Animal Husbandry, Dairy and Veterinary Science

Research Article ISSN: 2513-9304

Comparative studies on squab growth performance and egg morphometrical attributes of different pigeon breeds

Obaidul Islam[1], Shameema Khatun[1], Mustasim Famous[2] and Md. Nazim Uddin[1*]

[1]Department of Livestock Production and Management, Faculty of Veterinary, Animal and Biomedical Sciences, Sylhet Agricultural University, Bangladesh

[2]Department of Livestock Production and Management, Faculty of Veterinary, Animal and Biomedical Sciences, Khulna Agricultural University, Bangladesh

Abstract

The acceptance of pigeon farming is expanding day by day like chicken and duck farming in the Sylhet region of Bangladesh. The present research was conducted to compare the squab post hatch development and egg morphometric characteristics of different pigeon breeds. The study was conducted among eight breeds (Deshi, Racer, Giribaz, Deshi×Jalali, Pure Deshi, Shirajee, Lakkha and Deshi×Racer). The squab weight gain was collected at the age of 0, 7, 14, 21 and 28 respectively, egg morphometric attributes - egg width (short axis), length (long axis) and egg weight of each breeds were determined. The data were analyze using--- software and Duncan's Multiple Range test (DMRT) were performed to determine the level of significance. The average body weight of mature Giribaz, Deshi× Jalali, Shirajee and Deshi×Racer breeds of pigeon were below 300 gm; Deshi, Racer and Pure deshi were 300-350 gm, and Lakkha were below 400 gm. Post-hatch growth rate of different pigeon breed squab at different age was significantly different ($p<0.05$). The highest egg length was 4.12±0.003 cm in Shirajee, and the lowest was 3.67±0.005 cm in Giribaz pigeon. The highest egg width was 3.13±0.002 cm in Shirajee, and the lowest was 2.73±0.003 cm in Giribug pigeon. The highest egg weight was 20.07±0.01 gm in Shirajee, and the lowest was 14.47±0.002 gm in pure deshi pigeon. Moreover, a relationship between the body weight and egg length, width and weight of pigeons was observed in pigeons of all examined breeds.

Introduction

In almost all parts of the world, humans have been accustomed to pigeon breeding for about 10,000 years [1]. Bangladesh has a long history in backyard poultry farming. The climate and vast farmland where Bangladesh is live are very suitable for raising pigeons. Pigeons are widely used as experimental models for biomedical research and are also used in meat production. Commercial production of pigeons (pigeons) has existed in North America since the early 1900s [2,3]. Unlike other types of poultry, pigeons are bred in pairs, and young pigeons must be raised and fed by their parents until they are 4 weeks old on the market [2]. Although pigeons provide an alternative source of animal protein [4], the contribution of pigeons to the livestock sub-sector and overall poultry production has not been considered. The investment in pigeon breeding is relatively low, the care is less, the cost of food and lodging is low, the breeding method is simple and cheap, the breeding cycle is short, and the incidence of disease is low. Pigeons are used as a source of entertainment in natural beautification and ornamental birds, as a source of appetizing, delicious and easily digestible animal protein, as a source of biological fertilizers, especially for home gardening, and as a source of genetic and hormone research. Therefore, the profitable pigeon industry can be a simple and reliable source of employment opportunities, a form of using family labor and cash income. A constantly increasing and sustainable pigeon breeding rate can increase the rate of reduction of the gap between consumption and animal protein deficiencies; increasing the rate of poverty reduction can improve the socio-economic situation of poor rural communities. The pigeon's ability to convey information has been used reliably in warfare, trade, friendship maintenance and political management. But today, pigeons are also raised primarily for nutrition and family entertainment. Pigeon meat is delicious and rich in nutrients like protein, vitamins, calcium, and iron, so it has a huge market [5]. Pigeons are different from other poultry in their mating and rearing behavior, because young pigeons are completely dependent on their parents for feeding and caring for them. When the eggs hatch, both parents become aggressive during the incubation period [6]. The pigeon builds two nests to raise the young, alternately uses the two nests to hatch eggs and raise the hatched chicks to control the timely breeding cycle. Females reach sexual maturity around 7 months, lay eggs 8 to 12 days after mating, and hatch 18 days after hatching. The hatched chicks leave the nest between 25 and 32days. The breeding cycle of pigeons is about 2 months, and when the cycle ends, another breeding cycle will start continuously. It is important to understand the behavior of the parents on their young to meet the nutritional needs. This nutrition should meet their needs for them to show signs of improvement in weight, growth rate, and general health. Both parents and females are responsible for feeding and caring for their chicks. Newborn chicks5-7 days old are fed on the harvest milk secreted by the parent crop, and the milk production of both parents is similar [7]. Culture milk is the product of mature epithelial cells and is secreted from the inner wall of culture tissues. Under the induction of brood stock hatching behavior, the epithelial cells of the culture begin to proliferate, and the physiological structure and morphology of the culture tissue undergo many changes. The harvested milk is mainly composed of protein and lipids. On a dry weight basis, protein

