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Association of Body Weight with Testicular and Semen Quality Parameters in Indian Goat Breeds

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ABSTRACT

A scant literature exists on study of testicular biometry in live bucks in relation to semen quality. This study was aimed to determine the effects of scrotal circumference, testicular length, testicular width, testicular thickness and body weight on semen quality traits in indigenous bucks of Sirohi (n=25), Barbari (n=20) and Black Bengal (n=16) breeds. The scrotal circumference was measured in centimetre using flexible measuring tape, while the testicular length (mm), width (mm) and thickness (mm) were measured with Vernier calliper. Semen ejaculates were collected twice on weekly interval, early in the morning by using artificial vagina. The results of least squares analysis of variance for testicular parameters showed significant differences ($p<0.05$) among the bucks of all the three breeds. The bucks of Sirohi breed were found to be superior than Barbari and Black Bengal for most of the testicular parameters. Semen volume in Sirohi bucks was significantly ($p<0.05$) higher than Barbari and Black Bengal bucks. The body weight and testicular parameters were positively correlated with semen volume and negatively correlated with sperm concentration in all the breeds.

HIGHLIGHTS

- Body weight and testicular parameters were positively correlated with semen volume.
- Sirohi bucks were found to be superior than Barbari and Black Bengal for most of the testicular parameters.

Keywords: Barbari, Black Bengal, Testicular, Semen quality, Sirohi

Goats are considered as an integral part of farming systems in rural and semi-urban areas worldwide. They are most economically important ruminant in India after cattle and buffalo. They provide food economic security to landless and marginal farmers (Bhattarai *et al.,* 2018). They are important farm animals, as source of meat, milk, skin and wool (Ramukhiti *et al.,* 2018). Sirohi is a dual-purpose breed and is mostly reared by farmers in arid and semi-arid region along with most part of the Aravalli hills and districts of central and southern Rajasthan state in India. Barbari is also a dual-purpose breed and is mainly reared in western Uttar Pradesh state and its adjoining districts of Rajasthan state. While, Black Bengal is mainly raised for meat purpose throughout and is famous for its highest prolificacy and delicious meat throughout the West Bengal state and adjoining parts of neighbouring states *viz.* Bihar, Jharkhand, Orissa, Assam and Tripura (NBAGR, 2022).

Evaluation of male fertility prior to breeding is of paramount importance to achieve breeding success. Lack of elite breeding bucks is one of the major constraints in goat farming. The semen quality traits are directly

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influenced by various factors (Kumaresan *et al*., 2020). Scrotal circumference has been frequently used among all the testicular parameters because it exhibits high correlations with body weight and reproductive potential. The most precise way of genetic evaluation of a sire is to perform breeding soundness evaluation (BSE) of a buck based on physical soundness examination, testicular size, semen quality and in some cases libido or mating ability. Various factors*, viz.,* breed, age, nutrition and environment affect body weight and testicular size (Ramukhithi *et al*., 2021). In view of the above, the present study was aimed to assess the association among body weight, testicular parameters and semen quality traits in indigenous bucks of Sirohi, Barbari and Black Bengal breeds.

MATERIALS AND METHODS

Experimental Animals

The study was conducted during February to April 2021 on total 61 adult bucks of Sirohi (n=20), Barbari (n=25) and Black Bengal (n=16) breeds of indigenous goat, aged between 18 to 39 months following approval from institutional ethical committee. The bucks were maintained at Goat Breeding Farm of the University, Amanala, Jabalpur, Madhya Pradesh, India. The annual ambient temperature of the place ranges from 20 °C to 45 °C and relative humidity 10% to 70%. This region has a subtropical climate with three distinct seasons and an annual average rainfall of 1160 mm (MPCCKP, 2021). The animals were under the routine feeding and management practices of the farm. They were kept under semi-intensive system, allowing grazing for one hour twice in a day at 8.30 am and 3.00 pm, and stall feeding of concentrate mixture @ 10 g per kg of body weight to fulfill protein and energy requirement. Fresh and clean drinking water was provided to them *ad libitum.* Bucks were routinely dewormed with ivermectin at 6 months interval and vaccinated against FMD, HS, BQ and PPR. The general health status, and scrotum and testes of each buck were examined through visual inspection and palpation.

