



Early sex determination of Turkey by observation of differences in body weight between male and female

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Abstract

The present study was conducted to determine the early sex in turkeys by observation of the differences in body weight between male and female birds. A total of 30-day old black color unsexed poultts having almost similar body weight at hatching were considered for the experimentation and housed at the Poultry Farm of Bangladesh Agricultural University, Mymensingh-2202, Bangladesh. All birds were reared up to 12 weeks of age under intensive management with supplementation of commercial broiler starter and grower feeds. Birds were reared under similar management conditions. Significantly higher ($p < 0.01$) body weight was attained in male poultts (104g/bird) than the female (90g/bird) at the end of 1st week of age. Similarly, at the end of 2nd week of age higher ($p < 0.01$) body weight attained by male poultts (198.31g/bird) than the female (162.13g/bird). At the end of 3rd weeks of age male poultts attained higher ($p < 0.01$) body weight (307.23g/bird) than the female (251.33g/bird). After 4 weeks of rearing, male turkeys attained significantly higher ($p < 0.01$) live body weight (424.46g/bird) than the female turkeys (347.87g/bird). The weekly average body weight gains of male and female birds were 94.18g/bird and 76.5g/bird, respectively. Thus, the male and female birds were successfully identified on the basis of differences in their body weight. Weekly feed intake for both the male and female birds was also increased with their age. Up to 4 weeks of age, both the male and female poultts consumed same amount of feed (753.46g/bird). The FCR of male and female poultts differed non-significantly in 1st, 3rd and 4th week. On the contrary, in 2nd week of age the FCR of male poultts (1.60) was significantly lower ($p < 0.01$) than female (2.11). Survivability was 100% up to 4th week of age irrespective of sex of the poultts. The birds were reared up to 12 weeks of age until to confirm their sex by observation of the phenotypic appearance. Results of the phenotypic observation of male and female birds correspondence hundred percent accuracy with the results obtained in body weight based differences between male and female birds. It is therefore concluded that farmers can identify male or female poultts as early as first week of age on the basis of body weight differences.

Key words: Early sex determination, heritage turkeys, poultts, body weight variation, body weight gain

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Introduction

In Bangladesh, the poultry industry plays a pivotal role in creating employment opportunity, improving food

security, enhancing the supply of quality protein to people's meal and also contributes to country's

economic growth. Because of low investment, short production cycle and quick return, farmers prefer rearing poultry instead of cattle, goat, sheep or other large animals (Asaduzzaman *et al.*, 2017). In addition to backyard poultry production by rural people in Bangladesh, some enthusiastic industrialists came forward and launched commercial poultry production to ensure the supply of quality animal protein in terms of poultry meat and eggs. As a result, a remarkable growth and expansion of poultry industry has been observed since the last quarter of 20th century. In Bangladesh, chicken is predominant (90%) over all other poultry species followed by duck (8%) and remaining species such as quail, geese, pigeon etc. which comprises around 2% of total poultry population (Das *et al.*, 2008). USDA reports that the demand of poultry meat may increase up to 2.0 million tons in Bangladesh by the year of 2021 whereas the present poultry meat production is 1.46 million tons annually. In overall chicken meat production, broiler industry represents 60% of total production and remaining 40% come from the indigenous chicken (Islam *et al.*, 2015). But in recent years, a large segment of consumers shows negative attitudes and perceptions against the commercial broiler meat because they believe that broiler meat is hazardous to health because of the indiscriminate use of antibiotics, growth promoter and feed additives. As a result, consumers are searching for alternative poultry meat because modern consumers are more health conscious and they always prefer safe and quality meat. As Bangladesh is passing a transitional period from developing to the middle-income country (Byron and Habib, 2018) the overall purchasing capability of general masses is increasing day by day with the advancement of economic improvement. In response to consumer preferences, a good number of small and medium scale commercial broiler farm have been closed their business and are looking for alternative. Most of them were restarted farming with *sonali* chicken, turkey, guinea fowl etc. using existing set-up like poultry shed, equipment and other accessories and also more importantly they have

experience-based knowledge. Owen *et al.*, (2008) also emphasized the rearing of variable poultry species in order to maximize food production and meet protein requirements in developing countries. Therefore, the production of turkeys may be one of the choices in addition to commercial broiler in Bangladesh.

