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Carcass traits, blood parameters and meat composition of quail and pigeon available in Bangladesh

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Abstract

Common poultry birds like chicken, duck, quail and pigeon meat is gaining interest due to their genetic potentiality and management factors as well as special characters of their meat and egg. With a view to considers consumers demand, promising alternative bird farming and meat quality research, an attempt was undertaken to conduct a preliminary study to compare carcass characteristics, blood parameter, intestinal microbiology and meat composition of quail and pigeon of Bangladesh. The result revealed that, carcass traits, hematological parameters and intestinal microbiology did differ between quail and pigeon ($P<0.05$). The meat proximate composition data indicated that moisture and ether extract content did differ ($P<0.05$), however, crude protein and ash content did not differ between quail and pigeon ($P>0.05$). Thus, the preliminary study suggested that farmers can easily rear quail and pigeon for consumption of meat, however, further detail study can ensure detail physiological aspects and meat quality parameters of quail and pigeon.

Introduction

In Bangladesh, there are different types of livestock (cattle, sheep, goat etc.) and poultry (chicken, duck, turkey, quail and pigeon etc.) which generally provides meat, milk and egg and is distributed to the consumers table after collecting it from local markets (Huque and Khan, 2017). Among different poultry species chicken and duck are most common species contributing to the national protein demand and economy, where quail and pigeon also reared for both meat and egg purpose (Das et al., 2008; Vali, 2008). Quails belong to the order *Galliformes*, family *Phasinidae*, genus *Cortunix* and species *japonica*. It attains maturity and come into first lay between 5-6 weeks of age and produce between 200-300 eggs in their first year of lay (NRC, 1991). Japanese quails also known as common quails is mainly raised for meat and egg production and also are valued research animals (NRC, 1994). It attains a market weight of 140-180g between 5-8 weeks.

Pigeon is probably the first bird species have been reared by human being and utilized for various purposes historically (Johnston and Janiga, 1995). The domestic pigeon (*Columba livia domestica*) is a pigeon subspecies that was derived from the rock dove (also called the rock pigeon). The pigeon is under the order *Columbiformes*, family *Columbidae*, genus *Columba*, species *Columba livia* and subspecies *Columba livia domestica*. Pigeon are raised by many peasant farmers, they are hardly and less susceptible to many diseases of poultry birds. They are gentle and because of their long wings and powerful flight muscles, they are strong, swift flier. Pigeon is easy to raise foragers and requires less capital outlays in terms of housing, management and health care.

Although pigeon production may never rise enough to compete with commercial poultry as a major source of food, however as a significant addition to the diet as well as a source of substantial income, such types of birds can play a pivotal role for the third world villages (NRC, 1991). Regrettably, a lot of people don't know about the potentiality as animal protein source and the prolific nature of pigeon. Fascination is therefore evoked towards the pigeon that can be used to obtain maximum yield of edible meat. Although the meat from quail and pigeon is negligible compared to commercial chicken, however, several aspects and utilities make them popular (da Cunha, 2009). Smaller body size, lower maintenance cost, short generation interval, resistance to disease and special types of egg and meat (considered a delicacy) are the attracting factors gaining popularity among consumers as well as the farmers (Zieleziński and Pawlina, 2005). Quail and pigeon farming becoming a profitable avenue and the volume are increasing significantly (Zieleziński and Pawlina, 2005). Research on meat quality around the world is in progress; however, there is vast area of research scope. Majority of research on meat quality are conducted within the same species through dietary manipulation, management aspects, slaughtering steps or other associated factors (Bostami et al., 2017a and 2017b), age or sex differences, and breed or strain differences (Pomianowski et al., 2009; Boni et al., 2010; Omojola et al., 2012). The carcass and meat quality traits within species can be varied due to different factors, while between or among species can also be differed due to compositional, genetic and other factors. Ali et al. (2007)

reported that, chicken and duck meat quality can differ on the aspect of physico-chemical traits. However, research on comparison of meat quality attributes among or between species is comparatively limited. There is no wide research on carcass characteristics, blood parameters and nutritional quality of different poultry species that are available in Bangladesh, such as the quail and pigeon species although their meat is becoming popular by the consumers and farmers are interesting in farming of such types of fancy birds. To obtain specific knowledge on carcass characteristics, blood parameters, intestinal microbiology and nutritional quality of different types of poultry meat like quail and pigeon, a steady and advance research is required. Therefore, the aim of this study was to conduct a preliminary study to compare the quail and pigeon on the aspects of carcass characteristics, blood parameters, intestinal microbiology and meat composition. Thus the findings of this research might be helpful for further detail study to explore knowledge on physiological aspects and meat quality attributes of such types of poultry species.