Correspondence to: Md. Nazim Uddin, Department of Livestock Production and Management, Faculty of Veterinary, Animal and Biomedical Sciences, Sylhet Agricultural University, Sylhet-3100, Bangladesh, E-mail: nazimsau@gmail.com

Key words: *Breed, body weight, post-hatch, squab*

Received: October 10, 2021; **Accepted:** December 06, 2021; **Published:** December 13, 2021

accounts for about 60% of the total components of milk. Prolactin and insulin stimulate milk secretion in cultures; these hormones affect its weight and content [6]. Farmed milk contains a lot of crude protein and lipids (about 50% and 25-29%, respectively, based on dry matter), which can improve the growth performance of chicks. The harvested milk secretion lasts approximately 14 to 25 days after hatching. Since most pigeon breeders rely on available grains to feed their pigeons, information about the specific dietary requirements of pigeons is limited. A diet of 15-18% crude protein can improve the productivity and reproductive performance of pigeons [8]. Similarly, the study of weight characteristics in feeding programs is also affected by the weight of newborn chicks [9]. Eggshell weight, egg weight, eggshell thickness, albumin weight and egg yolk are all important egg attributes that affect egg quality, newborn chick weight and hatching performance. In the case of pigeons losing one or both of their parents, many practices have been established, such as artificial feeding, to protect the life, health and performance of the pigeons. In the event that one parent dies, the other parent will take care of the chicks and raise them individually. This can have an impact on the behavior, health and growth of the chicks. In the case of the death of both parents, the responsibility of caring for the child can be transferred to the adoptive parents [10]. Artificial feeding of chicks is to improve survival rate, well-being and growth performance [11]. In some pigeon farms, the chicks are separated from their parents after feeding crops for 3 days to prepare the parents for the next breeding cycle. Artificial rearing is the most effective method of raising chicks and has proven to be very successful [12]. The purpose of this work is to compare the growth performance of different pigeon breeds and the morphological characteristics of different pigeon breeding eggs.

Materials and methods

Ethical Statement

All methods and management procedures used in this study were complied with the guidelines established by Sylhet Agricultural University (Sylhet-3100, Bangladesh), and experiments were approved by the Animal Ethics Committee of Sylhet Agricultural University.

Study area

The research works were carried out during the period of July to December 2019 in pigeon farm which is the experimental site under the Department of Genetics and Animal Breeding, Faculty of Veterinary, Animal and Biomedical Sciences, Sylhet Agricultural University, Sylhet-3100, Bangladesh.

Selection of breeds

For this study eight types of different breed of squab were selected which are available in the greater Sylhet region of Bangladesh. These are Deshi (local pigeon), Racer, Giribaz, Deshi×Jalali, Pure Deshi, Shirajee, Lakkha and Deshi×Racer.

