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Research Article

Meat yield characteristics and physicochemical properties of different duck genotypes

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Abstract

This work was conducted to investigate the meat yield characteristics and physicochemical properties of Pekin (P), Nageswari (N) and two reciprocal F_1 crossbred P♂× N♀ and N♂× P♀. For this purpose 16 ducks (8 male and 8 female) of 4 duck genotypes were randomly selected from Animal Breeding and Genetics farm of BAU at their average weight. The average live weights of P, N, P♂ × N♀ and N♂ × P♀ genotypes at 12th week of age were 2370.00±70g, 1823.33±154.52g, 1896.67±105.25g and 1823.33±14.53g respectively. In case of live weight, Pekin duck showed significantly higher body weight compare to other genotype. However, no significantly difference were found in Nageswari and their crosses (p<0.05). Dressing (%) in Pekin, Nageswari, and the F_1 crossbreds P♂× N♀, N♂×P♀ were 68.81±1.05, 69.01±1.38, 71.13±1.20 and 69.11±0.55%, respectively with no significant difference in dressing percentage among the genotypes. Similarly, breast weight, leg weight, shank weight, head weight, wing weight, liver weights and gizzard weight did not show significant differences among the four genotypes. The pH level of four genotypes at 15 minute, 1 hour, 6 hour and 24 hour of post-mortem was observed for breast and leg meat. No significant differences were found in pH level of breast and leg meat at different post-mortem time. Cooking loss and drip loss of breast and leg meat also showed similar results with no significant differences among the genotypes. Proximate composition of breast and leg meat also did not show significant differences among the genotypes. In conclusion, the present result shows that genotype had no role in variation of duck meat.

Introduction

Duck is a waterfowl and has a different physiology to that of other poultry. Duck meat is very popular and has a high demand in many part of the world, particularly in Asia **(**Ali et al., 2007). Duck has been one of the most expensive commercially available meat types breed (Martin et al., 2007). Although duck is very popular in many part of the world, duck processing does not get enough attention by researchers. As a result duck meat and meat product does not become popular among the consumers. But now a day, among the meat and meat product, duck has took preference by the researchers. Duck meats like leg and breast which gives more choice to the health conscious people (Ali et al., 2007).

According to FAO data, the world production of duck meat was 4,460,226 ton in 2017 (Kokoszyński et al., 2019). Duck meat production accounted for 3.7% of the total poultry meat production, ranking third after chicken and turkey meat production. China is the largest duck meat producer in the world, which provided 68.8% (3,067,219 ton) of global duck meat production. Asia contributed about 84.2% (3,754,420 ton) of the global duck meat production (Kokoszynski et al., 2019). Asia also has the highest increase of total and of per capita duck meat by 308% and 244%, respectively. Ducks produce almost 10% of poultry meat in Asia compared with 4.1% in the world (Sumarmono, 2019).

The total number of poultry population of Bangladesh is 356.32 million. Among the poultry, the amount of ducks is 59.72 million in number (DLS, 2019). Duck has considered as the second most popular poultry species next to chicken in Bangladesh. Duck is a promising species of poultry in Bangladesh. Duck meat is one of the most commonly consumed meats in the world as well as in Bangladesh, similar to the chicken meat. Although duck meat is very famous in Bangladesh, duck meat processing does not get enough concern by researchers. A little bit works has been done on duck meat in Bangladesh but it is not good enough.

Therefore, it was aimed to produce a duck crossbred suitable for small scale farmer's level by crossing meat producing exotic breed Pekin and local native breed Nageswari in the previous experiment. The present study was conducted to compare meat yield characteristics and physicochemical properties of meat of Pekin, Nageswari and their reciprocal crossbreds P♂× N♀ and N♂× P♀.

Materials and Methods

Carcass characteristics

A total of 16 birds of 4 duck genotypes were selected for slaughter from the project entitled "Development of meat-type duck through reciprocal crossing suitable for semi-scavenging system in Bangladesh". Feed was withdrawn 12 h before slaughter, and the birds were allowed free access to water. The ducks selected for the dissection were slaughtered, de-feathered and eviscerated at the farm of the Department of Animal Breeding and Genetics department, Bangladesh Agricultural University, Mymensingh. All the ducks selected for the dissection were manually slaughtered and slaughter was done by cutting their jugular veins with the help of a sharp knife. The slaughtered birds were allowed to bleed completely and subsequently scalding was done by following right procedure. During evisceration, the digestive tract and other internal organs were dispelled from body cavity. Then the carcasses were weighed with the help of electronic balance. After that, carcasses were kept in a plastic box with ice and brought to the Poultry Science laboratory of Bangladesh Agricultural University where they were stored in a cold storage room at 2 to 4°C.