Turkey production is considered as one of the important and highly profitable agricultural industries with the raising global demand (Yakubu *et al.*, 2013). According to Food and Agriculture Organization (FAO, 2006), world turkey meat production was estimated at 5,797,748 tonnes. Consumers prefer turkey meat because of its leanest nature. Turkey meat has nutritional and sensorial properties which make it almost ideal raw material for rational and curative nutrition. The protein, fat, energy value of turkey meat is 24%, 6.6%, 162 Calories per 100 gm of meat (Asaduzzaman *et al.*, 2017). Several minerals such as potassium, calcium, magnesium, iron, selenium, zinc and sodium are present in turkey meat. It is also rich in essential amino acids and vitamins like niacin, vitamin B6 and B12. It is rich in unsaturated fatty acids, essential fatty acids and low in cholesterol (Turkey Management Guide, 2012, CPDO). Many consumers consider turkey meat more precisely the heritage turkey meat as a luxury one. They are willing to pay more due to its special taste, texture and quality. Despite the premium qualities, production efficiency of birds for even consumer's positive attitudes towards turkey meat, the species was not been introduced in Bangladesh.

The birds were introduced in Bangladesh by some enthusiastic bird-lover approximately 9-10 years back through cross-bordering from the neighboring countries (Das *et al.*, 2018). They were quickly adjusted to our local environmental condition, thrive well under low plane of nutrition, housing and management practices. Thus, it drew rapid and quick attention of some small and medium scale poultry farmers. In the recent years, many broiler or layer farmers and enthusiastic unemployed youth have been engaged in turkey

farming and kept around 50-200 turkeys at their homestead premises and getting profit by selling the poults (Das *et al.*, 2018). Shamim (2018) reported a total of 2500-3000 small and medium scale turkey farms are present in Bangladesh.

In rearing turkeys, one of the key problems faced by the farmers is to differentiate between male and female at early age. Usually, the farmers have to wait until 2.5-3 months for the phenotypic observations to identify male and female. If the sex of turkeys can identify at early age, farmers can supply separate diets for male and female birds. In the diet of male turkeys, for example, need more protein for target growth to reach their market weight within 4 months and farmer can get money by selling the male turkeys with premium price. Female birds, on the other hand, can be reared for egg and poults production.

Traditional methods of sexing turkeys have included vent sexing, karyotype analysis, and examination of gonadal morphology, of which the common method is vent sexing that based on the anatomical differences in the cloaca of newly hatched male and female poults (Hammond & Marsden, 1937; Canfield, 1952). This method of sexing requires extensive periods of training and experience. Upon dissection, the male embryo is characterized by a pair of tubular testes of about equal length and the female by a larger shield-shaped left ovary and a smaller right ovary (Burke, 1994). Molecular sexing also requires highly skilled person and experience as well which is not readily available in Bangladesh. Once the sexing of poults can be ensured at early age by the observation of body weight differences between male and female, the cost of rearing turkey can be decreased and consequently drawn more profit for turkey farmers. Keeping all above points in view, the present study is therefore designed to determine the early sex of male and female turkeys by the observation of individual body weight.

Materials and Methods

The present research was designed with a core objective to separate male and female heritage poults at

early stage of their life. To achieve the goal, a total of 30 black variety day old poults were considered. All the poults used in the experiment were brooded and reared upto 12th weeks of age in complete confinement at Bangladesh Agricultural University Poultry Farm, Mymensingh, Bangladesh.

Preparation of experimental house: A gable type, open-sided house was considered for brooding and rearing of the experimental poults. The house was cleaned and disinfected, and allowed to rest for at least 7 days prior to placement of the poults. Some necessary equipment such as feeders, drinkers, brooders etc. were cleaned and disinfected accordingly. The whole room area was sanitized with Virkon S (DuPont™ Virkon® S), maintaining a ratio of 1:100 (1%), a common but widely used effective disinfectant purchased from the local market. Before arrival of the poults, rice husk was provided as bedding materials. Afterwards, jute sack was placed over bedding material. Brooder and chick guard were properly placed and checked. Drinkers and feeders were also provided prior to the arrival of poults. Almost 1.5 sq. ft. floor space was allocated per poult. Floor space of the pen was 45 sq. ft. (9 ft. in length and 5 ft. in width).