Body Weight and Testicular Biometry

The body weight (kg) of each buck was measured using a digital weighing scale in the morning. The testicular length, width and thickness of each testis was measured in millimetres using Vernier calliper. Scrotal circumference was measured in cm with a metric tape in the broadest region of the scrotum after maximum ventrocaudal traction of the gonads. Each parameter was measured thrice and the mean values were used for further analysis. Overall testicular length, width and thickness of every buck were estimated as mean of right and left testicular length, width and thickness.

Semen Collection and Evaluation

The semen was collected twice on weekly interval from all the bucks in the morning between 8:00 and 8:30 am by artificial vagina on does in estrus. Semen was kept at 34 °C in water bath after collection and evaluated for ejaculate volume (mL) and sperm concentration (million/ml) by haemocytometer.

STATISTICAL ANALYSIS

The data was analyzed statistically using one way analysis of variance (ANOVA) and Duncan's multiple range test (DMRT) employing IBM SPSS Statistics for Windows (Version 28.0.1.0). Pearson's correlations among various parameters were estimated.

RESULTS AND DISCUSSION

The results of least squares analysis of variance for body weight, testicular parameters and semen quality traits in Sirohi, Barbari and Black Bengal bucks are presented in Table 01. All the parameters studied, except sperm concentration, differed significantly among three breeds.

The mean body weight of all three breeds differed significant from each other. It was significantly ($p<0.05$) higher in Sirohi bucks followed by Barbari and the least in Black Bengal bucks (Table 2). Our finding on body weight of Black Bengal bucks was in accordance to Islam *et al.* (2008), but in contrast to Kumar *et al.* (2014). However, the body weights of all three breeds under study were very near to norms established by NBAGR (2022).

The mean scrotal circumference (cm) of Sirohi and Barbari bucks was statistically similar and significantly ($p<0.05$) higher than Black Bengal bucks (Table 2). The testicular parameters are depicted in Table 03. Both the

Table 1: Analysis of variance for body weight, testicular and semen quality parameters in bucks

Trait	Mean Sum of Squares		F-value
	Breed (2)	Error (58)	
Body weight (kg)	656.453	5.948	110.366*
Scrotal circumference (cm)	88.031	3.277	26.860*
Right testicular length (mm)	3502.109	84.209	41.588*
Right testicular width (mm)	985.948	14.01	70.376*
Right testicular thickness (mm)	616.35	16.919	36.429*
Left testicular length (mm)	3161.227	286.579	11.031*
Left testicular width (mm)	1014.549	15.683	64.692*
Left testicular thickness (mm)	563.925	16.382	34.424*
Overall testicular length (mm)	3651.933	79.288	46.059*
Overall testicular width (mm)	999.303	14.047	71.139*
Overall testicular thickness (mm)	588.624	15.239	38.627*
Semen volume (ml)	0.032	0.001	47.733*
Sperm Concentration (millions/ml)	14664.025	37847.997	0.387

*Significant ($p<0.05$), figures in parenthesis are degree of freedom.

Table 2: Mean (±SE) body weight, testicular parameters and semen quality traits in bucks

Parameters/Breed	Sirohi (n=20)	Barbari (n=25)	Black Bengal (n=16)
Body Weight (kg)	42.74^{a}±0.691	35.16^{b}±0.478	30.96^{c}±0.331
Scrotal Circumference (cm)	24.10^{a}±0.543	23.49^{a}±0.339	19.94^{b}±0.196
Testicular Length (Overall) (mm)	108.27^{a}±2.290	106.82^{a}±1.870	083.97^{b}±1.452
Testicular Width (Overall) (mm)	50.61^{a}±0.942	42.88^{b}±0.684	35.68^{c}±0.906
Testicular Thickness (Overall) (mm)	46.72^{a}±0.886	46.78^{a}±0.676	36.77^{b}±1.140
Semen Volume (ml)	0.61^{a}±0.012	0.52^{b}±0.013	0.46^{c}±0.007
Sperm Concentration (millions/ml)	2475.39±061.18	2516.32±062.87	2577.57±105.90

Figures in parenthesis show number of observations, values with different superscript within a row differ significantly ($p<0.05$).

right and left testicular length were significantly ($p>0.05$) lower in Black Bengal bucks as compared to Sirohi and Barbari bucks, which were statistically similar. The right and left testicular width varied significantly ($p<0.05$) among breeds and the values were significantly lowest in Black Bengal, followed by Barbari and Sirohi, which also differed from one another, the values of Sirohi being the highest. Furthermore, both the right and left testicular thickness were significantly lower in Black Bengal bucks than those of Barbari and Sirohi bucks (Table 3).