Next, the whole eviscerated carcasses were dissected into different parts like; neck without skin, wings with skin, breast muscles (pectoralis major muscle), leg muscles (all thigh and drumstick muscles), skin with subcutaneous fat from the whole carcass, wings with skin, and the remainder of the carcass. The dissected carcass components were weighed accurately using digital weighing balance. After removing the breast and leg meat from the carcasses the pH, cooking loss, drip loss and chemical composition were measured as described below.

Physicochemical Properties of duck meat

pH measurement

In this study, the pH was taken from the selected duck at pre-rigor mortis (15 min) rigor mortis (1 hour, 6 hours) and post-rigor mortis (24 hours) period**.** After 15 minutes of slaughter, the pH of breast muscles (pectoralis major muscle) and leg muscles (drumstick muscle) was measured with the help of an automatic pH meter (model 210, HANNA). The carcasses were stored at 4°C for 24 hours. Again, after 60 minutes of slaughter, the pH of breast muscles and leg muscles was measured carefully. Frequently, after 6 hours and 24 hours of slaughter, the pH of breast muscles and leg muscles was measured following same procedures. Before measure the pH, each time the pH meter was calibrated with standard pH buffers (4.0 and 7.0 at 25°C) and adjusted to the meat temperature (4°C). After the dissection, the breast and leg muscles were individually sampled from each carcass to evaluate proximate analysis, to measure drip loss and cooking loss. The fundamental chemical composition of the breast and leg muscles from the ducks of the compared genetic groups was measured using standard methods (AOAC, 2007) at the Laboratory of Animal Science Department, Bangladesh Agricultural University, Mymensingh. The amount of crude protein, dry matter, ether extract and ash was calculated according to the standard methods.

Cooking loss

To evaluate the cooking loss of the breast and leg meat samples weighing 20±2 g. This sample was put in a polythene bag and placed in a water bath at 80°C for 30 minutes. After that the sample was removed from the water bath and chilled for 30 min in a room temperature (Ali et al., 2007). Cooking loss was calculated by expressing cooked sample weight as a percentage of precooked samples weight following the procedure of Yang et al. (2007).

$$\text{Cooking Loss (\%)} = \frac{(\text{Weight before cooking of sample} - \text{weight after cooking})}{\text{Weight before cooking of sample}} \times 100$$

Drip loss

Drip loss was determined on the samples of breast (pectoralis major muscle) and leg (thigh and drumstick) muscles 20±2 g sample was weighed with the help of digital weighing balance and placed separately in a pot to allow meat juice to drain out. To prevent contact between the draining juice and the meat sample, special care has been taken during placing the sample into the pot. The samples were then kept in a refrigerator and stored at 4°C for 24 hours. After that time, the meat samples were reweighed. Drip loss was calculated from the difference in weight before and after chilling and expressed in percent.

$$\text{Drip loss (\%)} = \frac{(\text{Initial wt} - \text{chilled wt})}{\text{Initial wt}} \times 100$$

Proximate composition of duck meat

Three samples from each meat type were analyzed for Dry mater, protein, fat and ash by the standard procedures of AOAC (2007).

Crude protein determination

The protein content of the samples was measured by the micro kjheldhahl methods (AOAC, 2007). 20±2 g of meat sample was weight accurately into a micro kjheldhahl flask, 200 mg of catalyst mixture and 3.5 ml conc. Sulphuric acid were added, the meat sample were heated on an heater for about 2 hours until the digestion was completed. After that, the sample was cooled and placed in a distillation apparatus. 20 ml of 40% NaOH were added and the resulted ammonia was received in 10 ml of 2% boric acid solution. The trapped ammonia was titrated against HCl (0.02N) using universal indicator (methyl red + bromo cresol green), the total nitrogen and protein were calculated by using the following formula.

$$N\% = \frac{(\text{volume of HCl} \times N \times 14 \times 100)}{\text{sample weight} \times 1000}$$

CP%= N%×6.25

Here,

CP%= Crude Protein

N%= Crude Nitrogen

N= Normality of HCl

14= Equivalent weight of nitrogen.

