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Article

Quality characteristics and hatchability of eggs and serum electrolytes concentration of Gola, Giribaz and Ghiachundi pigeon breed

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Abstract: The weather and vast areas of crop fields along with housing premises of Bangladesh are suitable for pigeon farming. The experiment was conducted to evaluate the characteristics of eggs and serum electrolyte concentration of Gola, Giribaz and Ghiachundi pigeon squabs. Three pairs of each breed were reared in the cage with commercial feed and water. After laying eggs, the length and width of eggs were recorded. After hatching of eggs, eggshell thickness was recorded. The thickness of the eggshell was 0.15±0.01 mm, 0.15±0.01 mm, 0.15±0.00 mm for Gola, Giribaz and Ghiachundi breeds respectively. The body weights of the squabs were recorded at 7th and 45th day. The squabs were sacrificed on 45th day and the blood sample was collected and serum sodium, potassium, calcium and phosphorus concentration were measured by using appropriate analytical techniques. Serum sodium, potassium, calcium and phosphorus were: 102.93±15.95 (mmol/L), 11.18±2.19 (mmol/L), 6.20±1.11 (mmol/L), 4.53±0.45 (mmol/L) for Gola breed; 101.48±2.12 (mmol/L), 12.15±0.96 (mmol/L), 5.65±1.09 (mmol/L), 4.53±0.36 (mmol/L) for Giribaz breed and 95.18±6.71 (mmol/L), 11.99±0.91 (mmol/L), 5.09±0.75(mmol/L), 4.81±0.24 (mmol/L) for Ghiachundi breed respectively. A positive correlation has been found between thickness of eggshell and phosphorus while there is a negative correlation with calcium for Gola breed; both have been found insignificant for Giribaz breed and only calcium has been found significant for Ghiachundi breed. A strong correlation between the final body weight of the squab and K for the Gola breed; between the final body weight of the squab and Ca, P, K for Giribaz breed and between the final body weight of the squab and Ca, Na, K have been found. It could be concluded that serum electrolytes having an influential effect on egg characteristics and body weight of corresponding pigeon breed.

Keywords: calcium; phosphorus; eggshell thickness; body weight; pigeon

1. Introduction

Since 2500 BC, Pigeons (*Columba livia domestica*) used by man for meat production, ornamentals, sports and experimental animals (Sales and Janssens, 2003). Pigeon farming has almost been a common practice among all classes of people in Bangladesh since the time immemorial. It is the most common domestic bird after chicken and duck in Bangladesh. Currently, a significant number of people solely or beside their main profession are involved in pigeon farming both in urban and rural areas (Asaduzzaman *et al.*, 2009). Pigeon meat is of high quality and a good dietetic for the sick, weak, ailing. Usually considered a delicacy, squab is tender, moist and richer in taste than many commonly consumed poultry meats (Andrew and Blechman, 2006). The meat is very lean, easily digestible, and rich in proteins, minerals, and vitamins (Canova and Jane, 2005). We all know that, feeding habits has a great effect on the growth and reproduction of all the living beings. For the hatchability traits, breed has little effect on hatchability of poultry eggs, although light breeds have been reported to have higher fertility and hatchability. The most influential egg characteristics that influence hatchability are: weight,

shell thickness and porosity, shape index and the consistency of the contents. (King'ori, 2011). Nutritional deficiencies having effects on the embryo to become more severe and to occur at earlier stages of development. The type of nutritional stress signs visible in the embryo often depend upon the severity of the maternal nutritional stress (Wilson, 1997). A deficiency of folic acid can cause vitamin A deficiency directly results in decreased hatchability, riboflavin is used in albumin and calcium or vitamin D deficiency leads to a thin shell (Uğurlu *et al*., 2017). Dietary factors that modulate the immune system and gut microflora should be considered when formulating diets and managing feeding practices (Choct, 2009). When any deviation from normal level of electrolyte occurs, disease condition develops in the body. (Mohammadiha, 1991). Sodium level helps to indicate the dehydration status of individuals. Increased K level may indicate kidney failure, dehydration or may lead to heart failure. P elevations are always associated with kidney disease, hyperthyroidism and bleeding disorders. (Tisdall *et al.,* 2006). Aged laying hens require relatively higher level of Ca than required levels from current Korean feeding standards for poultry (Hyun *et al.,* 2016). The source of calcium significantly affected eggshell quality, egg weight, egg height, egg diameter, albumen weight, yolk weight, shell weight, and shell thickness (Nisrin *et al.,* 2013). However, very little information is available on the serum electrolyte concentrations; its effect on hatching performance, egg parameters and maintaining quality characteristics of pigeons. Therefore, the present study was performed to assess the egg quality with hatchability and to measure some selected serum electrolytes (Na, K, Ca and P) of Gola, Giribaz and Ghiachundi pigeon breed.