Materials and Methods

The study was performed at the Livestock and Poultry Farm and Department of Animal Science and Nutrition, Faculty of Veterinary and Animal Sciences, Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur, Bangladesh. The quail and pigeon were collected from local market of Gazipur District of Bangladesh. Following collection all care and management, animal welfare, ethical rules were followed based on BSMRAU care and management and ethical approval committee (BSMARU/EAC/BS2018). Following all rules and regulations blood sample and meat samples were collected and prepared for further analysis.

Slaughtering of birds

After collection of the quails and pigeons from the local market of Gazipur, Bangladesh, they were put for rest and 12 hours of off-fed period was applied with only *ad libitum* water supply. Meat samples was collected from different quail and pigeon following halal slaughter where skin, vein, trachea, wind pipe and other parts were cut down without separation of head from the body. Where proper bleeding was ensured and death of the bird was confirmed through visual observation. Following slaughter meat samples were collected, processed and stored for further analysis. Ethical guidelines were followed and applied before and after slaughter of birds.

Carcass characteristics

Following slaughter and subsequent bleeding, skin and visceral organs were removed and weighed individually. The carcass weight, and other parts weight was measured and recorded properly. A total of 42 day aged 20 quail (Coturnix coturnix japonica) and 2 years old of 20 pigeons (Columba livia) were obtained from local market of Gazipur, Bangladesh. Before slaughter, quail and pigeons were in off-feed condition with providing water only for 12 h. Live weight, slaughter weight, carcass weight was recorded by using scientific balance, where carcass weight was calculated by removing the feathers and blood, and the semi-eviscerated weight was calculated by removing the trachea, esophagus, full crop, intestines, pancreas, spleen, gizzard content, and gonads from the carcass. The dressing percentage was calculated based on the body weight and carcass weight of quail and pigeon. Carcass yield was calculated as follows:

$$\text{Carcass yield} = \frac{\text{Empty carcass weight (g)} + \text{edible offal's weight (g)}}{\text{Live pre} - \text{slaughtering weight}} \times 100$$

The head, neck, wing, leg, breast meat and leg meat were separated from carcass and weighed. The different organs (heart, liver, spleen, lungs, kidneys, proventriculus, gizzard, pancreas, intestine without digesta) were weighed individually, and the organ index (%) was expressed as the organ weight as a percentage of body weight of quail and pigeon.

Collection and analysis of blood samples

Birds were chosen randomly from quail and pigeon species for blood sample collection. The 3 ml of blood was collected from vein of quail and pigeon species into anticoagulant EDTA treated tubes for determination of total Red Blood Cell (RBC), total White Blood Cell (WBC), hemoglobin (HB), hematocrit (HCT) and other determinants. The hematological parameters were assessed by using Automatic Fully Digital Hematology Analyzer, BC-3000 Plus, Shenzhen Mindray, Bio-Medical Electronics Co., LTD.

Microbial analysis

Samples were collected from the intestinal content (five samples per each treatment) and then separately transported them to a 250 ml Erlenmeyer flask containing 90 ml of sterile peptone (0.1% peptone) saline solution (0.85% NaCl), and blended the mixture well. The total bacterial count, *E. coli* and *Salmonella spp.*, and yeasts and molds count were calculated and analyzed using specific media following incubation and other steps explained in previous studies (Xia et al., 2004; Sheiha et al., 2020). The microbial count was expressed as log10cfu/g.

Determination of proximate composition

The proximate composition of the thigh meat samples was analyzed in triplicate for moisture and ash, crude protein (CP), ether extracts (EE), as described by the Association of Official Analytical Chemists (AOAC, 2000).

Statistical analysis

All data were subjected to independent t-test using the General Linear Models (GLM) function of the Statistical Analysis System (Version 9.4 SAS Institute, Cary, NC, USA) (SAS, 2014). The means were calculated using the least square method and presented with the standard error of the mean (SEM). Differences among means were determined by the Student's t-test. Statistical significance statements were based on $P < 0.05$.

