



Adaptation and morphometric characterization of Boer Goat in Bangladesh

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ABSTRACT

The present study was conducted to evaluate the adaptability and characterize Boer goat morphometrically under the farming condition of Bangladesh. Data on adaptability and characterization were collected from the imported flock of Boer goat maintained at American Dairy Limited, Sreepur, Gazipur. A total of 31 Boer goats (15 males and 16 females) at birth (0), 3, 6, 9, and 12 months of age were considered for morphometric characterization. From the study, it was revealed that Boer goats were adapted easily in our climatic and farming conditions. All the body measurements (body length, heart girth, height at wither, head length, head width, ear length, ear width, tail length) in both sexes were significantly ($p < 0.05$) varied at birth (0), 3, 6, 9 and 12 months of age. The body length at the age group of 0, 3, 6, 9 and 12 months were 23.19 ± 1.13 vs 21.44 ± 0.78 cm, 45.36 ± 1.21 vs 44.88 ± 0.79 cm, 63.23 ± 1.09 vs 59.57 ± 1.13 cm, 72.13 ± 1.12 vs 64.66 ± 1.18 cm, and 86.33 ± 1.42 vs 75.83 ± 1.43 cm, for male vs female Boer goats, respectively. Adult male Boer goats had significantly higher ($p < 0.05$) body length, heart girth, height at wither, ear length, ear width than adult female goats but sex did not influence ($p > 0.05$) the head length, head width and tail length. Scrotal circumference significantly ($p < 0.001$) differed in different age groups and corresponding values were 8.02 ± 0.44 , 11.91 ± 0.54 , 21.78 ± 0.42 , 24.43 ± 0.41 and 26.22 ± 0.40 cm at 0, 3, 6, 9 and 12-month of age, respectively. On the other hand, birth weight of male goats (2.90 ± 0.09 kg) were higher ($p > 0.05$) than female (2.29 ± 0.09 kg) goats. However, body weights differed significantly ($p < 0.001$) between male and female at the later ages where male attained 32.56 ± 0.69 kg, 45.56 ± 1.19 kg and female attained 24.33 ± 0.97 kg, 32.78 ± 1.29 kg at 6- and 12 month of ages, respectively. These results suggested that Boer goats are adaptable in the farming condition of Bangladesh as well as attained standard birth weight and higher adult body weight that can be used to mitigate the huge demand of meat in Bangladesh.

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Introduction

Boer goat (*Capra hircus*) is considered to be one of the most desirable goat breeds for meat production. It has gained worldwide recognition for excellent body conformation, fast growing rate and good carcass quality. Boer goat is famous for its large mature size and faster growth which results in heavy muscled carcasses (Erasmus, 2000). From the review of growth, development and carcass composition of 11 goat breeds around the world, it showed that Boer goats had the fastest growth rate as well as the highest mature weight (100-110 kg) (Hoover, 2000). As a result, there has been widespread use of Boer goat in different parts of the world. The adaptability of the breed, the quality of meat produced and their ability to perform well under extensive semi-arid climatic conditions, ranging from hot dry seasons to the extremely low temperatures of snow-clad mountainous regions (Casey and Van Niekerk, 1988; Barry and Godke, 1997) make this breed as an excellent choice to mitigate the increased demand of meat. Though this breed has a good adaptability to the different conditions but the productive and reproductive performances varied based on agro-climatic condition (Lu and Potchoiba, 1988, Lehloenya *et al.*, 2005). The

high demand of meat and skin in the local as well as foreign market focused the goat enterprise extremely prominent to the vulnerable group of the people in the existing socio-economic condition of Bangladesh (Husain, 1993). Therefore, government has emphasized on increased meat production of goat. Bangladesh has a goat breed (Black Bengal goat) which has relatively lower birth weight, growth rate and meat production (Husain *et al.*, 1996). In this situation, introduction of an exotic breed, which is sustainable in our country's climatic condition, might be a viable option to mitigate the increasing demand of meat production.