2. Materials and Methods

2.1. Experimental design

For the proposed investigation, three different breeds of pigeon (Gola, Giribaz and Ghiachundi) were selected from different farmers of greater Rajshahi region reserving the highest purity. Nine wooden cages were prepared for 9 pairs. A wide area covered with net was provided in front of the cages for better movement and comfort. For every breed, 3 pairs of pigeons were brought under investigation on their eggs and squabs. After the eggs being laid on the nest, the eggs were observed for diameter (length, width), color, cracks on egg shell, other deformities and the rate of egg hatchability was assessed. On the seventh day after the eggs being hatched, the body weight of the squabs was recorded which was again repeated on 45^{th} day after they came out of egg. The squab was sacrificed for blood collection on 45^{th} day.

2.2. Feeding

Traditional feed was supplied to the pigeon. Rice, maize, wheat, mustard and kaon was supplied as concentrate. Normal pure water was supplied two times daily and during the winter Luke warm water was supplied three times daily.

2.3. Production of egg and measurement of egg diameter

It was observed that within a few days each pair of pigeon mated together. Within 18 to 25 days at the age of 7 months, every pair of pigeons produced two eggs. Usually, pigeons can breed 8 times a year in optimum conditions and each time lay two eggs. First and second egg were identified and marked. After production, eggs were collected and then width and length of the eggs were recorded. This was done very carefully, doing no harm to the eggs.

2.4. Hatching of egg and production of squab

Young dependent pigeons are commonly known as 'squabs'. After the production of egg both the male and female started to incubate the eggs. The day that they started to incubate was recorded. The eggs took 18-19 days to hatch and all pairs brought 2 squabs each. The date was recorded and squab was identified (first and second) as the eggs were marked. After the eggs being hatched, egg shells were collected and shell thickness was recorded.

2.5. Measurement of body weight

At 7^{th} day after hatching, the weights of the squabs were measured by digital balance and record was kept. After taking the weight at 7^{th} day the squabs were kept with special care. During this period abundance of feed and water were confirmed. Then, at 45^{th} day weights were measured by digital balance and record was kept.

2.6. Blood collection and preparation of serum

At 45^{th} day, after measuring the weight of the squabs, they were sacrificed for blood collection. Blood was collected in the test tube that was labeled with breed's name, date and other identifying characters of the

corresponding one. After collection of blood test tubes were kept in slanting position for 6 hours. After that, the test tubes were incubated overnight at 4^0C in refrigerator. Then, serum was collected and centrifuged to get rid of unwanted blood cells. All the collected serum samples were kept in the deep fridge arranged on a board for further analysis.

2.7. Analysis of the samples

Measurement of calcium, sodium and potassium of serum were carried out by flame photometry (Corning 410, Sherwood Scientific Limited, UK) as described by Kirk and Sawyer (1991) and spectrophotometry method mentioned by Darcie and Lewis (2011) was used in the measurement of phosphorus. Flame photometry is a controlled flame test with the intensity of the flame color quantified by photoelectric circuitry. The intensity of the colour will depend on the energy that had been absorbed by the atoms that was sufficient to vaporise them. The sample is introduced to the flame at a constant rate. Filters select which colours the photometer detects and exclude the influence of other ions.