However, the overall testicular width was significantly ($P<0.05$) higher in Sirohi bucks as compared to both Barbari and Black Bengal (Table 2). In our observations, the bucks of Sirohi breeds were found to be superior than Barbari and Black Bengal bucks for certain testicular parameters, which may be due to the fact that their body shape and size remains relatively larger than Barbari and Black Bengal bucks.

The effect of breed was found to be significant ($p<0.05$) for semen volume. The mean semen volume was significantly ($p<0.05$) higher in Sirohi bucks followed by Barbari and the least in Black Bengal bucks, whereas sperm concentration did not differ significantly among three breeds (Table 2). These findings for semen volume and sperm concentration in Black Bengal bucks were in agreement with Islam *et al*. (2008).

Table 3: Mean (±SE) testicular parameters in bucks

Breed	Testicular Parameters					
	Right Testicle			Left Testicle		
	Length (mm)	Width (mm)	Thickness (mm)	Length (mm)	Width (mm)	Thickness (mm)
Sirohi (n=20)	111.12^{a}±2.523	50.75^{a}±0.974	46.73^{a}±1.097	105.40^{a}±5.946	50.44^{a}±0.972	46.68^{a}±0.785
Barbari (n=25)	106.41^{a}±1.809	43.21^{b}±0.697	46.62^{a}±0.670	107.21^{a}±2.078	42.50^{b}±0.700	46.89^{a}±0.732
Black Bengal (n=16)	084.58^{b}±1.438	35.90^{c}±0.816	36.45^{b}±1.030	083.33^{b}±1.575	35.42^{c}±1.033	37.02^{b}±1.282

Figures in parenthesis show number of observations, values with different superscript within a column differ significantly ($p<0.05$).

Table 4: Pearson's correlation coefficients among different traits in the experimental bucks (pooled data)

Parameters	Body weight (kg)	Scrotal circumference (cm)	Testicular length (mm)	Testicular width (mm)	Testicular thickness (mm)	Semen volume (ml)
Scrotal circumference (cm)	0.803**	—	—	—	—	—
Testicular length (mm)	0.679**	0.756**	—	—	—	—
Testicular width (mm)	0.837**	0.699**	0.771**	—	—	—
Testicular thickness (mm)	0.634**	0.749**	0.818**	0.697**	—	—
Semen volume (ml)	0.820**	0.509*	0.585*	0.856**	0.597**	—
Sperm concentration (million/ml)	-0.223	-0.027	0.005	-0.031	-0.076	-0.106

N = 61, * $p<0.05$, ** $p<0.01$.

Pearson's correlation coefficients (r) among testicular parameters, semen quality traits and body weight for the data of all the sixty-one bucks are presented in Table 4. The body weight was significantly ($p<0.01$) and positively correlated with scrotal circumference, testicular length, testicular width, testicular thickness and semen volume. The scrotal circumference was significantly ($p<0.01$) and positively correlated with testicular length, testicular width, testicular thickness and semen volume ($r=0.509$, $p<0.05$). The testicular length was significantly ($p<0.01$) positively correlated with testicular width, testicular thickness and semen volume ($r=0.585$, $p<0.05$). The testicular width was significantly ($p<0.01$) positively correlated with testicular thickness and semen volume, and testicular thickness was significantly ($p<0.01$) correlated with semen volume (0.597). However, the sperm concentration did not reveal appreciable correlation with semen volume or any of the testicular biometry traits studied (Table 4).