Previous literatures showed that there was a positive correlation between birth weight and growth rate, age at maturity and mature body weight which influence the future productive and reproductive performance of the animal (Banerjee, 1989). So, meat goat breed like Boer goat can be introduced to upsurge national goat meat production in Bangladesh but prior to that characterization is very important where the term "Morphometrics" refers to the quantitative analysis of form, a concept that encompasses size and shape (Elewa, 2004). The morphometric traits can be categorized into three main groups viz. traits associated with length,

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height and girth (Yakubu, 2010). Morphological measurements play an important role to estimate and assess the characteristics of the different breeds of animals (Martins *et al.*, 2009). Morphological measurements also can be used as a management tool to promote the productivity of goats (Abd-Allah *et al.*, 2019) as well as it can be used for several purposes including prediction of genetic improvement, growth rate, body condition score (BCS), conformation and carcass traits (Lambe *et al.*, 2008). From this point of view, the present research work was conducted to evaluate the adaptability and characterize Boer goat morphometrically based on age and sex in Bangladesh.

Materials and Methods

Site of the experiment

The present study was conducted under the Department of Animal Breeding and Genetics, Bangladesh Agricultural University and the research site was American Dairy Limited, Vagnahati, Sreepur, Gazipur which is geographically located at 24°12' North latitude and 90°28' East longitudes of Bangladesh.

Experimental animals

Boer goats were imported from Australia and they were reared under semi-intensive farming condition of American Dairy Limited. A total of 100 Boer goats were used for adaptation study and 31 Boer goats (15 males and 16 females) of different ages (0, 3, 6, 9, and 12 months) were used for the morphometric characterization.

Table 1. Methods of assessing the morphometric traits

| Parameters | Measuring techniques | Measuring tool | Measuring unit |
|-----------------------|---|----------------|----------------|
| Body length | Distance between points of shoulder to pin bone | Measuring tape | cm |
| Height at wither | Vertical distance between the fetlock and the point of wither | Measuring tape | cm |
| Hearth girth | Just behind the withers on top and just behind the elbows on the bottom | Measuring tape | cm |
| Head length | Distance between upper lip and pool of the head | Measuring tape | cm |
| Head width | From the distance between two eyes | Measuring tape | cm |
| Ear length | Distance between base and the tip of the pinna | Measuring tape | cm |
| Ear width | The broadest portion of the ear | Measuring tape | cm |
| Tail length | Distance between base and the tip of the tail | Measuring tape | cm |
| Scrotal circumference | Diameter at the broadest portion of the scrotum | Measuring tape | cm |

Source: FAO (2012)

Statistical analysis

The data generated from this experiment were entered in Microsoft Excel worksheet, organized according to sex and age and processed for further analysis. All the parameters were analyzed using GLM procedure of Statistical Analysis System (SAS) software (SAS Institute Inc., 2009) version 9.1.3.

Results and Discussion

Adaptation of Boer goats in Bangladesh

The key factors that determine the adaptability of a breed in a different ago-ecological condition than its' origin is measured through the relative ability of the individual to survive and reproduce the next generation to ensure continued survival of the population in that

Feeding and other managerial procedure

Boer goats were fed Napier or German grass twice a day on the ad libitum basis. The feed was supplemented with commercial concentrate (wheat bran 52%, maize 24%, Soybean meal 20%, rice polish 10%, dolomite 1%, limestone 2.475%, rock salt 0.4%, fennel flower 0.1%, Yeast 0.025%) in the morning and afternoon @ 100g per goat per day. Clean and safe water was made available at all the times. Throughout this study, the nutrition of male and female remained uniform. All the goats were vaccinated against *Peste des Petits Ruminants* (PPR) and dewormed routinely with Anti-helminthic. Natural mating was allowed for the heated female by selected breeding males. The flock was maintained under semi-intensive management system with the provision of sufficient access to fresh air and they were allowed to graze outside for two hours in a day.