Ether extract determination

Ether extract content of the sample was measured by Soxhlet apparatus using diethyl ether. At first flask weight was taken with a digital electric balance. 5 g of meat sample was taken in a thimble and added 200 ml acetone in the Soxhlet. Extraction was completed at 40-50°C within 7-8 hours. After that the flask was removed and dried in oven at 100°C for 30 minutes. The flask containing ether extract was then cooled in a desiccator and then weighed with digital electric balance. The obtained value for ether extract content was expressed in percent. The ether extract content was calculated by using the following formula.

$$\%\text{ of Ether Extract} = \frac{(\text{weight of the ether extract})}{\text{weight of the meat sample}} \times 100$$

Ash determination

Weighed (5g) meat samples were taken in porcelain crucibles and pre-ashed at 100°C in an electric oven. The crucible were then kept in muffle furnace and heated at 550°C for 6 hours. After that the crucible were then cooled in desiccators. The average weight in percentage of each sample of the remaining material was taken as Ash. The following formula was used to calculate ash percentage.

$$\text{Ash\%} = \frac{(W1 - W2) \times 100}{\text{sample weight}}$$

Here,

W_1= Weight of the crucible with ash

W_2= Weight of the empty crucible

Statistical analysis

In this experiment the data were analyzed by the analysis of variance of Completely Randomized Design procedure of Statistical Analysis Systems Institute (SAS) and a Duncan's procedure was used to measure the significant differences between means at a 5% level of significance (SAS, 2002).

Results and Discussion

Proximate composition, pH measurement and cooking loss of duck meat

To conduct this experiment 16 ducks of average body weight were selected randomly from slaughter from the project entitled "Development of meat-type duck through reciprocal crossing suitable for semi-scavenging system in Bangladesh". The meat yield characteristics of Pekin, Nageswari, Pekin ♂ × Nageswari ♀ and Nageswari ♂ × Pekin ♀ meat-type ducks at marketing age (12th weeks) are observed. In this experiment several meat yield characteristics like; live weigh, carcass weight, dressing, breast weight, leg weight, heart weight, liver weight, wing weight, shank weight, gizzard weight, head weight etc. were investigated. Meat yield traits were turned into percentage of individual live weight prior to analyzing the data statistically.

Meat yield characteristics

This experiment was conducted to evaluate the meat yield traits and different physio-chemical characteristics of Pekin, Nageswari, Pekin ♂ × Nageswari ♀ and Nageswari ♂ × Pekin ♀ meat-type ducks crossbred. The data obtained from this experiment are presented in Table 1.

Table 1. Meat yield characteristics of Pekin, Nageswari and their reciprocal crossbreds

Parameter	Pekin (P) [n=4]	Nageswari (N) [n=4]	P ♂ × N ♀ [n=4]	N ♂ × P ♀ [n=4]	Level of significance
Live weight (g)	2370.00^{a}±70.0	1823.33^{b}±154.52	1896.67^{b}±105.25	1823.33^{b}±14.53	0.01
Dressing %	68.81±1.05	69.01±1.38	71.13±1.20	69.11±0.55	0.45
Breast weight (%)	10.82±0.28	10.62±0.31	11.05±0.51	9.85±0.86	0.47
Leg weight (%)	10.33±0.47	9.11±0.23	9.84±0.18	9.57±0.33	0.14
Wing weight (%)	4.65±0.41	4.26±0.08	4.54±0.14	4.30±0.06	0.57
Head weight (%)	5.32±0.20	5.49±0.27	5.83±0.45	5.17±0.02	0.43
Shank weight (%)	2.37±0.06	2.29±0.14	2.65±0.29	2.49±0.06	0.50
Liver weight (%)	3.26±0.39	2.46±0.60	2.01±0.41	2.04±0.33	0.24
Heart weight (%)	0.79±0.09	1.03±0.12	1.03±0.28	0.77±0.01	0.54
Gizzard weight (%)	2.72±0.20	2.96±0.51	2.89±0.34	3.05±0.07	0.90

The data obtained from this experiment indicate that there was no significant variation among 4 ducks genotype except live weight. In case of live weight significantly higher body weight was found in Pekin while no significant differences ($p<0.05$) were found in Nageswari and their crosses. Among the 4 genotypes, other parameters like; dressing percentage, breast weight, leg weight, wing weight, head weight, shank weight, liver weight, heart weight, gizzard weight did not show any significant difference ($p<0.05$). Padhi (2010) conducted a study on production benefits of the crossbreeding of indigenous and exotic ducks growing and laying period body weight and production performance. They recorded the body weight of different crossbred indigenous duck × White Pekin, Khaki Campbell × White Pekin, Khaki Campbell × indigenous duck were 1.96± 36.36, 2.25±81.45, 1.45±17.46 kg respectively at marketing age (12 weeks).