The statistical model used was

$Y_{ij} = \mu + T_i + e_{ij}$

where Y_{ij}, observed value; μ, overall mean; T_i, treatment effect; and e_{ij}, random error.

Results and Discussion

Carcass characteristics

Table 1 shows the carcass characteristics and primal cut weights of quail and pigeon. It was revealed that, pre-and post-slaughter weight, dressing percentage and wing weight was lower whereas breast and thigh meat yield was lower in case of quail in comparison to pigeon ($P<0.05$). In case of poultry, carcass characteristics are benchmark of nutrient deposition, while the breast and thigh meat yield is an important standard of carcass characteristics. The variation between quail and pigeon carcass traits might be due to different species and genetic variation. Live weight, slaughter weight and carcass yield percentage of quail generally ranges from 150 to 400 g, 100 to 250 g, and 60 to 90% respectively (Nasr et al., 2017). The body weight of quail ranges from 160 to 200g, carcass weight percentage ranges from 70 to 80%, dressing percentage ranges from 80 to 85%, respectively (Reda et al., 2020). Liver weight, gizzard weight, heart weight, and spleen weight of quail ranges between 4.0 to 8.0g, 3.0 to 7.0 g, 1.0 to 3.0 g, 0.10 to 0.70 g respectively (Nasr et al., 2017). Liver, gizzard, heart and giblets weight of quail ranges from 2.0 to 3.0%, 2.1 to 2.8%, 0.70 to 1.50%, 5.5 to 6.5%, respectively (Reda et al., 2020).

Table 1. Carcass characteristics and primal cut weights of quail and pigeon

Parameters	Quail	Pigeon	SEM	P-value
Pre-slaughter weight (g/bird)	150.13[b]	442.41[a]	13.46	<0.0001
Post-slaughter weight (g/bird)	149.29[b]	441.62[a]	13.48	<0.0001
Dressing (%)	68.69[b]	84.83[a]	1.58	<0.0001
Breast meat yield (%)	20.68[a]	17.74[b]	0.94	0.041
Thigh meat yield (%)	15.31[a]	10.80[b]	0.96	0.004
Wing weight (%)	11.61[b]	16.24[a]	0.89	0.002
Back weight (%)	14.76	15.28	0.77	0.640

[a, b] Means in the same row with different superscripts are significantly different ($p<0.05$); SEM: Standard error of mean

The average slaughter weight was 224.10±10.20 g for males, 204.80±11.70 g for females, and 256.20±12.60 g for adults and 191.90±7.06 g for squabs (Ibrahim and Bashrat, 2009). Males differed significantly ($p<0.05$) from females as did adults from squabs (Ibrahim and Bashrat, 2009). They (Ibrahim and Bashrat, 2009) also stated that overall dressing percentage was 62.15% for males, 62.20% for females; 65.27% for adults and 59.03% for squabs. Omojola, et al., (2012) reported that the pigeon live weight (g) ranges between 250 to 350g, body weight (%) ranges between 70 to 100%, carcass weight ranges between 150 to 200g, dressing percentage ranges between 62 to 68%, respectively. The percentage of carcass yield, eviscerated yield, breast muscle yield and leg muscle yield of pigeon ranges between 82 to 88%, 62 to 69%, 20 to 27%, and 5 to 8%, respectively (Jiang et al., 2019).

Different organ weight of pigeon can be as follows: proventriculus weight ranges from 0.7 to 1.7g, gizzard weight ranges from 6.5 to 13.5g, liver weight ranges from 5.5 to 14.5g, heart weight ranges from 5.0 to 8.0g, spleen weight ranges from 0.10 to 0.60g (Kokoszyński et al., 2020). Breast meat, leg meat and abdominal fat yield percentage of domestic pigeon ranges from 17 to 24%, 5.2 to 7.3%, and 2.1 to 2.6%, respectively (Gao et al., 2016). Breast meat, leg meat, neck, wing and abdominal fat weight percentage ranges between 28 to 32%, 5.0 to 8.0%, 2.0 to 4.0%, 15 to 19%, 1.0 to 3.0%, respectively (Kokoszyński et al., 2020). Primal cuts of pigeon can be influenced by strain and sex (expressed as percent of live weight), where the different primal cuts from pigeon can be within the following ranges: breast 35 to 40%, thigh 6.11 to 6.65%, drum stick 4.5 to 5.8%, back 15.11 to 18.06%, respectively (Omojola, et al., 2012). Buculei et al., (2010) conducted a study to compare the meat quality of 3, 6 and 8 weeks old pigeons and turkeys with different ages, sex and breeds. It was reported that there is a difference between meat quality of young and old (Buculei et al., 2010). Buculei et al. (2010) stated that, though both pigeon and turkey meats consisted of muscles and skin, according to their study result, the most developed muscles are pectorals, followed by haunch and shank. The variation between quail and pigeon on the aspects of carcass characteristics in the current study might be due to the species genetic variation, where diet and other factors can also affect the variability in the carcass characteristics.

