Research article

Ecology Journal

ISSN (Print): 2708-6356, ISSN (Online): 2708-6364, Website: journal.esbangladesh.org
Ecol. J. (2021) 3 (2) : 115-119

NON-GENETIC FACTORS AFFECTING SEMEN QUALITY OF BUCK

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Received: 25 July 2021, Revised: 12 October 2021, Accepted: 15 October 2021

ABSTRACT

This study was aimed to find out the effects of non-genetic factors on semen quality of Black Bengal buck. Accumulated one year's data on 9 bucks in the nucleus breeding flock of Black Bengal goats were analyzed for the study of production traits. The traits considered were body weight, weight at every week interval and semen characteristics such as volume, sperm concentration, mass motility, sperm livability and normal sperm. Semen parameters were evaluated from bucks collected twice a week by artificial vagina method. The significance of effects on body weight and scrotal circumference were analyzed. The average volume of semen (ml/ejaculate), sperm concentration (10^9/ml), mass motility (%), live spermatozoa (%) and normal spermatozoa (%) at 10-15 kg body weight were 0.38, 2.3, 78.2, 85.2 and 85.68 respectively. The average volume of semen (ml/ejaculate), sperm concentration (10^9/ml), mass motility (%), live spermatozoa (%) and normal spermatozoa (%) at 15 to above body weight were 0.42, 2.5, 75.4, 84.8 and 85.32 respectively. Body weight of Black Bengal goat had a significant ($p<0.05$) effect on semen volume and scrotal circumference significantly influenced ($p<0.05$) all the semen characteristics. Semen volume and sperm concentration increased with scrotal circumference. It is suggested that non-genetic factors should be adopted as a technique for improving the productive traits.

Keywords: Goat, non-genetic, body weight, scrotal circumference, semen

Introduction

Goat is numerically and economically very important and promising animal genetic resources of developing countries, especially in Asia and Africa. In the livestock sector, Black Bengal goat is the only recognized breed amongst the domestic species available in Bangladesh. More than 70% farmers faced severe shortage of breeding bucks for serving their does (Khandoker *et al*. 2011). During selection of buck for breeding purpose, attention is given on the growth rate, body weight, sexual characteristics and soundness of sexual organ of the buck. Adult body weight is an important economic factor which influences the growth and production pattern of any goat (McGregor 1984). Among the reproductive traits, semen quality plays a major role in determining the fertility and reproductive efficiency of livestock production (Moussa 1997). Moreover, Semen analysis is the most widely used biomarker to predict male fertility potential (Esteves *et al*. 2012). The quality of semen fertility is determined by the volume of ejaculate, sperm concentration, sperm motility and percentage of live and normal spermatozoa. Male fertility as well as the semen characteristics or parameters are directly influenced by such factors as age, maturity, nutritional status, general health, endocrine balance and normality of sex organs (Peters 2002). For achieving good semen quality and sperm fertility, semen should be collected in a regular interval (Shamsuddin *et al*. 2000). Higher concentration of sperm is obtained when semen was collected once daily (Sharma *et al*. 1969). When two ejaculates are obtained consecutively, the second usually has lower volume and quality (Asad *et al.* 2004). Understanding the sources of variation in semen quality, early detection of highly fertile bucks and with good quality semen would be of great interest to all livestock breeders (Arredondo *et al.* 2015). However, limited information is available on semen characteristics such as volume, sperm concentration, motility, and total number of motile sperm cells/ejaculate, normal and abnormal spermatozoa of the Black Bengal buck. So, a deep understanding about the influence of age, body weight and scrotal circumferences (SC) on semen characteristics is necessary before selecting breeding bucks for mating or breeding purpose. From that viewpoint, the present study was therefore undertaken to uncover the effect of age, body weight and scrotal circumference (SC) on different semen characteristics of Black Bengal bucks.

Materials and Methods

Location of the experiment: The experiment was conducted in the field laboratory under the department of Animal Nutrition, Genetics and Breeding, Sher-e- Bangla Agricultural University, Bangladesh.

Management practices: Animals were managed and raised under confinement as an intensive system. They were housed in individual pens (4x2.5sq.ft) of wooden slatted floor raised above the ground level. The house was provided with necessary arrangements for feeding, watering and fresh air. Semen was collected by artificial vagina method from the buck twice a week (Sunday and Thursday). The bucks used in this experiment were kept under confined feeding system and fed twice daily on a diet consisting of Napier, German and/or Maize fodder ad-libitum. The feed was supplemented with commercial pellet twice per day @ 100 gm/ buck. They were allowed to exercise for 1 to 2 hours daily. The bucks were supplied germinated gram (20gm/buck/day). Clean and safe water was ad-limitum. Throughout this study, almost identical ration was provided for each of the bucks. The animals were identified with neckband tags. All bucks were vaccinated against Peste des petits Ruminants (PPR) and dewormed routinely.