Ahmad et al. (2021) trailed an experiment to investigate the morphological features, growth and meat yield performance of Pekin (P), Nageswari (N) and their reciprocal F1 crossbreds. They reported that the dressing % was non-significant among the three genotypes (Pekin, P♂ × N♀ and N♂× P♀) but differed significantly with Nageswari duck. Kokoszynski et al. (2020) conducted an experiment with Pekin ducks of French origin, crosses of wild mallard and Pekin duck, crosses of Khaki Campbell drakes and Orpington Fauve ducks. The average carcass weight of 110-week-old Pekin ducks (French origin) males and females was significantly ($p<0.05$) higher than that of crosses of wild mallard and Pekin duck crosses of Khaki Campbell drakes and Orpington Fauve ducks. The females, crosses of Khaki Campbell drakes and Orpington Fauve ducks had significantly heavier carcasses than crosses of wild mallard and Pekin duck females. They observed significant differences ($p<0.05$) in the carcass weight between males and females of Khaki Campbell drakes and Orpington Fauve ducks. Islam et al. (2002) conducted a study to determine the meat yield characteristics of Khaki Campbell, Jinding and Deshi duck in maritime area. They reported that after 150 days reared, the dressing percentage of Khaki Campbell, Jinding, Deshi were 60.14, 58.95, 57.07 percent respectively. Kwon et al. (2014) reported that the breast weight of Korean native duck was significantly higher than that from commercial meat-type ducks ($p<0.05$). The carcass yields of Korean native duck and commercial meat-type ducks were 70.0% and 67.5%, respectively. The breast meat is one of the primal cut of high economic value (Omojola, 2007). Powell (1985) reported that at comparable age, males tended to have less proportion of breast meat than females. Omozola et al. (2004) conducted a research to investigate different meat yield characteristics among Pekin, Muscovy and Rouen duck. Steklenev (1990) showed that the live weight for the Pekin and Muscovy at slaughter at 8-10 weeks were 2.93 and 2.29 kg respectively. The average live weight, dry shell weight without giblet (WOG), and raw breast weights were significantly higher ($p<.01$) for duckling than for chicken (Smith and Fletcher, 1992).

pH measurement

The pH of meat is a measurement of acidity. The pH of meat can range from 5.2 to 7.0. The highest quality products tend to fall in the pH range of 5.7 to 6.0. In this study, the pH was taken from the selected duck at pre-rigor mortis (15 min), on rigor mortis (1 hour), late hour of rigor mortis (6 hour) and post- rigor mortis (24 hours) period. The observed pH among the 4 duck genotypes are presented in Table 2. Fernandez et al. (2002) stated that the rate and range of postmortem pH decline are very important factors affecting meat quality. A fast pH fall may induce protein denaturation, resulting in decreased tenderness and juiciness and less intense (or pale) muscle coloration. The pH value for breast meat stored 4°C was 6.55, 6.44, 6.53 and 6.46 at 15 min postmortem while the pH of leg meats were 6.37, 6.46, 6.51 and 6.60. At 60 min postmortem pH values of breast meat were 6.21, 6.08, 6.12 and 6.09 at the same time the leg pH were 6.15, 6.42, 6.12 and 6.62. At 6 hour postmortem pH of breast and leg meat were 5.88, 5.91, 5.84, 5.94 and 5.77, 5.84, 5.89 and 6.05 respectively. The rate of pH collapse was high during the first 6 hour postmortem for meat, whereas, from 6 to 24 hours postmortem only a slight change was observed. This result is similar to that of Lesiak et al. (1996) who reported that the rate of pH decline was high during the first hour postmortem for all temperatures (0, 12, and 30°C) and a slight decline in pH from 6 to 24 hours postmortem.

From the obtained data we did not observed any significant variation in pH level of breast and leg meat of Pekin, Nageswari and their reciprocal crosses ($p>0.05$). Ali et al. (2007) reported that no significant differences ($p>0.05$) were found in pH between the two species of broilers (Ross) and ducklings (Cherry berry) at the same post-mortem time which is same to our results. Mazanowski et al. (2003) noted the average pH at 24 h post-mortem was 6.0 and 6.4 in meat from A44 and A55 strains of ducks. Smith and Fletcher (1992) found a different pH of duck and chicken breast muscle at 30 min, 1 h and 4 h post-mortem, but pH at 24 hours was similar. The pH of duck meat is in the range from 5.4 to 6.3 (Erisir et al., 2009).