Collection and identification of experimental birds: A total of 30 black day old poults were purchased from a hatchery in Bogura district of Bangladesh and brought to BAU Poultry Farm. To ensure uniform initial body weight of poults, a regular communication was made with the farmer so that the hatching eggs he considered must come from the parents having same age and were reared under identical management and diet. After collection, eggs were incubated in a single batch incubator. An alternative paper-based tagging was performed for the individual poult, which is not only cheaper but also convenient. The paper tag was developed by the researcher herself.

Brooding and rearing of poults: Turkeys are not the best starters in their life and really need some tender loving care to get them safely through the first four weeks of life. Brooding was performed in traditional

system by using 100 and 200 watts electric bulbs and heater coil under the hover, and then heat was decreased gradually by lifting up the bulbs and hover as per requirement of the temperature. Thermo-hygrometer was hanged at the bird's level in the brooder to record temperature and relative humidity. A total of 30 day old poults were brooded and reared up to 4 weeks of age in the brooding house. In current study, usually 2-3°C higher temperature was provided for successful brooding of the poults. After completion of brooding period birds were kept in the same pen until expression of their phenotypic characteristics to confirm the sex of birds. In this period 30 poults were weighed individually daily in the morning and recorded. Both temperature and humidity were recorded four times daily (6 AM, 12 PM, 5 PM, 10 PM) using an automatic thermo-hygrometer during the whole experimental period.

Feeding, drinking, lighting and environmental management: In Bangladesh, since the turkey has been introduced recently, specialized feed formulae based on the nutrients requirement yet has not been developed. Thus, farmers usually use broiler starter and broiler grower feed at initial stage, and later they supply layer grower during growing period followed by layer-layer diet during laying period. It has been well reported that the nutrients requirement of heritage turkey, protein in particular, is much higher (approximately 28%) than the broiler diet (22%). During this experiment the diet supplied to the birds was broiler starter and broiler grower (twice a day i.e. at early in the morning and afternoon). For this reason, the nutrients requirement (protein for example) was not up to the satisfactory levels. For the first 5 weeks, broiler starter and then broiler grower was provided without any supplementation. Fresh, clean and potable drinking water was provided twice a day i.e. early in the morning and afternoon prior to feed supply. Multivitamins and calcium (Calvita, Gentry Pharmaceuticals Ltd., Sreepur, Gazipur @ 5 ml/liter) were supplied with water for few days to satisfy the additional requirement. Continuous lighting was

provided using electric bulb along with natural lighting at day time for first 3 weeks of age. The light intensity was 20-40 lux. Afterwards, the birds were exposed to natural lighting during entire experimental period.

Immunization of the experimental birds: As mentioned earlier, the species is very new in Bangladesh and therefore a scanty of research have been conducted on the outbreak, prevention and control of diseases. However, the preliminary observations clearly indicated that the birds are quite susceptible to common diseases of chicken such as Infectious Bronchitis Disease (IBD), Newcastle Disease (ND), Fowl pox, MC-Complex etc. Thus, we decided to vaccinate the birds against the common diseases of chicken. After hatching, poults were vaccinated with IBD and ND vaccine (CEVAC® BIL, produced in Hungary, contains Massachusetts B48 strain of IB virus and the Hitchner B1 strain of ND virus) and booster dose was performed at 18 days of age. Fowl pox vaccine was administrated at 35 days of age through puncturing of wing web (w/w). At 50 days of age, PoulShot® LaSota is used for immunizing fowl against ND through drinking water.

Litter management and biosecurity measures: Fresh and dry rice husk was used as litter materials with the thickness of 2" for comfort of the birds. As compared to chicken, the voluminous droppings of turkey make the litter damp quickly. As a result, extra attention was paid in the management of litter used. Since the turkeys are heavy birds and more aggressive than any other species of poultry, drop down water and wet litter around the waterer is very common. Thus, damp and wet litter was changed partially or fully once in a 14 days so that the overall litter condition became good to ensure the optimum comfort of the birds.