Data collection procedures

Data were collected according to the FAO (2012) guidelines for characterization of goat breed. All the measurements were taken early in the morning prior to feeding. Live weight was measured using digital weighing balance. Each goat was ear tagged and separate data sheets were maintained for each goat to record the data.

Parameters studied

The following traits were considered for the morphometric analysis (Table 1).

environment (Naskar *et al.*, 2012). According to Dwyer and Lawrence (2005), we critically examined the survival adaptations of our intensively managed imported Boer goats through the behavioural and physiological adaptations of does and kids during pregnancy, parturition and lactation. Erasmus (2000) also emphasized on 'reproductive fitness' as the most important criterion relating to adaptation. Therefore, judging the performances related to production and reproduction may be the best measures for the adaptation of a breed in certain environment compared to the performances where they are well adapted. In our study, performances of imported Boer goats under the farming condition of Bangladesh are shown in Table 2. This study revealed that the average birth weight of Boer

goat was 2.59 ± 0.21 kg, average growth rate 80.18 ± 3.33 g/d, and average milk yield 383.33 ± 30.54 ml/day. On the other hand, Boer goats showed their first sexual maturity at the age of 208 ± 5.14 days and average number of kids per doe was 1.13 ± 0.04 . However, the survivability of the Boer goat was 95.2% facing fewer incidences of diseases (Table 2).

Table 2. Adaptation to environment and performances of Boer goats in Bangladesh

| Parameter | Performance (Mean \pm SE) |
|--|--------------------------------|
| Production performance | |
| Birth weight (kg) | 2.59 ± 0.21 (12) |
| Average daily gain from birth to 3 month(g) | 80.18 ± 3.33 (12) |
| Average milk yield up to one month (ml/day) | 383.33 ± 30.54 (18) |
| Reproduction performance | |
| Age at sexual maturity (days) | 208 ± 5.14 (28) |
| Litter size (no) | 1.13 ± 0.04 (74) |
| Average kid mortality rate (%) | 4.8 |

Previous researches also showed that Boer goats can be adapted and reared in much wider range of climatic conditions in different countries (Erasmus, 2000, Casey and Van Niekerk, 1988; Barry and Godke, 1997). Boer goats have the superior adrenal function and they are able to maintain higher cortisol production than Angora goats (Engelbrecht and Swart, 2000). Moreover, stress coping mechanism of Boer goat is equivalent to that of Merino sheep, a hardy breed.

Performances of Boer goats varied in different agro-climatic condition. Birth weight of Boer goat kids were reported 3 to 4 kg in the United States (Lu and Potchoiba, 1988) and 2.3 to 2.5 kg for South African Boer goats (Lehloenya *et al.*, 2005). The average daily gains were reported 193 g/day and 131 g/day for supplemented and non-supplemented Boer goats respectively (Almeida *et al.*, 2006). This clearly indicated the variation of the performances of our imported Boer goats which might be due to different agro-climatic condition and management system.

Previously it has shown that Boer goats also have a wide range of tolerance to the natural condition and disease resistance to the disease (Mirkena *et al.*, 2010). Though relatively a very few information is available on the Boer goat's resistance towards diseases but it is resistant to diseases such as blue tongue, pulpy kidney (enterotoxaemia) and gall sickness (Steyl, 1966). On the other hand, regarding external parasites, Boer goats are particularly subject to blue tick infestations (*Linognathus africanus*), especially during the winter and spring (Erasmus, 2000). Moreover, it has also been reported that the Boer goat is immune to tuberculosis, and, therefore, the advantage of utilizing goat milk is that this disease cannot be contracted by humans (Boer Goat News, 1998). During our study period, 4.8% of kid mortality was reported (Table 2) due to enterotoxaemia and pneumonia which is also very common in other breeds. Besides these, we did not find any major disease incidences as well as any parasitic infestation which

coincides with the findings of the previous mentioned research works. Erasmus *et al.* (1985) reported mortality rates of 10.8% for kids born as singles, 8.3% born as twins. According to Olivier (1980), the causes of kid mortalities might be exposure to cold, shortage of milk of the doe and a too small birth weight of the kid. This is the first report on the adaptation of Boer goats in Bangladesh. From the performances of Boer goats in our climatic condition, it is revealed that Boer goat has a good adaptability in our farming condition.