Table 2. pH of breast and leg meat Pekin, Nageswari and their reciprocal crossbreds

Parameter	Storage time	Pekin (P) [n=4]	Nageswari (N) [n=4]	P ♂ × N ♀ [n=4]	N ♂ × P ♀ [n=4]	Level of significance
Breast	pH at 15 min	6.55±0.07	6.44±0.09	6.43±0.06	6.46±0.04	0.60
	pH at 1 hrs	6.21±0.15	6.08±0.07	6.12±0.14	6.09±0.12	0.90
	pH at 6 hrs	5.88±0.05	5.91±0.05	5.84±0.01	5.88±0.06	0.77
	pH at 24 hrs	5.93±0.06	5.81±0.06	5.90±0.43	5.87±0.02	0.80
Leg	pH at 15 min	6.37±0.15	6.46±0.20	6.51±0.11	6.60±0.09	0.73
	pH at 1 hrs	6.15±0.17	6.43±0.28	6.12±0.04	6.62±0.04	0.60
	pH at 6 hrs	5.77±0.05	5.84±0.11	5.89±0.04	6.05±0.08	0.14
	pH at 24 hrs	5.95±0.08	5.92±0.13	6.04±0.05	6.06±0.6	0.60

Values are means±SD of 3 replicates of 4 birds each.
Means with different superscripts in the same column differ significantly ($p<0.05$)

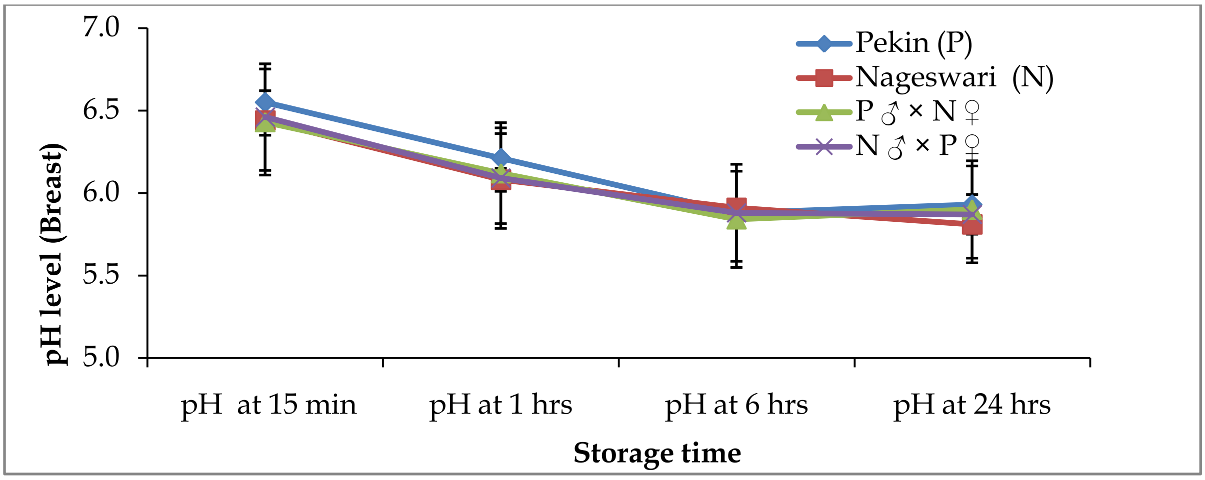

Figure 1. Pattern of pH decline of breast meat during 24 hours postmortem from Pekin, Nageswari and their reciprocal crossbreds