Management of squab

Each pair of breeding pigeons was raised in an open dovecote, which was ventilated both naturally and mechanically, with a photoperiod of 16 h of daily light. During this study, water cup, the trough and floor were cleaned and disinfected routinely. Breeding pigeons were allowed to free access of water and feed with sufficient health care sand. The experimental duration was 45 d (including an incubation period of 17 d and a lactation period of 28 d). At the end of the experiment, 25 squabs from each treatment were selected randomly for the growth performance and egg morphometric attribute was evaluated.

Growth performance

All newborn squabs were weighed early in the morning (07:00 h) before feeding. They were weighed every day until the end of brooding stage (4 weeks). The body weight gain (BWG), average feed intake (AFI) was calculated in the case of parent-fed squabs by weighing the squabs before feed supplementation and reweighing after being fed by the parent, with subtraction of the two weights to get the amount of feed intake for the squab, and then calculation of the total feed intake per day for each squab. In case of hand feeding, the amount of feed for squab was weighed. The researchers ensured that the squabs were not fed for 2 h before the commencement of weighing. Feed conversion was calculated as feed intake (g)/total gain (g). Live body weight (LBW) and BWG were evaluated based on individual bird data, whereas AFI and feed conversion ratio (FCR) were assessed based on the replicate unit. The body weight gain (BWG) was calculated by subtracting final weight from initial weight of chicks. The FCR was calculated for each squab as feed intake divided by body weight gain and then statistically calculated for each group as described by The relative growth rate (RGR) was calculated using the following equation: (^{1}/2(Final weight – initial weight)/(Final weight +initial weight)×100), as described by Protein efficiency ratio (PER) was determined according to as the number of grams of weight gain produced per unit of weight of dietary protein consumed. Survival rate was calculated directly according to as the percentage of surviving squabs with respect to the total number of squabs in each group. Each two squabs were considered replicate with 100% survival if both were still alive, 50% of the unit if one squab died during the experiment, and 0% if both squabs of the replicate had died and each group contained 10 replicates.

Statistical analysis

Statistical analysis was done the reveal the significant differences of the parameters among the breeds, and different age groups of pigeons. Data was presented as Mean ± SE. The Duncan's Multiple Range test (DMRT) was performed to observe significant differences between the parameters. All analysis was performed using SPSS software version was 20. $P<0.05$ considered as significant.

Results and discussion

Postnatal development and production attributes produced by humans differ from those of birds in their inherent habitats in several ways, where foods supply is timely, food shortages appear to be faster, and competition is the deciding force. For the survival of birds. Even in the feeding system of poultry, there are considerable differences in the production characteristics and postnatal development of the birds, which are mainly due to the diet and nutritional status of the birds and their genetic race [13]. Significant differences in egg morphological characteristics and post-hatch weight gain were found among pigeon breeds available in the Sylhet region of Bangladesh. The weight gain (development after birth) of a pigeon is related to the breed, nutritional status, and management system of the pigeon. On day 0, the highest pigeon weight found in Racer was27.96 ± 0.46 grams, while the lowest pigeon weight found in Deshi was 18.74 ± 0.16 grams (Table 1). But Darvati et al. [14] pointed out that the average weight of the local pigeons at a day's age is 14.02 ± 1.20g, which is closer to the body weight of De Shi in this study. On day7, the highest chick weight of Deshi × Racer was 115.15 ± 1.11 g, while the lowest chick weight of Giribaz was 76.03 ± 0.23 g. On the 14th day, the highest chick body weight was found to be 208.12 ± 0.83g in Pure deshi, and the lowest chick body weight was found tobe 151.78 ± 1.24 g in Deshi. Bhowmik [15] found that on the 15th day, the weight of Jalali pigeons was 225.53

Table 1. Weight of different breed of squab (n=25)

