaccine	Age at first dose (days)	Age at booster dose (days)	Route of vaccine administration
Duck plague	1.0 ml	21	40	Subcutaneous and intramuscular
Avian Influenza	0.5 ml	30	45	Subcutaneous and intramuscular
Duck Cholera	0.5 ml	60	72	Intramuscular

Growth performance measurement

Body weight (BW) was recorded weekly using digital weighing scale (Mega digital scale, Mega regular ACS-CS, Japan Standard).

Feed intake was calculated by reducing the feed offered with the remaining feed, with the following equation:

Feed intake (g) = Feed offered (g) – remaining feed (g).

Feed conversion ratio (FCR) was calculated weekly by the following formula.

FCR= Feed intake (g)/ Body weight gain (g)

Mortality rate calculation

Mortality rate was calculated by the following formula-

No. of birds' death / Total No. of birds in flock × 100

Slaughtering of duck

The slaughtering was done by the Halal method, where "Bismillah" is read and three channels (esophagus, jugular vein, and carotid artery in the neck) are cut off completely by a sharp knife. To ensure that the ducks are not stressed condition during slaughtered, the duck was first rested with fasting from feed for 6 hours but just provided with drinking water, resulted in maximum blood came out and enough energy was available so that the rigor mortis process was complete. The fasting was done to obtain a valid empty body weight because there are no variations due to feed weight and facilitate the slaughter process (Hafid, 2022). During slaughtering complete bleeding is desirable, nevertheless, blood should come out as much as possible. The process of bleeding in poultry usually lasts for 1-2 minutes, depending on the size of the bird being slaughtered.

Removal of Feather

After slaughter and complete bleeding, the feather was removed from the duck's body starting from the neck and pulling down towards the feet until the skin and feathers are completely separated from the body. For the purpose of getting carcasses and meat that is clean from fine feathers, the skin was also peeled following feather removal.

Evisceration

After removing the hair or the fur, the viscera were removed by following process. Removal of the viscera was started with the separation of the crop and trachea along with the oil glands in the tail. Then the body cavity was opened by making an incision from the cloaca towards the sternum. The cloaca and viscera were removed, and then the organs (liver, bile, and heart) were separated. The bile contents were removed and separated from the liver and discarded. Then different parts like head, neck, and legs were also separated.

Carcass percentage and carcass parts

Carcass parts were obtained and measured in the percentage of carcasses and carcass parts after separating the non-carcass parts (offal, skin, feathers, feet, and head). The carcass percentage was obtained by comparing the duck carcass weight with the live weight of duck before slaughter and then multiplying by one hundred percent. The carcass was separated by separating the two wings, both thighs and the neck from the body. The chest was separated at the end of the shoulder blades and the ribs at the back, and the wings were separated at the joint between the wings and the body. All parts of the carcass consisting of two wings, two thighs, one breast and one back were separated; each of them was then weighed and recorded. The percentage of each part of the carcass was compared with the carcass weight and multiplied by one hundred percent (Irham, 2012).

Statistical analysis

All data were analyzed by one-way analysis of variance (ANOVA) followed by LSD posthoc test using IBM SPSS Statistics for Windows, Version 20.0 (IBM, 2011).

Results and Discussion

Final body weight and average weekly body weight gain:

Pekin (PK) ducks had the highest growth performance and body weight throughout the experimental period followed by Desi Black (DB) and Nageswari (NG) attained the lowest live weight among the three genotypes during the postulated time Final body weight of PK is significantly (P<0.05) higher than DB and NG after ten weeks of brooding and rearing as it is shown in Figure 1. Mean final weight of PK, DB and NG was 2007.8± 17.32 gm, 1712.54 ± 16.7gm and 1434.63±16.63 gm respectively.

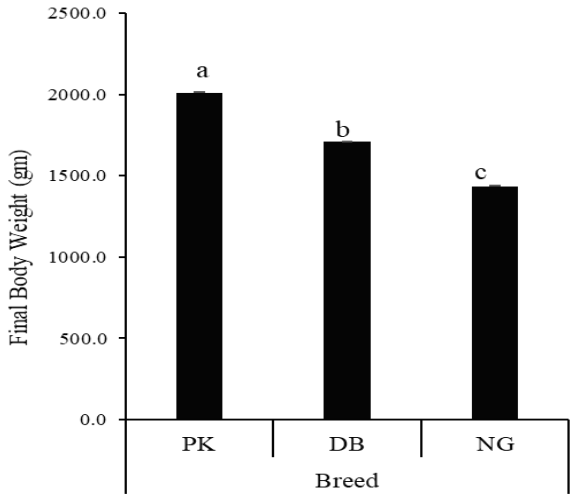

Figure 1: Final Body weight of three genotypes after ten weeks of brooding and rearing. Values are presented as Mean ±SE. Different letters indicating the level of significant difference ((P<0.05).