Hematological parameters

Hematological parameters of quail and pigeon were shown in Table 2. A higher value of RBC (T/L), hemoglobin (g/dL), WBC (G/L), lymphocytes (%) and heterophils (%), and lower value of monocytes (%) and eosinophils (%) were observed in the blood of quail relative to that of pigeon ($P<0.05$). Basophils (%) and H/L ratio of quail blood did not differ as compared to pigeon ($P>0.05$). According to Togun and Oseni (2005) hematological analysis involves the determination of physiological aspects of animal, which have been found useful for disease prognosis, for therapeutic purposes and for monitoring the feed stress. Blood analysis provides the opportunity to clinically investigate the presence of several metabolites and other constituents in the body (Doyle et al., 2006). Nutrition and other factors affect the blood profile of healthy animals (Yeong, 1999; Addass et al., 2012; Habib et al., 2001). Aro et al. (2013) reported that hematological parameters like white blood cell count, red blood cell count, platelets count, haematocrit value, hemoglobin concentration, among others are used for routine screening for the health and physiological status of livestock and humans. Blood parameters are excellent medium for measurement of potential biomarkers, because its collection is relatively non-invasive and it encompasses an enormous range of physiological process in the body at any given time (Ginsburg and Haga, 2006). Changes in blood profile can be due to disease (Yadav et al., 2002), stress and nutritional factor (Afolabi et al., 2001), age, sex and breed (Tanbuwal et al., 2002; Chineke et al., 2006), feed additives like herbs and spices as phyobiotic (Alagbe, 2017). However, the difference in the hematological parameters in the present research might be attributed to the species variation and some other factors.

Table 2. Hematological parameters of quail and pigeon

Parameters	Quail	Pigeon	SEM	P-value
RBC (T/L)	3.55[a]	3.09[b]	0.09	0.001
Hemoglobin (g/dL)	12.36[a]	9.24[b]	0.45	<.0001
WBC (G/L)	28.68[a]	17.38[b]	0.60	<.0001
Monocytes (%)	3.13[b]	16.36[a]	0.76	<.0001
Lymphocytes (%)	49.63[a]	42.03[b]	0.86	<.0001
Eosinophils (%)	0.36[b]	2.78[a]	0.25	<.0001
Basophils (%)	1.62	1.58	0.08	0.747
Heterophils (%)	45.79[a]	38.80[b]	0.72	<.0001
H/L ratio	0.92	0.94	0.03	0.712

[a, b] Means in the same row with different superscripts are significantly different ($p<0.05$); SEM: Standard error of mean; H/L ratio: Heterophils/Lymphocytes

Ipek et al. (2008) reported that, hematological parameters of quail while feeding control diet is as follows: RBC (10^6 mm^3) ranges from 3.11 to 4.21, WBC (10^3 mm^3) ranges from 35 to 40, Hb (g/dl) ranges from 10.23 to 14.14, PCV (%) ranges from 40.5 to 53.10, heterophil (%) ranges from 45.23 to 53.34, lymphocyte (%) ranges from 37.44 to 47.31, heterophil/lymphocyte ranges from 1.11 to 1.63, respectively. Shehab et al. (2012) reported that, the hematological parameters of quail can be as follows: Hb (g/dl) ranges from 6.0 to 9.0, PCV (%) 46.0 to 50.0, RBCs($x10^6$ /µl) 2.8 to 4.2, MCV (fl) 155 to 165, respectively.