Name of the breed	0 day	7 day	14 day	21 day	28 day
Deshi	18.74 ± 0.16^{a}	91.86 ± 0.34^{c}	151.78 ± 1.24^{a}	276.99 ± 0.99^{d}	339.38 ± 1.42^{d}
Giribaz	20.32 ± 0.38^{b}	76.03 ± 0.23^{a}	155.09 ± 2.36^{ab}	236.96 ± 2.71^{a}	269.70 ± 2.88^{a}
Racer	27.96 ± 0.46^{c}	84.88 ± 0.98^{b}	160.40 ± 1.30^{c}	283.80 ± 2.00^{c}	348.30 ± 2.21^{e}
Deshi×Jalali	19.70 ± 0.43^{ab}	93.56 ± 0.75^{cd}	175.97 ± 1.38^{d}	240.89 ± 0.98^{a}	295.58 ± 0.77^{c}
Pure deshi	22.44 ± 0.24^{c}	94.49 ± 0.53^{d}	208.12 ± 0.83^{f}	296.93 ± 0.93^{f}	340.15 ± 1.84^{d}
Shirajee	24.46 ± 0.34^{d}	91.60 ± 0.44^{c}	195.64 ± 1.02^{e}	252.55 ± 0.64^{c}	296.56 ± 0.80^{c}
Lakkha	19.45 ± 0.27^{ab}	113.29 ± 1.23^{e}	156.69 ± 2.64^{bc}	293.06 ± 1.91^{f}	352.11 ± 4.03^{e}
Deshi×Racer	21.53 ± 0.29^{c}	115.15 ± 1.11^{e}	152.85 ± 0.90^{ab}	245.37 ± 0.97^{b}	276.30 ± 1.00^{b}
F-test significance	84.33**	283.92**	183.22**	250.06**	245.36**

**P < 0.01. Different letters in each column represent significant difference at P < 0.05 level based on Duncan's multiple range tests.

Table 2. Phenotypic attributes of egg of different breed of pigeon (n=25)

Breed name	Egg length(cm)	Egg width(cm)	Egg weight(cm)
Deshi	3.69 ± 0.002	2.74 ± 0.002	15.36 ± 0.03
Giribaz	3.67 ± 0.005	2.73 ± 0.003	14.80 ± 0.005
Racer	4.06 ± 0.002	3.07 ± 0.001	19.19 ± 0.003
Deshi×Jalali	3.97 ± 0.004	2.95 ± 0.002	16.83 ± 0.009
Pure deshi	3.73 ± 0.001	2.75 ± 0.003	14.47 ± 0.06
Shirajee	4.12 ± 0.003	3.13 ± 0.002	20.07 ± 0.01
Lakkha	3.96 ± 0.002	3.08 ± 0.002	16.77 ± 0.008
Deshi×Racer	4.02 ± 0.001	3.04 ± 0.001	18.94 ± 0.003

Table 3. Correlation of egg length among different breed of pigeon

	Deshi	Giribuj	Racer	Deshi×Jalali	Pure deshi	Shirajee	Lakkha	Deshi×Racer
Deshi	1							
Giribuj	-0.014	1						
Racer	0.194	0.06	1					
Deshi×Jalali	-0.19	0.045	-0.156	1				
Pure deshi	0.094	0.296	0.337	-0.082	1			
Shirajee	0.327	0.048	0.096	0.195	0.273	1		
Lakkha	-0.008	0.02	0.215	-0.313	0.01	-0.213	1	
Deshi×Racer	0.218	0.112	0.015	0.183	0.143	-0.009	0.168	1

* Correlation is significant at the 0.05 level (2-tailed).

Table 4. Correlation of egg width among different breed of pigeon

	Deshi	Giribuj	Racer	Deshi×Jalali	Pure deshi	Shirajee	Lakkha	Deshi×Racer
Deshi	1							
Giribuj	-0.125	1						
Racer	0.266	0.221	1					
Deshi×Jalali	-0.152	0.076	-0.12	1				
Pure deshi	-0.031	0.255	0.218	-0.149	1			
Shirajee	.447*	0.27	0.075	-0.181	-0.022	1		
Lakkha	-0.294	0.258	0	0.068	-0.002	0.182	1	
Deshi×Racer	0.224	0.056	0.279	-0.081	.441*	0.28	0.148	1

* Correlation is significant at the 0.05 level (2-tailed)