Morphometric characterization:

A total of 31 Boer goats (15 males and 16 females) during birth (0), 3, 6, 9 and 12-months of ages were used for morphometric characterization. The means along with standard errors for morphometric traits of Boer males and females are presented in the Table 3, 4 and 5.

Body length

The body length of Boer goat at the age groups of 0, 3, 6, 9 and 12 months were 23.19 ± 1.13 , 45.36 ± 1.21 , 63.23 ± 1.09 , 72.13 ± 1.12 and 86.33 ± 1.42 cm, respectively for male (Table 3) and corresponded value for females were 21.44 ± 0.78 , 44.88 ± 0.79 , 59.57 ± 1.13 , 64.66 ± 1.18 , 75.83 ± 1.43 cm, respectively (Table 4). In both sexes, body length differed significantly ($p < 0.001$) among the ages (Table 3 and 4). Besides these adult male Boer goats had a significantly ($p < 0.01$) higher body length (86.33 ± 1.42) than that of female adult goats (75.83 ± 1.43) (Table 5). Data on characterization of Boer goat based on age and sex variation is very limited. However, Pieters, (2007) reported that the body length varied from 55.00 to 79.50 with an average of 68.22 ± 0.80 in his study. Talukder and Choudhury (2018) measured the body length of Boer goats and found 69.96 ± 2.09 cm without mentioning age and sex. On the other hand, Keith *et al.* (2009) worked on twenty-one pubertal Boer goats approximately, 8-9 months of age and reported 64.6 ± 6.2 cm body length. Further study by Ford *et al.* (2009) reported that body length of Boer was 62.8 ± 5.7 cm at 9-12 months of age. Okere *et al.* (2014) found 31.95 ± 2.64 cm at 6 month age in Boer male which is lower than our present study. This variation might be due to management practices and nutritional status of those goats.

Height at wither

In the present study, the value for the height at wither of Boer male at 0, 3, 6, 9 and 12-month of age were 28.17 ± 1.03 , 46.17 ± 0.27 , 57.19 ± 0.96 , 69.12 ± 0.88 and 72.12 ± 0.84 cm, respectively (Table 3). Bolacali *et al.* (2017) observed that wither height at birth were 29.2 ± 0.60 cm for Boer male which was similar with present study. Talukder and Choudhury (2018) also reported 67.98 ± 1.19 cm height at wither which corroborate with present findings. On the other hand, Ariff *et al.* (2010) observed that height at wither of Boer goat was 68.12 ± 1.19 cm at 12 month of age which was very close to the present findings.

Table 3. Morphometric measurements (Mean±SE) of Boer male goat from birth to 12-month of ages