Average weekly body weight gain of PK is significantly (P<0.05) higher than DB and NG after ten weeks of brooding and rearing as shown in Figure 2. Weekly live weight gain at first week and tenth weeks of age was in PK, DB and NG was 83.24± 3.45gm and 289.8±8.32gm; 68.78±5.95 gm and 244.4±6.25gm; and 60.23± 3.27 gm and 187.12± 12.32gm respectively.

That indicates PK growth faster than desi NG breed.

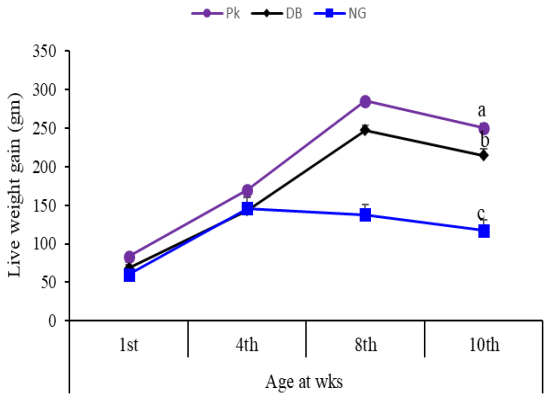

Figure 2: Weekly live weight gain of three genotypes of ducks up to ten weeks of brooding and rearing. Values are presented as Mean ±SE. Different letters indicating the level of significant difference ((P<0.05).

Feed intake and feed conversion ratio (FCR)

Daily feed intake at tenth weeks of age per bird in different breeds are significantly (P<0.05) different as shown in Figure 3. Considering feed intake in daily basis at the tenth weeks of age was 141.69±4.26 gm, 130.34±5.72 gm and 124.45± 7.14gm for PK, DB and NG respectively.

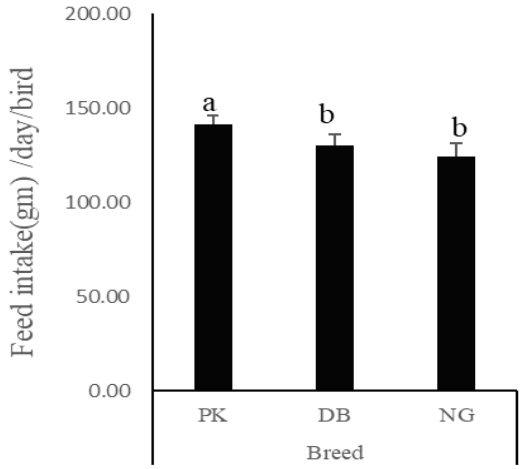

Figure 3: Feed intake of ducks of different breeds gm /bird/day at tenth weeks of age. Values are presented as Mean ±SE. Different letters indicating the level of significant difference ((P<0.05).

Feed conversion ratio is significantly (P<0.05) different between NG and other two breeds showing in Figure 4 but PK and DB are not significantly (P<0.05) different. FCR value for the three breed was 3.42, 3.74 and 4.66 at tenth weeks of age for PK, DB and NG respectively. From the figure it can be easily understand that PK and DB can convert feed into body weight gain efficiently than the NG.

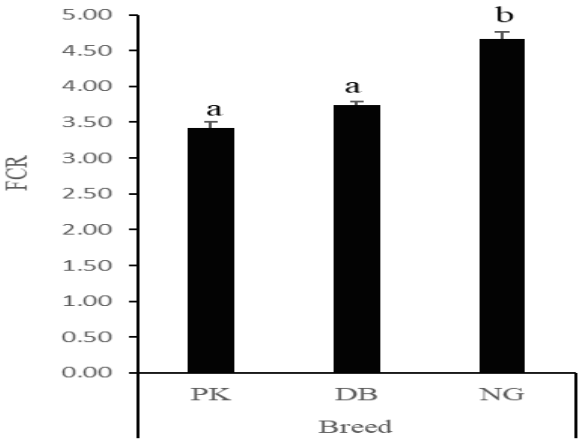

Figure 4: Feed conversion ratio of three genotypes. Values are presented as Mean ±SE. Different letters indicating the level of significant difference ((P<0.05).