Table 5. Correlation egg weight among different breed of pigeon

	Deshi	Giribuj	Racer	Deshi×Jalali	Pure deshi	Shirajee	Lakkha	Deshi×Racer
Deshi	1							
Giribuj	-0.239	1						
Racer	-0.203	-0.164	1					
Deshi×Jalali	0.199	0.04	-0.315	1				
Pure deshi	.441*	-0.155	0.095	0.317	1			
Shirajee	0.14	-0.037	0.1	0.119	0.265	1		
Lakkha	-0.122	-0.237	0.236	-0.013	0.117	0.114	1	
Deshi×Racer	0.044	-0.144	0.003	0.335	0.092	0.246	0.082	1

* Correlation is significant at the 0.05 level (2-tailed)

± 3.89grams. On the 21stday, the highest weight of the pigeons found in the pure bottom stone was296.93 ± 0.93 grams, and the lowest weight of the pigeons found in the Giribaz pigeons was 236.96 ± 2.71 grams. However, Islam [16] reported that on day 20, the weight of Jalali pigeons was 217.10 grams, while the weight of Giribaz pigeons was 214.00 grams. On day 28, the highest chick weight of Lakkhawas352.11 ± 4.03 g, while the lowest chick weight of Giribaz pigeons was 269.70 ± 2.88 g. But Bhowmik [15] reported that on the 30th day, the weight of Jalali pigeons was 275.59 ± 1.48grams, while Darwati et al. [14] reported that the average weight of local pigeons on the 28th day was 290.40 ± 27.98grams. Azad [17] also reported that in the case of the Gola breed, the weight of the males was 304.10 grams, and the weight of the hens was 257.50 grams. In addition, the post-birth weight of one age group was significantly different from that of other age groups of all the species studied ($p < 0.05$) (Table 2). Majewska and Drenikowski [18] examined the daily gain of 8.83 to 12.61 grams between the seventh and fourteenth day of rearing, and then itwas reduced to 0.47 to 1.77 grams between days 21 and 28. Zielezinski and Pawlina [19] found a pattern Similar. Pawlina and Borys [20] studied a breed of meat pigeon (Wroclaw beef) and noted a decrease in daily gain at the end of 4 weeks of age, indicating that the pigeons are mature. Therefore, 4 weeks of age (D28) is the best time to cull pigeons for meat because their subsequent breeding is economically inefficient. Ibrahim and Sani [21] noted that pigeon egg size is a key factor in hatchability index and chick weight. In this study, the longest egg length found in Shirajee was 4.12 ± 0.00 cm, and the shortest egg length found in Giribaz pigeons was 3.67 ± 0.005 cm. This is like the findings of Saxena [22], but Bhowmik [15] reports. It took 3.75 ± 0.06 cm in the case of Jalali pigeons. The largest egg width found in Shirajee was 3.13 ± 0.002 cm, and the smallest egg width found in Giribaz pigeons was 2.73 ± 0.003 cm, which is like the result of Bhowmik [15], which was 2.81 ± 0.05Cm. Pigeon discoveries Jalali and Saxena et al. [22] who reported 2.85 cm. The highest egg weight found in Shirajee was 20.07 ± 0.01 cm, but Bhowmik [15] reported that the egg weight of Jalali pigeons was 16.18 ± 0.08 grams, while Robinson [23] pointed out that the average weight of domestic pigeon eggs was 18.9 grams, and Sales and Janssens [24] reported that the average egg weight of domestic pigeons is 21.4grams, like this study. The minimum egg weight of Pure deshi pigeons is 14.47 ± 0.06 cm, which is like Ibrahim and Sani [25]. They found that the average egg weight of street pigeons (Columba livia) is 14, 46 ± 0.11g, but Abdul Azem et al. [26] and Darwati et al. [14] reported that the egg weights of pigeons were 13.78 to 17.38 grams and 10.7 to 23.3 grams, which are consistent with the results of the current work [27-30]. The changes in the weight of pigeon eggs in different studies may be mainly due to the changes in the weight of adult pigeons of different breeds clearly observed in this study (Table 3 and Table 4). Old pigeons weighing less than 300 grams lay eggs weighing 14.80-20.07grams, pigeons weighing 300-350gramslay eggs weighing 14.47-19.19grams and pigeons weighing 350-400 grams lay eggs that weigh less than 25grams.This relationship was also observed between body weight and the length and width of the egg (Table 5). Robertson [31-36] reported the relationship between pigeon weight and egg weight.