2.8. Statistical analysis

All data were subjected to statistical analysis using SPSS 20 program by one-way ANOVA followed by post-hoc Turkey's test.

3. Results and Discussion

3.1. Body weight and hatchability of eggs of Gola, Giribaz and Ghiachundi pigeon breed

Body weights of squab on 7^{th} and 45^{th} day and hatchability are shown in Table-1. Body weight of the squab at 7^{th} day was 129.17 ± 38.04 gm for Gola breed; 119.50±43.31 gm for Giribaz breed and 91.17±5.98 gm for Ghiachundi breed respectively. Body weight of the squab at 45^{th} day was 240.17±21.00 gm for Gola breed; 242.33±15.68 gm for Giribaz breed and 265.83±17.81 gm for Ghiachundi breed respectively. The hatchability was 90%, 80% and 90% in Gola, Giribaz and Ghiachundi respectively.

3.2. Eggshell thickness and egg diameter of Gola, Giribaz and Ghiachundi pigeon breed

Thickness of eggshell was 0.15±0.01 mm, 0.15±0.01 mm, 0.15±0.00 mm for Gola, Giribaz and Ghiachundi breed respectively. The width and length of egg was 27.79±1.93 mm & 37.20±0.83 mm for Gola, 27.63±1.40 mm & 37.50±1.18 mm for Giribaz and 27.31±0.60 mm & 35.25±1.31 mm for Ghiachundi respectively (Table 2). In reference to the normal value, none of the parameters showed any alteration.

3.3. Serum electrolyte concentrations of Gola, Giribaz and Ghiachundi pigeon breed

Serum sodium, potassium, calcium and phosphorus were: 102.93±15.95 (mmol/L), 11.18±2.19 (mmol/L), 6.20±1.11 (mmol/L), 4.53±0.45 (mmol/L) for Gola breed; 101.48±2.12 (mmol/L), 12.15±0.96 (mmol/L), 5.65±1.09 (mmol/L), 4.53±0.36 (mmol/L) for Giribaz breed and 95.18±6.71 (mmol/L), 11.99±0.91 (mmol/L), 5.09±0.75(mmol/L), 4.81±0.24 (mmol/L) for Ghiachundi breed respectively (Table 3). In reference to the normal value, none of the serum electrolyte parameters showed any alteration. These findings are in close agreement with the works reported by Lumeij and Bruijne (1985). Due to breed difference there was a slight fluctuation among the electrolytes.

3.4. Correlations of serum electrolytes and egg parameters with final body weight of the squab at 45^{th} day for corresponding three breeds

According to the table-4, there is a positive correlation between phosphorus and thickness of eggshell while there is a negative correlation with calcium in Gola breed. The finding matches with the result found by Clunies *et al.* (1992). This is due to increased calcium absorption while phosphorus is low and vice versa mentioned by Taylor (1965). A strong correlation was found between the final body weight of the Gola squab and potassium concentration. This is similar with the result found by Oliveira *et al.* (2005). There is also a strong correlation between the final body weight of the squab and the surface area of egg, which is similar with Ibrahim and Sani (2010). According to the table-5, calcium and phosphorus was found non-significant in affecting thickness of eggshell in Giribaz breed, which is similar with Swiatkiewicz *et al*. (2015). A strong correlation was found between the final body weight of the Giribaz squab and blood electrolytes (Ca, P and K). There is also a strong correlation between the final body weight of the Giribaz squab and the surface area of egg, which is similar with Ibrahim and Sani (2010). According to the table-6, there is a positive correlation between calcium and thickness of eggshell in Ghiachudi breed, which is similar with Nisrin *et al.* (2013). A strong correlation was found between the final body weight of the Ghiachudi squab and blood electrolytes (Ca, Na and K). There is also a

strong correlation between the final body weight of the Ghiachudi squab and the surface area of egg, which is similar with Ibrahim and Sani (2010).

Table 1. Body weights of corresponding pigeon squab at 7th and 45th day and hatchability of eggs.