Kasprzak et al. (2006) reported that, they examine the blood parameters during the breeding cycle in wild pigeon living in the urban environment. The values of RBC and Ht measured in the investigation were 3.2–3.6 cell×10^6 /ml and 52–59%, respectively (Kasprzak et al., 2006). The values can be in different ranges in various pigeon species such as *Columba livia* (G.) (Yadava, 1978), racing pigeon (*Columba livia*) (Fourie and Hattingh, 1980), homing pigeon (*Columba livia f. domestica*) (Bordel and Haase, 1993), nicobar (*Caloenas nicobarica)*, common crowned pigeon (*Goura cristata*), Victoria crowned (*Goura victoria*), Scheep-maker's crowned pigeon (*Goura scheepmakeri*) (Peinado et al. 1992), pigeon guillemot (*Cepphus columba*) (Seiser et al., 2000), and rock pigeons (*Columba livia*) (Gayathri et al., 2004). The high hematocrit value and MCV values, which distinguish pigeons from the other avian species, as observed by Peinado et al. (1992) were reported by Kasprzak et al. (2006). Concentrations of hemoglobin were slightly lower than those in other pigeon species examined in previous studies (Yadava 1978; Fourie and Hattingh 1980; Gayathri et al., 2004; Kasprzak et al., 2006). Consequently, the calculated MCH and MCHC values were 39–42 pg and 22–25 g/dl, respectively, reported as the lower in ranges in pigeons (Peinado et al., 1992; Seiser et al., 2000; Gayathri et al., 2004). Change in the blood profile during the breeding cycle is a well-documented phenomenon in birds (Bell et al., 1965; Jones 1983; Gayathri et al., 2004; Sergent et al., 2004).

The hematological parameters can be different in various species, including domestic and wild pigeons, quails, turkey or others (Yadava, 1978; Fourie and Hattingh, 1980; Bordel and Haase, 1993; Peinado et al., 1992; Seiser et al., 2000; Gayathri et al., 2004). A decrease in both hematocrit and hemoglobin values may reflect the changes in food and watersupply, as reported in other avian species in previous study (Totzke et al., 1999). Generally, nutritional deficiency during energy consuming stage may result in significant physiological stress, which manifests itself in the decreased hematocrit and hemoglobin values. Nonetheless, Dawson and Bortolotti (1997) advocated that the nutritional stature of healthy birds does not seem to influence erythropoiesis and hematocrit. Additionally, Svensson and Merila (1996) suggested that the lower hematocrit meanwhile molt may imitate infections, less efficiency in deposition of fat and poor nutritional state. In fact, pigeons living in urban areas may endure sporadically from poor diet. The higher hematocrit values noticed midst a laying phase can imply hemo concentration after water deprivation; also, the lost mass in the laying phase may pinpoint that pigeons turn into dehydrated. However, Kasprzak et al. (2006) stated that since neither hydration nor nutritional status was not measured or controlled during their studies, it was not clear, need further detail studies. Therefore, along with previous and current study, it is demonstrated that, several aspects can affect hematological parameters of poultry species like quail or pigeon. Further detail study can confer the mechanism of changes the value of hematological parameters.

Intestinal microbial count

As shown in Table 3, the intestinal microbial load data indicated that, *E. coli* count was higher in quail while compared with pigeon, however, there was found no significant differences between quail and pigeon intestinal total microbes, *Salmonella spp*., and yeast and mold count ($P>0.05$). Intestinal microbiota is considered important for host nutrition, metabolism, and immunity (Sohail et al., 2010) and can be affected by age, stressors, diet, and performance enhancers (Hume et al., 2003; Rehman et al., 2008). Whereas intestinal microbial composition remains stable in healthy adults (Amit-Romach et al., 2004), environment and management stressors, such as overcrowding, deprived feeding, extreme cold or hot climate, and transportation, destabilize the normal intestinal microbial profile (Suzuki et al., 1983; Lan et al., 2004). The intestinal microbial load data of quail reported that the total bacterial count ranges from 5.0 to 6.5, total yeast and mold count ranges from 4.5 to 6.5, *Coliform spp.* ranges from 5.1 to 6.1, *E. coli* ranges from 5.01 to 6.60, Lactic acid bacteria ranges from 5.2 to 6.3, *Enterobacter spp.* ranges from 4.5 to 6.4, *Salmonella spp.* ranges from 1.11 to 6.82, respectively (Reda et al., 2020). The variation in the intestinal microbial loads between quail and pigeon might be due to the species variation as well as different diet and feeding behavior.