Mortality rate

Mortality rate in NG significantly (P<0.05) higher than the PK and DB as shown in Figure 5. The mortality was 10.45%, 17.78% and 32.38% in PK, DB and NG ducks respectively during the total study period.

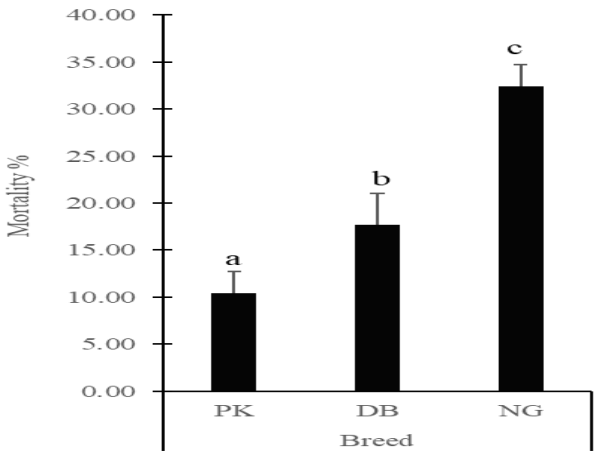

Figure 5: Mortality rate of different duck breeds in experimental period. Values are presented as Mean ±SE. Different letters indicating the level of significant difference ((P<0.05).

Carcass Yield characteristics

Different carcass yield characteristics are shown in the Table-3. All considered parameters were significantly different (P<0.05) except abdominal fat weight, liver weight, heart weight gizzard weight percentage in three genotypes of duck. As final live weight was highest in PK (Figure 1) so the carcass weight and dressing percentage was also significantly (P<0.05) higher in PK compare to DB and NG. In case of breast meat there was no significant (P<0.05) difference among the breeds although PK is highest in breast meat weight. Interestingly, PK and NG are significantly different (P<0.05) in case of thigh meat, but no significant difference between PK and DB. In respect of breast length, width and drumstick weight there is no significant difference (P<0.05) between DB and NG, but PK is significantly different (P<0.05) with these two breeds. In considering wing weight and back weight PK and NG are significantly different (P<0.05) but DB is not significantly different (P<0.05) within these breeds.

Table 3. Different carcass characteristics of three genotypes of duck at ten weeks of age. Values are presented as Mean ±SE. Different superscripts indicating the level of significant difference ((P<0.05)

Carcass characteristics	Breeds of duck		
Parameters	**Pk**	**DB**	**NG**
Final live weight (g)	2007.8±17.02^{a}	1712.54±16.56^{b}	1434.63±16.63^{c}
Carcass weight (g)	1260.29±13.45^{a}	1036.711±10.89^{b}	859.86±9.68^{c}
Dressing (g/100g BW)	62.77±2.31^{a}	60.76±2.45^{b}	59.92±2.62^{b}
Abdominal fat weight (g/100g BW)	1.2±0.24^{a}	0.73±0.31^{a}	0.65±0.95^{a}
Liver weight (g/100g BW)	2.95±1.32^{a}	2.41±1.45^{a}	2.75±2.13^{a}
Heart weight (g/100g BW)	1.35±0.65^{a}	1.03±0.85^{a}	1.30±1.10^{a}
Gizzard weight (g/100g BW)	4.81±1.75^{a}	4.09±2.13^{a}	4.54±2.41^{a}
Breast meat (g/100g BW)	14.22±3.41^{a}	13.37±2.97^{a}	13.10±2.55^{a}
Thigh meat (g/100g BW)	14.42±3.1^{a}	13.78±2.15^{ab}	12.29±2.52^{b}
Breast length (cm)	21.75±1.78^{a}	17.58±2.32^{b}	18.85±2.15^{b}
Breast width (cm)	18.65±2.10^{a}	17.65±2.31^{ab}	15.68±1.95^{b}
Drumstick Weight (g/100g BW)	12.20±3.14^{a}	10.80±2.67^{b}	10.20±2.72^{b}
Wing Weight (g/100g BW)	14.23 ±2.17^{a}	13.40±2.35^{ab}	12.07±2.65^{b}
Back Weight (g/100g BW)	12.20±2.78^{a}	11.00±2.37^{ab}	10.20±2.79^{b}

Discussion

Different studies have reported that during brooding and rearing period the live weight may vary according to experimental period and management practice. A study on different duck genotypes of 12 weeks brooding and rearing reported that the final body weight was for PK and NG was 2038.35±29.74gm and 1542.44±33.61gm respectively at 12 weeks of age (Tanvir Ahmad et al., 2021) which is more or less similar to our present findings.