| Parameters (cm) | Age (month) | | | | | Sig. level |
|-----------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------|
| | Birth (0) | 3 | 6 | 9 | 12 | |
| Body length | 23.19±1.13 ^c (15) | 45.36±1.21 ^d (13) | 63.23±1.09 ^c (12) | 72.13±1.12 ^b (11) | 86.33±1.42 ^a (11) | *** |
| Height at wither | 28.17±1.03 ^d (15) | 46.17±0.27 ^c (13) | 57.19±0.96 ^b (12) | 69.12±0.88 ^a (11) | 72.12±0.84 ^a (11) | *** |
| Hearth girth | 30.77±0.88 ^d (15) | 47.92±0.41 ^c (13) | 65.20±1.11 ^b (12) | 70.05±1.18 ^a (11) | 71.78±1.01 ^a (11) | *** |
| Head length | 9.32±0.34 ^d (15) | 13.77±0.34 ^c (13) | 14.84±0.26 ^c (12) | 16.58±0.41 ^b (11) | 19.15±0.45 ^a (11) | ** |
| Head width | 8.79±0.21 ^d (15) | 11.82±0.32 ^c (13) | 12.18±0.32 ^c (12) | 13.86±0.25 ^b (11) | 16.15±0.31 ^a (11) | ** |
| Ear length | 12.21±0.64 ^c (15) | 15.79±0.22 ^d (13) | 19.16±0.71 ^c (12) | 21.20±0.72 ^b (11) | 23.74±0.73 ^a (11) | ** |
| Ear width | 5.28±0.36 ^d (15) | 6.85±0.83 ^c (13) | 7.71±0.21 ^b (12) | 9.01±0.37 ^a (11) | 9.49±0.47 ^a (11) | * |
| Tail length | 9.41±0.25 ^c (15) | 11.17±0.28 ^b (13) | 11.93±0.61 ^b (12) | 13.19±0.38 ^a (11) | 13.83±0.22 ^a (11) | * |
| Scrotal circumference | 8.02±0.44 ^c (15) | 11.91±0.54 ^d (13) | 21.78±0.42 ^c (12) | 24.43±0.41 ^b (11) | 26.22±0.40 ^a (11) | *** |

***p<0.001, **p<0.01, *p<0.05. Means with different superscripts differ significantly for each trait within the same row (p<0.05); Parenthesis indicates the number of observation.

Table 4. Morphometric measurements (Mean±SE) of Boer female goats from birth to 12-month of ages

| Parameters (cm) | Age (month) | | | | | Sig. level |
|------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------|
| | Birth (0) | 3 | 6 | 9 | 12 | |
| Body length | 21.44±0.78 ^c (16) | 44.88±0.79 ^d (14) | 59.57±1.13 ^c (12) | 64.66±1.18 ^b (12) | 75.83±1.43 ^a (11) | *** |
| Height at wither | 26.22±0.82 ^d (16) | 45.04±0.29 ^c (14) | 50.98±0.83 ^b (12) | 55.21±1.06 ^a (12) | 56.98±0.96 ^a (11) | *** |
| Hearth girth | 29.48±0.50 ^d (16) | 45.76±0.38 ^c (14) | 50.42±1.22 ^b (12) | 59.79±1.28 ^a (12) | 61.99±1.21 ^a (11) | *** |
| Head length | 8.19±0.24 ^c (16) | 10.83±0.31 ^d (14) | 13.59±0.19 ^c (11) | 15.65±0.44 ^b (12) | 18.08±0.40 ^a (11) | ** |
| Head width | 8.18±0.23 ^c (16) | 9.45±0.28 ^d (14) | 11.69±0.23 ^c (12) | 13.62±0.28 ^b (12) | 15.38±0.41 ^a (11) | ** |
| Ear length | 11.24±0.51 ^d (16) | 14.41±0.22 ^c (14) | 16.14±0.51 ^b (12) | 17.37±0.27 ^b (12) | 19.68±0.83 ^a (11) | * |
| Ear width | 4.91±0.22 ^c (16) | 6.68±0.18 ^b (14) | 6.84±0.19 ^b (12) | 7.58±0.42 ^a (12) | 7.79±0.44 ^a (11) | * |
| Tail length | 8.21±0.24 ^d (16) | 9.69±0.37 ^c (14) | 11.83±0.34 ^b (12) | 12.98±0.43 ^a (12) | 13.44±0.29 ^a (11) | * |

***p<0.001, **p<0.01, *p<0.05. Means with different superscripts differ significantly for each trait within the same row (p<0.05); Parenthesis indicates the number of observation.

Besides these, height at wither of Boer female was found 26.22±0.82, 45.04±0.29, 50.98±0.83, 55.21±1.06 and 56.98±0.96 cm at the age of 0, 3, 6, 9 and 12 month of age, respectively (Table 4). Moreover, adult female Boer goats had significantly (p<0.01) lower height at wither (56.98±0.96 cm) than adult male goats (72.12±0.84 cm) (Table 5). Bolacali *et al.* (2017) observed that wither height at birth were 27.9±0.56 cm for Boer female which is in agreement with the present study. Moreover, Pieters (2007) observed height at wither in commercial Boer goat irrespective of age and sex and found 47.00-67.50 cm with an average 56.49±0.50 cm.