Conclusion

The advancement of pigeon breeds can be improved through selection and other qualified breeding policies to improve pigeon performance. Significant differences in egg morphology and post-hatch weight gain were observed indifferent breeds of pigeons. Around 4 weeks of age is a good time to cull pigeons for meat. There is a correlation between body weight and egg length, width, and weight of pigeons of all controlled breeds.

References

1. Levi W (1977) The Pigeon. Levi Publishing Company, Inc. USA.
2. Levi VM (1974) In Textbook. The Pigeon. Levi Publication Co Inc., Sumter, SC.
3. Shapiro MD, Domyan ET (2013) Domestic pigeons. *Curr Biol* 23: R302-R303.
4. Stanhope B (1978) The species our ancestors forgot production possibilities of Japanese quail, squab pigeons, guinea fowl and pheasants, Victoria. *J Agric Victoria* 76: 250-251.
5. Kabir MA (2013) Productivity of crossed indigenous pigeon in semi-intensive system. *Basic Res J Agricul Sci Rev* 2: 1-4.
6. Bhuyan P, Nath D, Hazarika M (1999) Influence of age and sex on nutritive value (proximate composition) of squab and pigeon meat. *Indian Vet J* 76: 530-532.
7. Mohamed R, Shukry M, Balabel T, Elbassiouny A, Rehmani A, et al. (2016) Assessment of plasma prolactin and nest defense behaviour during breeding cycle of pigeon (Columba liviadomestica). *J Environ Agric Sci* 7: 19-22.
8. Dumont JN (1965) Prolactin-induced cytologic changes in the mucosa of the pigeon crop during crop-"milk" formation. *Z Zellforsch Mikrosk Anat* 68: 755-782. [Crossref]
9. Gao CQ, Yang JX, Chen MX, Yan HC, Wang XQ (2016) Growth curves and age-related changes in carcass characteristics, organs, serum parameters, and intestinal transporter gene expression in domestic pigeon (Columba livia). *Poult Sci* 95: 867-877. [Crossref]
10. Khurshid A, Farooq M, Durrant FR, Sarbiland K, Chand N (2003) Predicting egg weight, shell weight, shell thickness and hatching chick weight in Japanese quails using egg traits as regressors. *Int J Poult Sci* 2: 164-267.
11. Du Z, Li W, Shi Z, Shen Y, Li H (1993) Effect of artificial feeding of pigeons at different ages. *Gansu Nongye Daxue Xuebao* 28: 10-12.
12. Tsat S, Yeh W, Chi Y, Itakura C (1994) Force-feeding and candidiasis in pigeons. *Avian Pathol* 23: 569-574. [Crossref]
13. AbdelFattah AF (2016) Parental care during incubation, brooding and growth rates of egyptian baladi pigeon nestlings. *Br J Poult Sci* 4: 29-33.
14. Xie JJ, Lemme A, He JY, Yin P, Figueriredo-Silva C, et al. (2017) Fishmeal levels can be successfully reduced in white shrimp (Litopenaeusvannamei) if supplemented with DL-Methionine or DL-Methionyl-DL-Methionine. *Aquac. Nutr* 5: 1-9.
15. Darwati S, Martojo H, Sumantri C, Sihombing DTH, Mardiastuti A (2010) Productivity, repeatability of productive and reproductive traits of local pigeon. *J Indon Trop Anim Agri* 35: 268-274.
16. Bhowmik N, Mia MM, Rahman MA (2014) Morphometric measurements, productive and reproductive performance of jalali pigeon. *Intern J Develop Res* 4: 908-911.
17. Islam MR (2010) Pigeon farming and meat yield of some genetic groups in Mymensingh District. MSc, Department of Poultry Science, Bangladesh Agricultural University, Mymensingh, Bangladesh.
18. Azad MAK (2009) Nutrient availability and body composition of semi-scavenging gola pigeon and meat yield of their squab. Department of Poultry Science, Bangladesh Agricultural University, Mymensingh, Bangladesh.
19. Xie P, Jiang XY, Bu Z, Fu SY, Zhang SY, et al. (2016) Free choice feeding of whole grains in meat-type pigeons: 1. effect on performance, carcass traits and organ development. *Br Poult Sci* 57: 699-706. [Crossref]
20. Zielezinski M, Pawlina E (2011) Analizawzrostugoł, ebiróznychras, Growth analysis of various pigeon breeds. *Rocz Nauk PTZ* 7: 45-51.
21. Pawlina E, K Borys (2009) Growth of wrocław meat breed pigeons in relation to the number of birds in the nest. *Rocz Nauk PTZ* 5: 44-49.
22. Ibrahim T, Y Sani (2010) Relationship between egg weight and hatch weight in pigeons (Columba livia). *Int J Poult Sci* 9: 599-601.
23. Saxena VL, Pandey E, Agarwal S, Saxena AK (2008) Execution of breeding and nidificationbehaviour in pigeon (Columba livia) and dove (Streptopeliachinensis). *Asian J Expt Sci* 22: 405-410.
24. Robinson RA (2005) Bird facts: Profiles of birds occurring in Britain and Ireland. BTO Research Report, Thatord: BTO. http://www.bto.org/bird facts. Sales J and GPJ Janssens, 2003. Relationship between egg weight and hatch weight in pigeons (Columba livia). *World's Poult Sci* 59: 221-232.
25. FAO (Food and Agricultural Organization) (2010) Draft guidelines for molecular characterization of animal genetic resources for food and agriculture. Rome: FAO.
26. Abdel-Azeem FA, Abdel-Rafea AE, AbdullahAE (2007) Studies on the effect of different dietary metabolizable energy levels on some performance of local baladi pigeons. *Egypt Poult Sci* 26: 595-611.