Analysis of semen characteristic:

Volume of ejaculate: Volume per ejaculate was recorded immediately after by graduated collection vials.

Sperm concentration: The total number of spermatozoa of raw semen was enumerated by haemocytometer method. The following formula was used for calculating the total number of spermatozoa/mL of fresh semen.

$$N = \frac{Cx4000}{S} \times D$$

Where:

N= Number spermatozoa per mL of semen

C= Number of spermatozoa counted in given number of small squares

S= Number of small squares counted

D= Dilution ratio

Motility (%):

Sperm motility is observed just after semen collection and it expressed in percentage.

Procedure: A clean dry glass slide warm approximately to 100 °F (38.7 °c). The semen sample is mixed properly by slowly inverting the vial 2 or 3 times (do not agitate vigorously). One drop of semen sample is placed on the slide and was spread on the warm slide. Examine under microscope at low magnification (4×). Percentage of motility is calculated the following formula:

$$\% \text{ of motile sperm} = \frac{\text{No. of motile sperm}}{\text{No. of total sperm}} \times 100$$

Sperm livability: The technique is used by using the nigrosin-eosin stain to evaluate live and dead sperm. It is so called "live-dead" stain and it also allows assessing membrane integrity at the same time as morphology.

Procedure: A clean, dry slide is taken and 1 or 2 drops of stain is placed on the middle of the slide with the help of a glass rod. A small amount of semen is mixed with the stain**.** A second slide is drawn over the semen on the first slide and thus the smear is made. Excess stain is removed by wiping the edges of slides with cotton. The smear is dried rapidly by placing them on a hot plate at 150-200 ^{o}F temperature (65-93 °C). The slide is placed under the microscope, live and dead sperms are counted from randomly selected field. The sperms were counted under 25× objective.

The dead sperms are those which absorbed dye and appeared blue color under microscope and those alive did not absorb stain; that is showed white in color. A spermatozoa which is partially stained such as nucleus only is counted as dead. Percentage of live sperms was counted by the following formula:

$$\% \text{ Live sperm} = \frac{\text{Number of live sperm}}{\text{Total number of sperm}} \times 100$$

Normal sperm:

Procedure: Two drops of buffer is placed on a clean dry glass slide. One drop of mixed semen is added in buffer. The buffer with semen is spread by covering with another slide. The smear is dried in the air**.** The

smear is stained with Rose Bengal stain for 5 minutes. Then remove/rinse of excess stain by dipping slide in distilled water. The smear is dried in the air**.** The slide is placed on the stage of microscope and counted in high magnification. Generally a total of 333 sperms are counted used random fields on different parts of the slide and is recorded in the table 1.

Grades of semen according to percentage of abnormal sperm:

i. Abnormality < 10 percent: High quality semen
ii. 11-20 percent abnormality: Good quality semen
iii. Greater than 20 percent abnormality: Poor quality semen
iv. Greater than 30 percent abnormality: Rejected grade.

Statistical analysis: The Least Square procedure was used to analyze the data for the trait volume per ejaculate, concentration and motility. The data generated from this experiment were entered in a Microsoft Excel worksheet, organized and processed for further analysis using the software Statistical Analysis System (SAS, 1998).

Results and Discussion

Body weight had a significant ($p<0.05$) effect on semen volume but no significant effect on other semen parameters such as sperm concentration, mass motility, sperm livability and normal sperm (Salhab *et al.* 2003). Highest semen volume found in above 15kg body weight (0.42ml) (Table 1). Scrotal circumference significantly influenced ($p<0.05$) all the semen characteristics investigated in the Black Bengal bucks (Table 2).

Semen volume and sperm concentration increased with scrotal circumference. Highest semen volume (0.52ml) was recorded at the scrotal circumference of 20 cm and lowest (0.32ml) at 16 cm. The highest sperm concentration (2.4×10^9 cells/ml) was at the scrotal circumference of 20 cm and the lowest (2.2×10^9 cells/ml) in 17 cm. Mature bucks were heavier, with a larger scrotal circumference; semen volume, sperm concentration and the percentage of abnormal sperm were recorded when compared to the yearling bucks. Body weight had a significant effect on semen volume. Other semen parameters are not affected by body weight (Table 1). The result is in agreement with the findings of (Salhab *et al.* 2003) and Mahal *et al.* 2013).

Table 1. Effect of body weight on semen quality of buck

Semen characteristics	Body weight groups (Kg)		
	10-15	15 to above	Significant
Volume (ml)	0.3±0.0b	0.4±0.1a	*
Sperm concentration (million/ml)	2.3±0.2	2.5±0.1	NS
Mass motility (%)	78.2±0.5	75.4±0.2	NS
Sperm livability (%)	85.2±0.4	84.8±0.5	NS
Normal sperm (%)	85.6±0.4	85.3±0.5	NS

Means with different letters in the same column differ significantly. Where, * ($p<0.05$); NS, Not significant, SE- Standard Error.