Table 3. Intestinal microbial count (log10cfu/g) of quail and pigeon

Parameters	Quail	Pigeon	SEM	P-value
Total microbes	8.97	8.85	0.73	0.915
E. coli	1.56[a]	1.31[b]	0.08	0.038
Salmonella spp.	1.36	1.22	0.08	0.235
Yeast and mold	3.23	3.27	0.11	0.792

[a, b] Means in the same row with different superscripts are significantly different (p<0.05); SEM: Standard error of mean.

Meat proximate composition

Table 4 is showing the meat proximate composition of quail and pigeon. Where it was depicted that, moisture content was higher whereas ether extract content was lower in the quail meat relative to pigeon meat (P<0.05). Other components like crude protein or ash content did not differ between quail and pigeon meat (P>0.05). Effects of different factors such as breed, age, sex and nutritional condition on fat deposition and fatty acid profile of poultry species are not widely studied. Veritably, scanty studies on the fatty acid composition and cholesterol content of meat from Japanese quail have been published (Botsoglou et al., 2004; Genchev et al., 2008; Boni et al., 2010; Yalcin et al., 2017), and attainable results are not perpetually directly commensurable. In addition, far too little assiduity has been paid to the conviction of meat quality traits of adult or spent quails at the end of their productive life (Santhi and Kalaikannan, 2017). Literally, even if research shows that quail meat production is economically most competent when performed at the age of 35 days, there may also be markets for comparatively larger size quails having higher weight to be sold as broiler or processed, and for the older quails and having slower growth rate (Minvielle, 2004). On the contrary, the old breeding birds are slaughtered and sold on commercial market without any discrepancy being made on age. Domestic pigeons (*Columba livia*) known as delicious nutrient meat, are reared as a kind of commercial meat-type poultry in China and in other countries (Xu et al., 2019).

Table 4. Meat proximate composition of quail and pigeon

Parameters	Quail	Pigeon	SEM	P-value
Moisture (%)	76.10[a]	68.15[b]	1.05	<0.0001
CP (%)	22.45	24.59	0.80	0.077
EE (%)	2.63[b]	6.41[a]	0.56	0.000
Ash (%)	1.73	1.48	0.10	0.121

[a, b] Means in the same row with different superscripts are significantly different (p<0.05); SEM: Standard error of mean; CP: Crude protein, EE: Ether extract.

It was mentioned that, in case of turkey meat, the fat deposition is swayed by the age, sex, breed, feed quality and quantity, husbandry system and environment temperature (Buculei et al., 2010). It is suggested that pigeon meat can be consumed without any restrictions since it has a low fat content (Buculei et al., 2010). However, in the current study, pigeon meat shows higher ether extract content while compared with quail meat. Water, protein, fat and collagen percentage of pigeon breast meat ranges from 65 to 70%, 23 to 28%, 1.5 to 5.5%, and 1.5 to 3.0%, respectively (Kokoszyński et al., 2020). It was reported that the quail meat mean values of moisture, protein, fat, ash and energy contents ranged from 60.1 to 69.2%, 55.0 to 68.8%, 28.8 to 42.1%, 2.40 to 3.63% and 696 to 1 000 kJ, respectively (El-Dengawy and Nassar, 2001). Pomianowski et al., (2009) compared breast and thigh muscle of 3 meat-type breeds of pigeons (Europigeon, Wrocławski, King) where the Kings pigeon shows the breast meat protein content of 21.73% in and Wrocławski pigeon shows the breast meat fat and ash content of 7.07% and 1.11%, respectively. It was reported that, in the meat of the *M. gallopavo* the moisture content was 78.52%, crude protein content was 82.57% and ash content was 5.34%, while in the meat of *C. livia domestica* highest fat content was 16.99% (Javaid et al., 2017). The proximate composition of meat obtained from quail and pigeon in the present experiment might be due the variation in species and diet. The chemical composition of muscle fiber and the quality of the meat can be influenced by genetics, type of breed or strain and different environmental factors (Listrat et al., 2016).

Conclusion

The present study revealed that, quail and pigeon differs in terms of carcass traits, hematological parameters and intestinal microbial composition. Though the crude protein and ash content was almost same in quail and pigeon's meat, they differed regarding moisture and ether extract content. However, more researches are necessary for the characterization of vitamins, minerals and amino acid profiles and more works are important for knowing consumer preferences and commercialization for suggesting farmers to rear these birds as alternative meat sources in Bangladesh

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Conflicts of Interest

The authors declare no conflict of interest.

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