27. Robertson HA (1988) Relationships between body weight, egg weight and clutch size in pigeons and doves (Aves: Columbiformes). *J Zool Lond* 215: 217-229.

28. Asaduzzaman M, Mahiuddin M, Howlider MAR, Hossain M, Yeasmin T (2009) Pigeon farming in Gouripurupazilla of Mymensingh district. *Banglad J Anim Sci* 38: 142-150.

29. Beena V (2019) Applications of livestock in biomedical research. *J Dairy Vet Anim Res* 8: 107–109.

30. Bradley A, Mennie N, Bibby PA, Cassaday HJ (2020) Some animals are more equal than others: Validation of a new scale to measure how attitudes to animals depend on species and human purpose of use. *PLoS ONE* 15: e0227948.

31. Essam AM (1997) Behaviour and management of pigeons. PhD, Faculty of Veterinary Medicine, Moshtohr, Zagazig University.

32. Griminger P (1983) Digestive system and nutrition. Pages 19-39 in Physiology and Behaviour of the Pigeon. Abs, M., ed. Academic Press, New York, NY.

33. Gofur MR (2020) Textbook of Avian Anatomy. 1st edn. Uttoran Offset Printing Press, Rajshahi, Bangladesh.

34. Hsiung DT, Simonds N, Lowe J (2005) The food of China: A Journey for food lovers, Murdoch books. pp: 125.

35. Levi WM (1957) The Pigeon. Published by-Levi Publishing Company. Inc. Sumter, S. C. USA.

36. Mariam SA (2007) Study on management, behavory, physiology and meat characteristics of pigeons in Khartoum State. PhD Thesis, Khartoum Univ., Khartoum, Sudan. McCutcheon JE and M Marinelli, 2009. Age matters.