Another study reported that the mean live weight of Deshi black and Nageswari duck's 12th week of age were 1384.90gm and 1522.10gm respectively (Morduzzaman et al., 2015) which is a little bit different from our present findings. In our study, we found mean live weight 1712.54 gm in DB breed and 1434.63 gm in NG breed after ten weeks of rearing period. This is may be due to lack of flock uniformity and high mortality in NG breed. That indicates PK growth faster than DB and NG breed.

Body weight of birds is one of the prominent traits that breeders consider for genetic improvement program as because this trait can be easily measured (Xu et al. 2011). Body weight can be measured by direct genetic maternal effects (Velleman et al. 2003) along with environmental factors. Development of bird embryo directly related with maternal body weight (Hartmann et al. 2003). Genetic difference of body weight and body composition affect carcass composition (Xu et al. 2011). This suggests the possibility of PK may be strategically bred to favor meat type traits.

In case of FCR, information on feed consumption and conversion efficiency particularly in ducks is very scanty. However, our present finding in case of PK (3.42) is similar to the findings of Sankaralingam et al., 2023 who found the FCR value in Pekin duck was 3.68 at eight weeks of age of rearing. FCR value of present finding in NG duck (4.66) very similar to another report (4.63) described on the performance of Nageswari duck (Bhuiyan et al., 2017).

Mortality rate is very crucial in brooding period and primarily depends on the immune status of the flock and careful management practices. As management and weather varies from region to region and farmer to farmer so it is difficult to compare across flocks under different management practices. However, average mortality rate of our present study in case PK breed is 10.45% which is lower than another study reported 15% mortality in Pekin duck (Sankaralingam et al., 2023). We found 17.78% mortality in DB which is lower than Islam et al., 2012 they found 30% mortality in coastal region. In case of NG breed, we found 32.38% mortality which is much higher than Sharma et al., 2003 they reported about 10% mortality in Nageswari breed in Assam of India. The embryonic mortality was 35.81%, for BLRI-2 duck (Islam et al. 2014) which is similar to our present study of NG brooding. Hocking (2009) reported that egg quality, sanitary condition, storage condition, incubator quality and gas exchanges (O2 and CO2) are the vital factors for embryonic mortality of duck eggs. This huge difference in mortality maybe due to egg quality, hatchery operation during incubation and feed competition and dissimilarities in flock uniformity. In NG some birds grown very quickly and most of the time they occupy the feeding tray. The small groups were provided in different feeding tray but they cannot recover the gap in early stage. Although ducks were given vaccination as per schedule but mortality was examined due to duck cholera, which may be caused by vaccination failure and other environmental factors.

Pekin is the duck breed which is preferable for meat production and the main target of breeder to use this breed in a breeding program is to improve early growth and body weight ultimately increase the meatiness (Kokoszynski and Bernacki, 2011; Xie et al., 2014). Three Research on lines of Pekin ducks revealed that preslaughter live weight, carcass characteristics like breast muscle weight, neck weight, and liver weight and gizzard weight was significantly higher care to other lines (Kokoszyński et al. 2019). Similarly, another tudy reported that Pekin crossbred ducks had higher growth rate and meat yield characteristics like breast meat weight, leg meat yield and other region meat yield in carcass at 8 weeks age (Padhi and Sahoo, 2012; Górska et al., 2014) that support our present findings.

Conclusion

In this study, growth performance, live weight gain, feed conversion ratio, mortality and carcass characteristics of three duck genotypes is reported for selecting the best baseline population for next generation breeding for meat type duck variety. According to findings of the present study it is very clear in all aspect Pekin is the best breed. Along with the Pekin, Desi black (DB) can be considered for the next generation breeding as it ranks second in this study is respect of growth parameters, mortality rate, and carcass parameters. Considering the parameters studied in all three genotypes (PK, DB, NG) it can be recommended that PK and DB should be kept for next generation as parent stock to produce the hybrid by crossing between them as their growth parameter is better than NG and mortality rate is less.

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Conflict of interest

There is no conflict of interest among the authors regarding this study and publication.

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