Hearth girth

In the present study, age significantly (p<0.001) affected the heart girth in both sexes of Boer goats (Table 3 and 4). Hearth girth of Boer male was found 30.77±0.88, 47.92±0.41, 65.20±1.11, 70.05±1.18 and 71.78±1.01 cm at the age of 0, 3, 6, 9 and 12 months, respectively (Table 3). Moreover, hearth girth of adult male Boer goats (71.78±1.01 cm) was significantly (p<0.01) higher than the female goats (61.99±1.21 cm) (Table 5). Keith *et al.*, (2009) reported the hearth girth of Boer male was 75.3±4.87 cm at the age of 8-9 months which is close to the findings of the present study. However, other researchers reported 90.3±0.1 cm heart girth at 12 month of age (Pieters *et al.*, 2009) and 85.72±3.34 cm in Boer male (Ford *et al.*, 2009) which is higher than the present study. Heart girth may vary due to rearing system, management practices, feed supplied and body weight attained at that time.

Table 5. Effect of sex on morphometric measurements (Mean±SE) of mature Boer goat

| Parameters (cm) | Sex | | Level of significance |
|------------------|-----------------|-----------------|-----------------------|
| | Male | Female | |
| Body length | 86.33±1.42 (11) | 75.83±1.43 (11) | ** |
| Height at wither | 72.12±0.84 (11) | 56.98±0.96 (11) | ** |
| Hearth girth | 71.78±1.01 (11) | 61.99±1.21 (11) | ** |
| Head length | 19.15±0.45 (11) | 18.08±0.40 (11) | NS |
| Head width | 16.15±0.31 (11) | 15.38±0.41 (11) | NS |
| Ear length | 23.74±0.72 (11) | 19.68±0.83 (11) | * |
| Ear width | 9.49±0.47 (11) | 7.79±0.44 (11) | * |
| Tail length | 13.83±0.22 (11) | 13.44±0.29 (11) | NS |

*p<0.05; ** p<0.01; NS=Non-significant; Parenthesis indicates the number of observation.

On the other hand, hearth girth of Boer female were 29.48±0.50, 45.76±0.38, 50.42±1.22, 59.79±1.28 and 61.99±1.21 cm at the age of 0, 3, 6, 9 and 12 months, respectively. Chiemela *et al.* (2015) found that hearth girth of Boer female were 60.11±2.73 cm at 2 year of age.

Head length

Head length significantly (p<0.01) differed in different age groups in male and female Boer goats (Table 3 and 4). But sex had no significant effect on the head length of adult Boer male (19.15±0.45 cm) and female (18.08±0.40 cm) goats (Table 5). Head length of Boer male goats was found 9.32±0.34, 13.77±0.34, 14.84±0.26, 16.58±0.41 and 19.15±0.45 cm whereas 8.19±0.24, 10.83±0.31, 13.59±0.19, 15.65±0.44, 18.08±0.40 cm was found in Boer female at the age of 0, 3, 6, 9 and 12 month of age, respectively. Pieters *et al.* (2009) found that head length of Boer goats was 17.2±0.3 cm which is in agreement with the findings of the present study.

But Chiemela *et al.* (2015) found that head length was 20.23 ± 0.45 and 17.56 ± 0.54 cm in Boer male and female goats at 2 years of age, respectively. Talukder and Choudhury (2018) reported the head length of Boer goat was 22.29 ± 0.52 cm. This variation might be due to the age variation of the studied animals.