A strict but possible biosecurity measures was taken. Potassium permanganate solution was used as disinfectant in the footbath. TH₄⁺ (Manufactured by-Sogeval, France) solution maintaining a ratio of 1:100 was sprayed over the floor areas, litter, equipment and machineries, walls, doorsteps and around the house

once before arrival of the poults and then on regular basis. Before entering into the shed, hands and foots were sprayed with disinfectant every time. Separate plastic sandals, apron and gumboot were used during routine care of the birds.

Data collection, record keeping and statistical analysis: Data on daily body weight of each bird, weekly average body weight, body weight gain, bird's survivability, vaccination and medication were recorded. Records on weekly feed consumption were maintained until end of the experiment. The feed conversion ratio (FCR) was calculated dividing the total feed consumption by average body weight gain. The recorded data were analyzed using Independent t-test and Paired t-test procedure using SPSS software.

Results and Discussion

Body weight: Weekly body weight of male and female turkeys reared under intensive system with identical management and fed similar diet is shown in Table 1.

Result showed the significant differences ($p < 0.01$) in the live body weight of male and female birds.

In the 1st week, average body weight of male turkey was 104.00g/bird and female was 90.00g/bird. The average body weight of female was also lower (162.13g/bird) than the male (198.31g/bird) turkey at 2nd week of their age. For the 3rd week, live body weight of female turkey (251.33g/bird) was found significantly lower than the male turkey (307.23g/bird). As like previous weeks, the average body weight of male was significantly higher (424.46g/bird) than the female (347.87g/bird) in 4th week. Statistical analysis of the data clearly revealed that there were significant differences ($p < 0.01$) in the body weight of male and female turkeys for each week of rearing. Results described in Table 1 clearly postulated significantly higher body weight in black colour male turkey even in first week of rearing compared to female turkey, suggesting that one can identify male or female poults even after 7 days of rearing by the observation of their body weight differences.

Table 1. Weekly body weight of male and female turkey poults.

Age (weeks)	Body weight (g) (Mean±SE)		Differences in body weight (g)	P-value	Level of significance
	Male (n=14)	Female (n=16)			
Initial body weight	46.57±1.47	43.38±0.94	3.19		
1 st	104.00±3.43	90.00±1.59	14.00	0.000	**
2 nd	198.31±5.76	162.13±2.81	36.18	0.000	**
3 rd	307.23±7.25	251.33±3.97	55.9	0.000	**
4 th	424.46±8.48	347.87±8.00	76.59	0.000	**

** , $P < 0.01$; BW= Body weight and value indicate, Mean± Standard Error (SE).

In a recent published report by Sogut *et al.* (2016), it was shown that male poults hatching weight (63.10g/poult) was significantly higher than that of the female (61.87g/poult). Further, they mentioned the significant differences in body weight at 2nd week (male = 234.71g/bird, female = 224.75g/bird) and 4th

week (male = 687.14g/bird, female = 642.40g/bird) of age. Jahan *et al.* (2018) also mentioned that the average body weight of male poults was higher than the female (male = 720g/bird, female = 630g/bird) at 4th week of age. Ilori *et al.* (2010) also found the similar result, that is, the body weight of male poults were showed higher

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at 1st week (male = 94.71g/bird, female = 71.72g/bird) and at 4th week (male = 357.68g/bird, female = 316.14g/bird) of age.

Thus, it is likely that the body weight of male poult is always higher than the female even from the point of hatching. Now, we suggest that anyone can easily identify the male and female poult at first week of age based on the differences in body weight of male and female poult.

Body weight gain: Body weight gain of male and female turkey poult is presented in the Table 2. The analyzed data in the table indicates that there was no

significant differences in weekly body weight gain between male and female turkey poult. Weekly average body weight gain of male and female turkey poult up to 4th weeks of age was 94.18g/bird and 76.5g/bird respectively.

Isguzar (2003) investigated that, in the first seven weeks of age, turkeys attained a very low intensive growth rate. Yilmaz *et al.* (2011) conducted an experiment on Hybrid Converter poult and observed that the average body weight gain of male and female turkey poult was 158g and 148g respectively in 1st week and 476g and 432g respectively in 2nd week.

Table 2. Weekly average body weight gain of male and female turkey poult.