Similar significant positive correlations between scrotal circumference and testicular parameters in bucks of different breeds have been reported across the world (Kumar *et al*., 2014; Ajani *et al.*, 2015; Sahi *et al.,* 2019; Gore *et al*., 2020). Like present findings, significant positive correlations were also reported between body weight, scrotal circumference and various seminal parameters in RedScoto bucks (Aliyu *et al*., 2016). Further, like present findings significant positive correlations between testicular biometry and semen parameters were reported in Osmanabadi bucks (Kumbhar *et al*., 2019) and Saanen Toggenburg bucks (Gore *et al*., 2020). Unlike current observations, significant positive correlations were reported among body weight, scrotal circumference and semen concentration in Osmanabadi bucks by Kumbhar *et al*. (2019).

CONCLUSION

Bucks of Sirohi breed were found to be superior for body weight, semen volume and most of the testicular parameters. Semen volume in bucks was highly correlated with body weight, scrotal circumference, testicular length, testicular width and testicular thickness. It is therefore recommended that body weight, scrotal circumference and testicular biometry of indigenous bucks must be part of andrological evaluation, while selection of bucks for

breeding purpose.

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REFERENCES

Ajani, O.S., Oyeyemi, M.O. and Moyinoluwa, O.J. 2015. Correlation between age, weight, scrotal circumference and the testicular and epididymal parameters of Red Sokoto bucks. *J. Vet. Med. Anim. Health,* **7**: 159-163.

Aliyu, A.M., Ram Pal, S., Nasir, M. and Umar, A.S.A. 2016. Study of semen characteristics as influenced by body weight and scrotal circumference in Red Sokoto bucks. *J. Agric. Vet. Sci.,* **9**: 48-51.

Gore, D.L.M., Muasya, T.K., Okeno, T.O. and Mburu, J.N. 2020. Comparative reproductive performance of Saanen and Toggenburg bucks raised under tropical environment. *Trop. Anim. Health Prod.,* **52**: 2653-2658.

Islam, M.R., Afroz, S., Khandoker, M.A.M.Y., Akter, Q.S. and Rahman, A.H.M.S. 2008. Semen characteristics of Black Bengal buck in relation to age, body weight and scrotal circumference. *J. Bangladesh Agric. Uni.,* **6**: 65-71.

Kumar, R., Pramod, R.K., Kumar, R., Negi, M., Singh, S.P., Singh, R. and Mitra, A. 2014. Testicular biometry and seasonal variations in semen parameters of Black Bengal goats. *Indian J. Anim. Sci.,* **84**: 635-639.

Kumaresan, A., Gupta, M.D., Datta, T.K. and Morrell, J.M. 2020. Sperm DNA integrity and male fertility in farm animals: a review. *Front. Vet. Sci. Sci*., **7**: 1-15.

Kumbhar, U.B., Gulavane, S.U., Gaikwad, S.M., Shelar, R.R., Deshpande, V., Rebeiro, R. and Yadav, K. 2019. Correlation of testicular ultrasonography, testicular biometry, serum testosterone levels and seminal attributes in pre and post-pubertal age for breeding soundness evaluation in Osmanabadi bucks. *Trop. Anim. Health Prod.,* **51**: 1467-1480.

MPCCKP, 2021. Madhya Pradesh climate change knowledge portal. http://www. climatechange.mp.gov.in.

NBAGR, 2022. National Bureau of Animal Genetic Resources. http://www.nbagr.res. in/regcat.html.

Ramukhithi, F.V., Chokoe, T.C., Ronald, T. and Lehloenya, K.C. 2021. Characterization of semen and phynotypic parameters in relation to male goat fertility. *IntechOpen*, DOI: 10.5772/ intechopen.99213.

Ramukhithi, F.V., Nephawe, K.A., Lehloenya, K.C., Seshoka, M.M., Jonker, T., Kotze, A., Chokoe, T.C. and, Nedambale, T.L. 2018. Characterization of seminal plasma constituents of unimproved indigenous and Tankwa goats. *South African J. Anim. Sci.,* **48**(5): 944-953.

Sahi, S., Afri-Bouzebda, F., Bouzebda, Z., Ouennes, H. and Djaout, A. 2019s. Testicular biometry and its relationship with age and body weight of indigenous bucks (Algeria). *Adv. Anim. Vet. Sci.*, **7**: 882-887.