Table 2. Effect of scrotal circumference of buck on semen quality

Semen characteristics	Scrotal circumference (cm)					
	16cm	17cm	18cm	19cm	20cm	Significant
Volume (ml)	0.3 ±0.1c	0.3 ±0.0c	0.4 ±0.1b	0.4 ±0.1b	0.5 ±0.1a	*
Sperm Concentration (million/ ml)	2.2 ±0.1ab	2.1±0.0b	2.2±0.0ab	2.3±0.1ab	2.4±0.1a	*
Mass motility (%)	80.1±0.9ab	79.2±0.7ab	78.6±0.7ab	80.9±0.6a	76.2±0.4b	*
Sperm livability (%)	88.2 ±1.2a	84.3±2.4ab	82.2 ±1.2b	85.6±0.6ab	85.1±0.5ab	*
Normal sperm (%)	86.5±0.6b	89.2±0.7ab	87.1±0.9ab	89.9±0.6ab	90.1 ±0.9a	*

Means with different letters in the same column differ significantly. Where, * ($p<0.05$), SE- Standard Error.

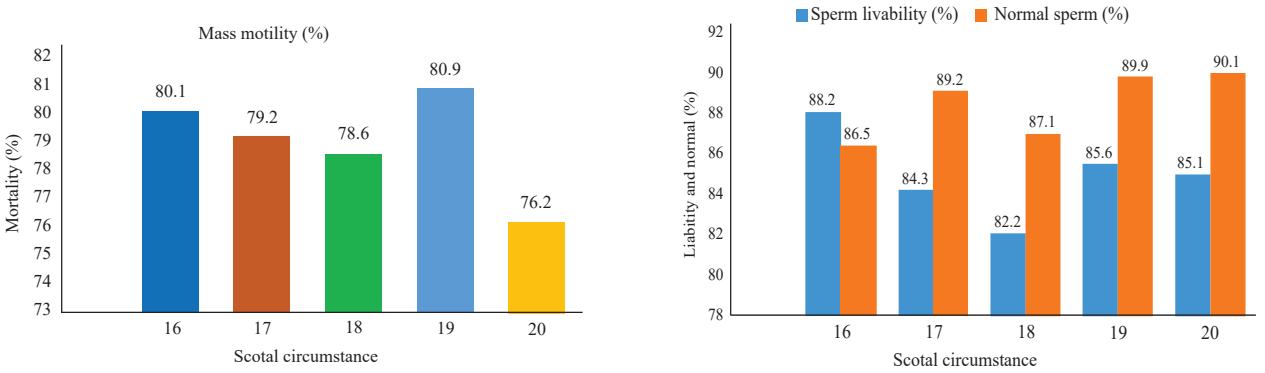


Figure 1. The effect of scrotal circumstance on semen quality.

Scrotal circumference (SC) significantly influenced ($p<0.05$) all the semen characteristics investigated in the Black Bengal bucks (Table 2). The SC is an important trait that is closely associated with the testicular growth and sperm production capacity of domestic animals. Thus, selecting males based on their SC would result in larger testes, potentially with the capacity to produce more spermatozoa (Mahal *et al.* 2013). Being a highly heritable component of fertility, it is important to include SC when evaluating breeding animals (Bailey *et al.* 1996). The higher SC measurements indicate higher testicular mass and larger sperm production (Furstoss *et al.* 2009). Highest normal sperm (90.1%) was recorded at the scrotal circumference of 20 cm and lowest (86.5%) at 16 cm (Figure 1). If the scrotal circumference is increased, then semen volume, sperm concentration and even all other semen parameter will be increased. So scrotal circumference is an important factor for buck selection.

Conclusion

The results of this study revealed that body weight had a significant effect on semen volume rather than sperm concentration, mass motility, sperm livability and normal sperm count. Scrotal circumference also influenced all the semen characteristics investigated in the Black Bengal bucks. It is also revealed from the study that semen volume and sperm concentration increased linearly with scrotal circumference. This study has shown the importance of some non-genetic factors including body weight and scrotal circumference for semen characteristics which could be accounted for genetic evaluations. The non-genetic effects were very important to the growth, milk yield and semen characteristics, which need to be controlled or adjusted when compare with the production of animal. These result provide an important perspective on the selection objectives of Black Bengal goats by considering different environmental factors. The results of productive traits is generally aimed at increasing meat, milk and progeny in Black Bengal goats.

Acknowledgment

We gratefully acknowledged the ministry of science and technology, Bangladesh for financial support to conduct this research.

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