Head width

In the present study, head width significantly ($p < 0.01$) increased with ages in male and female Boer goat (Table 3 and 4). Head widths were found 8.79 ± 0.21 , 11.82 ± 0.32 , 12.18 ± 0.32 , 13.86 ± 0.25 and 16.15 ± 0.31 cm at 0, 3, 6, 9 and 12-month of age, respectively for male (Table 3) and corresponding value for female were 8.18 ± 0.23 , 9.45 ± 0.28 , 11.69 ± 0.23 , 13.62 ± 0.28 and 15.38 ± 0.41 cm, respectively (Table 4). However, Head width of adult Boer goat did not differ significantly ($p > 0.05$) between sexes (Table 5). Pieters (2007) found head width of Boer goat ranged from 4.80-10.50 cm. Chiemela *et al.* (2015) found that head length of Boer male was 9.02 ± 0.43 cm at 2 years of age which was lower than the present study. This variation might be due to age, body weight and individual variation of the animals.

Ear length

In this study, ear length significantly ($p < 0.05$) differed between adult male (23.74 ± 0.72 cm) and female (19.68 ± 0.83 cm) Boer goats (Table 5). Ear length of Boer male at 0, 3, 6, 9 and 12 months of age were 12.21 ± 0.64 , 15.79 ± 0.22 , 19.16 ± 0.71 , 21.20 ± 0.72 and 23.74 ± 0.73 cm, respectively (Table 3). On the other hand, ear length of Boer female were 11.24 ± 0.51 , 14.41 ± 0.22 , 16.14 ± 0.51 , 17.37 ± 0.27 and 19.68 ± 0.83 cm at the age of 0, 3, 6, 9 and 12 months, respectively (Table 4). Talukder and Choudhury (2018) reported ear length of Boer goat was 19.43 ± 0.90 cm. Pieters *et al.* (2009) found that ear length ranged from 14.4 and 26.0 cm with an average of 21.4 ± 0.3 cm which corroborates with the result of the present study. Moreover, Chiemela *et al.* (2015) reported that right ear length and left ear length was 20.78 ± 0.44 and 20.09 ± 0.77 cm, respectively at two years age of Boer female.

Ear width

In the present study, ear width of Boer male was 5.28 ± 0.36 , 6.85 ± 0.83 , 7.71 ± 0.21 , 9.01 ± 0.37 , 9.49 ± 0.47 cm (Table 3) whereas ear width of Boer female was 4.91 ± 0.22 , 6.68 ± 0.18 , 6.84 ± 0.19 , 7.58 ± 0.42 , and 7.79 ± 0.44 cm at 0, 3, 6, 9 and 12 month of age respectively (Table 4). Age had a significant effect on the ear width in both sexes ($p < 0.05$). Moreover, adult males (9.49 ± 0.47 cm) had significantly higher ($p < 0.05$) ear width than adult female goats (7.79 ± 0.44 cm) (Table 5). No relevant data on Boer goat is available. However, Rahman *et al.* (2008) reported that ear width of Black Bengal male was 3.95 ± 0.09 , 4.12 ± 0.14 , 5.30 ± 0.09 , 5.66 ± 0.09 and 5.90 ± 0.12 cm, at birth, 3, 6, 9 and 12 months of age, respectively. On the other hand, Paul *et*

al. (2011) observed that ear width of Black Bengal does were 3.26 ± 0.20 , 4.85 ± 0.11 , 5.21 ± 0.13 , 5.23 ± 0.11 , and 5.40 ± 0.12 at birth, 3, 6, 9 and 12 months of age, respectively and Jalil *et al.* (2018) reported that ear width of Black Bengal female was 5.3 ± 0.06 cm at 6-12 month of age which was lower than the present study. This might be due to different breed variation of goat.