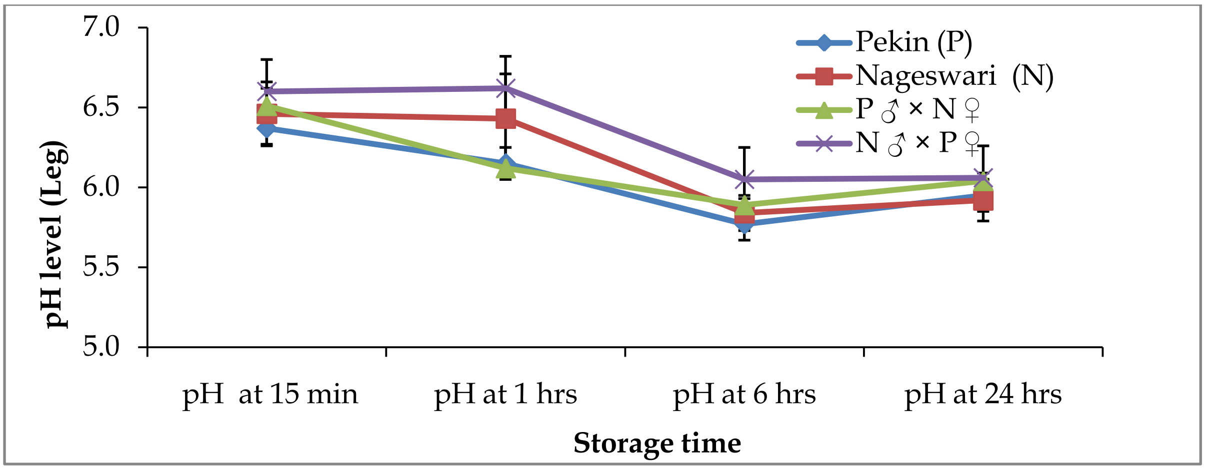

Figure 2. Pattern of pH decline of leg meat during 24 hours postmortem from Pekin, Nageswari and their reciprocal crossbreds

Cooking loss

The data of cooking loss of breast and leg meat is presented in Table 3. To measure cooking loss 20±2 g of breast and leg meat was taken from 4 genotypes of duck. The data obtained from this experiment indicated that there was no significant difference (p>0.05) in cooking and drip loss among the 4 genotypes of duck.

Ali et al. (2007) who performed a study and observed that the cooking loss of breast meat from commercial meat-type ducks ranged from 34.5% to 35.6%. Cooking loss (%) was higher in duck breast compared to chicken breast during the whole storage time. Storage conditions are the most vital factor in meat physical characteristics. Muhlisin et al. (2013) also reported that they did not found any significant difference in cooking loss of breast meats between Korean native duck and commercial meat-type ducks, which agreed with this study. Alvarado and Sams (2000) found higher cooking loss in duck breast compared to chicken breast at different post-mortem deboning times. Joseph et al. (1992) stated that duck muscles have comparatively lower water holding capacity than chicken muscles, resulting in greater cooking loss and less emulsion stability. Biswas et al. (2006) also found lower cooking yield in duck meat patties compared to broiler and spent hen meat patties. Lower homogenate cooking yields were observed for turkey breast muscle held at 30°C post-mortem, whereas 0 and 12°C minimized water losses (Lesiak et al., 1996). Qiao et al. (2017) who found that the cooking loss of the breast and leg muscles of spent layer ducks aged 500 days to be lower than in the meat of 38-day-old Cherry Valley ducks and 70-day-old hybrids of Cherry Valley and Chinese native duck. Choi et al. (2016) demonstrated a study to observe the effects of postmortem temperature on the physicochemical characteristics of pre-rigor Pekin duck breast muscles. In this study, they found that cooking loss at 15 min after slaughter was 17.0%. As storage periods increased, cooking loss in meat stored at each temperature significantly increased for 2 hours but was not significantly different thereafter. Also, storage temperature does not affect cooking loss in duck breast muscle. Geesink et al. (2000) observed that cooking loss in longissimus muscle of lamb was not affected by initial temperature treatment (16 h, 5 to 35°C). McKee and Samsal (1998) found that a postmortem storage temperature of 40°C increased the cooking loss in turkey breast fillets compared to 0°C treatment. Heo et al. (2015) found significantly higher cooking loss in BA (B strain (♀) × A strain (♂) than in AA (A strain (♀) × A strain (♂), AB, A strain (♀) × B strain (♂); BB, B strain (♀) × B strain (♂) hybrids of Korean native ducks. Again, Onk et al. (2019) expressed higher cooking loss in pectoralis major muscle from native ducks than in the same muscle from Pekin ducks. Chartrin et al. (2006) found significantly higher cooking loss of breast muscle from Pekin ducks compared to Mule, Muscovy and Hinny ducks. Wołoszyn et al. (2011) found significantly higher cooking loss in breast muscles of Khaki Campbell ducks compared to Pekin and Mini Duck (hybrid of wild mallard duck and Pekin duck). Cooking losses were significantly correlated with lipid and water levels and breast muscle weight (+0.54, −0.31, and −0.43, respectively), (Chartrin et al., 2006). The amount of cooking loss during heat treatment of breast muscles of Pekin-44 outdoor system ducks was significantly higher ($p<0.05$) then in Pekin-44 indoor system.