Age (Weeks)	Weekly average body weight gain (Male)		Weekly average body weight gain (Female)		P-Value	LS
	Male	Mean ± SE	Female	Mean ± SE		
1 st	57.43		47.25			
2 nd	94.14	94.18±13.14	72.5	76.5±11.04	0.343	NS
3 rd	107.86		88.75			
4 th	117.29		97.5			

NS (Non-significant), BWG= Body weight gain, wks=weeks and value indicate- Mean± Standard Error (SE), LS=Level of significance.

Feed intake: Feed intake of turkey poult is presented in Table 3. Result shows that feed intake was increased with their age. Average feed intake in 1st, 2nd, 3rd and 4th week of their age was 80.53g, 152.4g, 237.2g and 283.33g respectively. Up to 4 weeks of age total feed intake was 753.46g/bird.

Jahan *et al.* (2018) conducted an experiment and observed that total feed consumption of male and female was 950g/bird and 810g/bird respectively.

The observation from the book “Nutrient Requirements of poultry” (1994) was that the feed intake of male and female turkey in 1st week of age was both 110 gm, in 2nd weeks was 190g and 180g and in 3rd weeks was 370g and 340g, respectively.

Table 3. Weekly average feed intake of poult (0-4 weeks).

Age (weeks)	Weekly average feed intake (g/bird)	Weekly average feed intake (g/bird) (Mean ± SE)
1 st	80.53	188.37±45.02
2 nd	152.4	
3 rd	237.2	
4 th	283.33	
Total	753.46	

Feed conversion ratio (FCR): The FCR of turkey poults at different ages are presented in Table 4. Result showed that there were no significant differences of FCR between male and female turkey poults at 1st, 3rd and 4th weeks of their age. But, in the 2nd week there was significant difference in FCR between male and female poults which was 1.60 and 2.11, respectively.

FCR of initial couple of weeks were lower but with the passage of time the FCR increases due to higher feed consumption and relatively lower growth rate and this result also resembled with the study of Sampath *et al.* (2012) who observed that the feed conversion ratio of turkey was very high and tends to increase from 1.3 to 3.4 as the birds continue to grow. However, the final FCR obtained from intensive and semi-intensive system 3.40 and 3.20, respectively.

The result obtained from the study similar to published research work, Havenstein *et al.* (2007) indicated that the FCR of heritage turkey increased with the age. Waibel *et al.* (2000) observed that the feed to gain ratio of 2.729 up to 20 weeks of age for large white male turkey in experiment carried out at University of Minnesota. FCR for turkeys raised up to 20 weeks of age is approximately 2.729 (Austic and Neshein, 1990) who agreed with the results of Waibel *et al.* (2000).

Table 4. Feed conversion ratio of turkey poults.

Age (weeks)	FCR (Mean±SE)		P-value	Level of significance
	Male	Female		
1 st	1.49±0.12	1.74±0.08	0.06	NS
2 nd	1.60±0.06	2.11±0.08	0.00	**
3 rd	2.57±0.44	2.93±0.34	0.16	NS
4 th	2.79±0.58	3.07±0.40	0.197	NS

**=P<0.01; *=NS (Non-significant), P>0.01; FCR=Feed conversion ratio and value indicate- Mean ± Standard Error (SE).

Conclusion and Future remarks

One of the key problems facing turkey farming is to differentiate male and female turkey at early age. From the results of the present study, sex of turkey can be determined as early as after 1st week of age. Average body weight of male turkey was 104.00g/bird and female was 90.00g/bird after 1st week of age. On the other hand, the average body weight of male was also significantly higher than the female. Significant differences have been observed between male and female at all ages. Results of phenotypic observation correspondence 100% accuracy with the results obtained for body weight variation as early as first week of observation. In conclusion, farmers can identify male or female poults as early as first week of age on the basis of body weight variation.

Future works can be designed and conducted focusing the following area: hatching eggs for a particular color type heritage turkey should be collected from a flock must have similar age and therefore almost uniform egg size so that the newborn poults should have almost uniform body weight at hatching. To avoid the variation at initial body weight of the poults, statistical analysis for concomitant variables can be done and another experiment can be designed with more number of poults for all color types of birds and therefore the weight variations between male and female for all color can be carried out.

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