Tail length

Tail length of Boer male and female at 0, 3, 6, 9 and 12 month of age were 9.41 ± 0.25 , 11.17 ± 0.28 , 11.93 ± 0.61 , 13.19 ± 0.38 , 13.83 ± 0.22 cm (Table 3) and 8.21 ± 0.24 , 9.69 ± 0.37 , 11.83 ± 0.34 , 12.98 ± 0.43 and 13.44 ± 0.29 cm, respectively (Table 4). Tail length increased with the ages ($p < 0.05$) in both male and female goats. However, tail length of adult male (13.83 ± 0.22 cm) and female goats (13.44 ± 0.29) did not differ significantly. Pieters *et al.* (2009) conducted a research at South Africa and investigate tail length of Boer goat was 12.2 ± 0.3 cm at 12 month of age. Talukder and Choudhury (2018) reported the tail length of Boer goat was 13.91 ± 0.71 cm which is similar to the result of the present study.

Scrotal circumference

From the present study, it was observed that the scrotal circumference significantly ($p < 0.001$) differed in different age groups. The value for scrotal circumference of Boer male goats were 8.02 ± 0.44 , 11.91 ± 0.54 , 21.78 ± 0.42 , 24.43 ± 0.41 and 26.22 ± 0.40 cm at 0, 3, 6, 9 and 12-month of age, respectively (Table 3). Keith *et al.* (2009) worked on twenty-one pubertal Boer goats and obtained 26.4 ± 2.59 cm scrotal circumference at approximately, 8-9 months of ages. Ford *et al.* (2009) conducted a research at USA and observed that scrotal circumference of Boer male was 27.30 ± 3.34 cm at 9-12 month of age. These results are in close vicinity with the results of the present study.

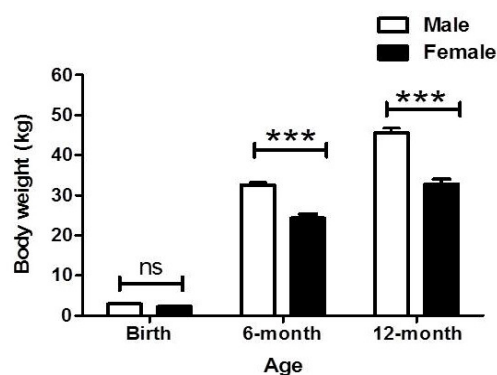


Fig. 1. Body weight of Boer male and female goats at different ages (***) $p < 0.001$; ns= non-significant)

Body weight

The result of present study showed that there were no significant difference in birth weight of male (2.90 ± 0.09 kg) and female (2.29 ± 0.09 kg) Boer goats but male kids were heavier than female kids. However, body weights differed significantly ($p < 0.001$) between male and

female at 6-month (32.56 ± 0.69 vs 24.33 ± 0.97 kg) and 12 month (45.56 ± 1.19 vs 32.78 ± 1.29 kg) of age (Fig. 1). Đuričić *et al.* (2012) observed that the average birth weight of Boer kids was 3.48 ± 0.04 kg (1.70 kg to 5.4 kg) and the birth weight of Boer male goat kids was significantly ($P < 0.05$) higher than female Boer kids. In the United States, birth weight of Boer goat kids normally range from 3 to 4 kg, with males kids weighing about 0.5 kg more than females, while typical weaning weights range from 20 to 25 kg, depending upon weaning age (Lu and Potchoiba, 1988). Lehloenya *et al.*, (2005) reported birth weights ranging from 2.3 to 2.5 kg for South African Boer goats following synchronization and artificial insemination.

Besides these, Keith *et al.* (2009) reported that the average body weight of Boer goat was 34.9 ± 5.22 kg at approximately, 8-9 months of age. On the other hand, in other study, Malan (2000) found that the mature weight of a Boer buck ranges between 100-120 kg and 70-80 kg for a doe. Though this breed has a good adaptability to the different conditions but the productive and reproductive performance varied based on agro-climatic condition. Not only the agro climatic condition but also management system, and feeding practice, nutritional status greatly affect the birth weight and subsequent body weight of animals.

Conclusion

This is the first report on the adaptation of Boer goats in Bangladesh which revealed that Boer goats can be easily adapted in our climatic and farming condition with less disease incidence and mortality. On the other hand, higher birth weight and subsequently higher body weight indicated that Boer goat can be introduced to solve the demand of meat and ensure nutritional security in Bangladesh.

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