Breed of pigeon	Squab body weight (gm)		Hatchability (%) (n=10)
	Weight at 7th day	Weight at 45th day	
Gola	129.17±38.04[a]	240.17±21.00[b]	90
Giribaz	119.50±43.31[a]	242.33±15.68[b]	80
Ghiachundi	91.17±5.98[b]	265.83±17.81[b]	90

Values with different superscripts differ significantly ($p<0.05$) in the same row.

Table 2. Egg parameters of corresponding pigeon squab (n=18).

Parameters	Thickness of eggshell (mm)	Diameter of egg (mm)	
		Width	Length
Gola	0.15±0.01	27.79±1.93	37.20±0.83
Giribaz	0.15±0.01	27.63±1.40	37.50±1.18
Ghiachundi	0.15±0.00	27.31±0.60	35.25±1.31

Table 3. Serum sodium, potassium, calcium and phosphorus concentration of corresponding pigeon squab (n=18).

Parameters	Sodium (mmol/L)	Potassium (mmol/L)	Calcium (mmol/L)	Phosphorus (mmol/L)
Gola	102.93±15.95	11.18±2.19	6.20±1.11	4.53±0.45
Giribaz	101.48±2.12	12.15±0.96	5.65±1.09	4.53±0.36
Ghiachundi	95.18±6.71	11.99±0.91	5.09±0.75	4.81±0.24

Table 4. Correlations of serum electrolytes and egg parameters with final body weight of the squab at 45th day for Gola breed.

Gola	Thickness of egg shell (mm)	Ca (mmol/L)	P (mmol/L)	Na (mmol/L)	K (mmol/L)	Weight of squab at 45th day (gm)	Surface Area
Thickness of egg shell(mm)	1						
Ca (mmol/L)	-0.394	1					
P (mmol/L)	.806**	-0.172	1				
Na (mmol/L)	-0.238	.985**	-0.013	1			
K (mmol/L)	-0.312	0.54	-0.19	0.539	1		
Weight of squab at 45th day(gm)	-0.303	0.501	-0.17	0.507	.939**	1	
Surface Area	-0.088	.663*	-0.078	.693*	.909**	.792**	1

* Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level

Table 5. Correlations of serum electrolytes and egg parameters with final body weight of the squab at 45th day for Giribaz breed.

Giribaz	Thickness of egg shell (mm)	Ca (mmol/L)	P (mmol/L)	Na (mmol/L)	K (mmol/L)	Weight of squab at 45th day (gm)	Surface Area
Thickness of egg shell(mm)	1						
Ca (mmol/L)	0.336	1					
P (mmol/L)	0.231	.988**	1				
Na (mmol/L)	0.435	.698*	0.618	1			
K (mmol/L)	0.246	.976**	.977**	.727*	1		
Weight of squab at 45th day(gm)	0.062	.809**	.882**	0.311	.848**	1	
Surface Area	0.27	.821**	.848**	.633*	.832**	.818**	1

* Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level

Table 6. Correlations of serum electrolytes and egg parameters with final body weight of the squab at 45th day for Ghiachundi breed.

Ghiachundi	Thickness of egg shell (mm)	Ca (mmol/L)	P (mmol/L)	Na (mmol/L)	K (mmol/L)	Weight of squab at 45th day (gm)	Surface Area
Thickness of egg shell(mm)	1						
Ca (mmol/L)	.639*	1					
P (mmol/L)	-0.292	-0.278	1				
Na (mmol/L)	.671*	.981**	-0.445	1			
K (mmol/L)	0.327	.921**	-0.315	.892**	1		
Weight of squab at 45th day(gm)	0.552	.897**	-0.043	.827**	.841**	1	
Surface Area	0.611	.966**	-0.212	.926**	.907**	.976**	1

* Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level

4. Conclusions

The research could open a gateway for the scientists and appropriate authority to take necessary steps in pigeon farming with new dimension especially with the emphasis on health and reproduction thereby reducing the vast mortality of pigeon every year. This may add extra value to the poultry industry where there could be a huge opportunity both for employment and earning money through supplying squabs in local and foreign markets.

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Conflict of interest

None to declare.

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