Drip loss

To measure drip loss 20±2 g of breast and leg meat was taken from 4 genotypes of duck. The data obtained from this experiment indicated that there was no significant difference ($p>0.05$) in drip loss among the 4 genotypes of duck. The data found from the experiment are presented in table 3.

Drip loss is a process normally involving the transfer of water from myofibrils to extracellular space; it is attacted by structural features at different levels within the muscle tissue (Bertram et al., 2002). Drip loss is related to a contraction of postmortem muscle and deterioration of muscle proteins (Kristensen and Purslowal, 2001; Melody et al., 2004). The leg muscles of Pekin ducks of French origin and crosses of Khaki Campbell drakes and Orpington fauve males ducks were characterized by higher ($p<0.05$) drip loss compared with the leg muscles of crosses of wild mallard and Pekin ducks males. The drip loss of leg muscles from Pekin ducks of French origin females was higher than that of crosses of wild mallard and Pekin ducks and crosses of Khaki Campbell drakes and Orpington fauve ducks muscles. In the leg muscles of crosses of wild mallard and Pekin ducks males, drip loss was significantly lower than in the female muscles from this group (Kokoszynski et al., 2020). Honikel et al. (1986) reported that while chilling excised red bovine muscle (M. sternomandibularis) and red porcine (M. cleiddooccipitalis) between -2°C to +38°C the drip loss of both muscle types increased linearly with increasing pre-rigor shortening. Northcutt et al. (1994) also stated that chicken meat expounded to high temperature (40 to 41°C) lost significant amounts of drip during the processing period. Greater drip loss was observed for turkey breast muscle held at 30°C post-mortem, whereas 0°C and 12°C minimized water losses (Lesiak et al., 1996). Qiao et al. (2017) found the cooking loss and drip loss (%) of the breast and leg muscles of spent layer ducks aged 500 days to be lower than in the meat of 38-day-old Cherry Valley ducks and 70-day-old hybrids of Cherry Valley and Chinese native duck. This was probably associated with the lower water content of the meat from the older birds (Boni et al., 2010).

Table 3. Cocking loss and drip loss of breast and leg meat from Pekin, Nageswari and their reciprocal crossbreds

	Parameter	Pekin (P) [n=4]	Nageswari (N) [n=4]	P♂ × N♀ [n=4]	N♂ × P♀ [n=4]	Level of significance
Breast	Cocking loss	29.81±1.36	24.80±2.79	26.36±1.39	28.85±0.85	0.24
	Drip loss	1.64±0.16	1.76±0.43	1.83±0.19	1.61±0.26	0.84
Leg	Cocking loss	30.47±2.58	28.43±1.88	27.32±1.32	29.12±0.47	0.65
	Drip loss	1.80±0.23	2.43±0.65	1.97±0.12	1.52±0.08	0.38

Proximate composition of Breast and leg meat of Pekin, Nageswari and their reciprocal crossbreds

In this experiment meat sample were analyzed to estimate the proximate composition of the 4 genotypes of duck. The proximate compositions of duck meat like; dry matter, crude protein, ether extract and ash are presented in Table 4. From this experiment, no significant difference was found in proximate compositions among the 4 genotypes of duck.

Although, no significant differences ($p>0.05$) in dry matter content were found among the 4 genotypes duck meat, the value was higher in pekin♂ × **N**ageswari♀ duck meat in this study. The range of overall observed DM content among the treatments was 26.07 to 27.51 percent in breast meat and 26.68 to 28.13 percent in leg meat.

Table 4. Proximate composition of Breast and leg meat of Pekin, Nageswari and their reciprocal crossbreds

	Parameter	Pekin (P) [n=4]	Nageswari (N) [n=4]	P♂ × N♀ [n=4]	N♂ × P♀ [n=4]	Level of significance
Breast	DM (%)	26.07±0.28	27.25±0.43	27.51±1.21	26.85±0.19	0.32
	CP (%)	15.92±1.24	18.26±1.80	16.74±1.02	16.43±0.34	0.59
	EE (%)	1.67±0.04	2.47±0.22	2.72±0.16	2.30±0.43	0.09
	Ash (%)	1.81±0.15	1.78±0.29	1.65±0.12	1.33±0.03	0.27
Leg	DM (%)	26.68±0.94	28.13±1.30	27.58±1.45	27.07±1.28	0.86
	CP (%)	15.87±0.82	19.07±0.86	18.49±1.34	17.38±1.22	0.24
	EE (%)	1.98±0.33	2.85±0.28	2.43±0.15	2.94±0.96	0.59
	Ash (%)	1.35±0.04	1.42±0.28	1.31±0.16	1.31±0.16	0.74

From the data of proximate composition analysis, we did not found any significant difference in CP content among the 4 genotypes of duck. Although no significant difference was found among the four genotypes of duck but Nageswari duck show higher CP content than others. Ali et al. (2007) reported that crude protein content were significantly higher in chicken breast than duck breast ($p<0.05$).

Muhlisin et al. (2013) found significantly higher protein content in the breast muscles of Korean native ducks than in imported commercial ducks ($p<0.05$). Heo et al. (2015) noted that in two-strain hybrids (AA, AB, BB, BA) of Korean native duck found no significant differences in the protein content of breast muscles ($p<0.05$). Hong et al. (2014) found significantly higher protein content in breast muscles of strain B compared to strain A of Korean native ducks aged 49 d as well as no significant differences in the amount of protein in breast muscles of ducks aged 42 and 56 d**.** The protein content of duck breasts and legs are 20.8 and 19.6%, respectively (Cobos et al., 2000), which is lower than levels in chicken (Jaturasitha et al., 2008) and turkey meat (Maruyama et al., 1996). Kokoszynski et al. (2020) the compared ducks of different genotypes had a high content of CP in breast and leg muscles. Higher CP content was measured in breast than in leg muscles. Smith et al. (1993) stated that duckling breast meat contained lower protein than chicken breast meat.

The range of overall observed ether extract (EE) content among the treatments was 1.67 to 2.72 percent in breast meat and 1.98 to 2.94 percent in leg meat. Observation from the data, the mean value indicated that there were no significant differences of EE content among the 4 genotypes of duck. Ali et al. (2007) described that fat content was significantly higher in duck breast than chicken breast meat ($p<0.05$). Mazanowski et al. (2003) and Ali et al. (2007) reported that the fat content in duck breast meat was 1.7%. Ismoyowati and Sumarmonoal (2019) conduct a research and reported that fat content in duck meat is higher than that of chicken, and turkey i.e. 1-2% on average. Kokoszynski et al. (2020) trailed a research and reported that carcasses from native ducks that are more than eight weeks old are distinguished by a relatively high amount of breast muscles (14.0 - 18.4%) and leg muscles (11.2 - 12.4%). Ismoyowati and Sumarmono (2019) noted the meat of the Muscovy duck contains less fat than any other breed. Peking duck and Muscovy have different intramuscular fat in different major pectoralis muscle (2.3% vs. 4.6%). Smith et al. (1993) stated that duckling breast meat contained significantly more moisture and lipid, but lower protein, ash and calories than chicken breast meat. Szasz and Bogenfurst (1998) reported that the fat percentage of pekin ducks was 20 at 12 weeks of age the Pekin ducks in which was better than Muscovy ducks.

Results of this experiment showed no significant effect ($p>0.05$) on ash content. Ali et al. (2007) found that ash content were significantly higher in chicken breast meat than duck breast meat. Smith et al. (1993) stated that duckling breast meat contained significantly lower ash than chicken breast meat. Ismoyowati and Sumarmono (2019) carried an experiment with broiler, duck, turkey and quail species to investigate different parameters. They reported that ducks meat contained significantly higher ash than broiler, turkey and quail species.

Huda et al. (2011) conducted an experiment to calculate the proximate and physicochemical properties of Pekin and Muscovy duck breasts and thighs for further processing. They stated that, the protein content of Muscovy duck breast was higher than that of thigh. The fat content of Muscovy duck thigh was higher than that of breast meat. Between the two species they observed that the moisture and ash content of Peking duck were higher than those of Muscovy duck while the protein and fat content of Peking duck were lower than in Muscovy duck when compared to ostrich and chicken, the protein content was lower but the moisture of both Peking and Muscovy duck meat was higher. The fat content of breast and thigh meat of Peking and Muscovy was higher than that of chicken and ostrich while the ash content of these ducks was lower than in chicken but only Muscovy ducks showed lower ash content compared to ostrich. Duck meat has higher fat content than chicken and turkey meat (Smith et al., 1993; Baéza, 2006; Witak, 2008).

Conclusions

Meat yield characteristics and physicochemical properties of Pekin (P), Nageswari (N) and two reciprocal F_1 crossbred P♂× N♀ and N♂× P♀ did not differ significantly.

Conflicts of Interest

The authors declare that there are no potential conflicts of interests.

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