Studies on testicular biometry and reaction time in Surti bucks

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Abstract

A study was conducted for a period of 60 days separately during the breeding and non-breeding seasons, with an objective to use various reproductive traits as selection criteria to exploit maximum reproductive potential of Surti bucks for breeding purpose. Eight apparently healthy adult Surti bucks were selected randomly on basis of their breed characteristics, age and sexual activity and were divided into two groups to collect semen once daily (Group-I, n=4) and twice daily (Group-II, n=4), with first and second successive ejaculate with no predetermined time. The reproductive traits viz. scrotal circumference, right and left testicular length, right and left testicular circumference and right and left testicular diameter were measured at every 10 days interval during both the seasons, i.e. 1st, 10th, 20th, 30th, 40th, 50th and 60th day whereas reaction time was measured prior to each semen ejaculation. The biometric results of reproductive traits such as scrotal circumference, right and left testicular length, circumference and diameter apart from the reaction time of individual bucks were significantly ($p<0.05$) influenced by the season and ejaculation frequencies. All of these traits except the reaction time were higher during the breeding season and also the ejaculates obtained once daily. The pooled biometrics of scrotal circumference was significantly ($p<0.05$) higher during the breeding season (26.23±0.12 cm) than the non-breeding season (25.55±0.15 cm). The pooled data of reaction time during non-breeding season (44.24±0.68 seconds) were significantly higher ($p<0.05$) than breeding season (25.15±0.70 seconds). The reaction time of 65.15±1.83 and 32.32±1.12 seconds was resulted at the ejaculation frequency of second successive and once daily, respectively during the non-breeding season in comparison to 42.38±1.24 and 19.28±0.58 seconds during the breeding season.

Key words: ejaculation frequency; reproductive traits; season; Surti buck; testis

Introduction

Goat (*Capra hircus*) rearing is a source of livelihood for small and marginal farmers including landless laborers in India. It is an important source of sustainable livelihood of rural population across the globe (Zailani et al 2016; Salvana et al 2021). It provides regular constant and substantial income through milk, meat and manure. Surti goat is considered as a dual purpose breed located in South Gujarat from Vadodara to Valsad districts which regularly gives 1 to 1.5 liter milk/day. It is a white colored medium to compact sized breed. To improve the productivity potential of goats, incorporation of superior germplasm into progeny is essential and is only possible with the use of outstanding sires. The primary selection on the basis of testicular measurements has been advantageous followed by individual's libido and assessment of seminal attributes. In order to ensure optimum reproductive performance, a thorough reproductive organ examination and evaluation is important. Scrotal measurements and libido are found to be affected by several factors. Season of year (Gogoi *et al*., 2008) and semen collection frequency are of concern with these traits (Zarazaga *et al*., 2009). However such studies are very scanty especially in Surti bucks, therefore, we placed on record a study of influence of season and ejaculation frequencies on testicular biometry and reaction time in Surti bucks.

Materials and methods

The present study was conducted at the Livestock Research Station, Kamdhenu University, Navsari-396450, Gujarat, for a period of 60 days separately during the breeding (March to April, 2023) and 60 days during non-breeding seasons (June to July, 2023). Geographically, the Livestock Research Station is located at 20°92' North latitude and 72°89' East longitude with an altitude of about 38.0 m above mean sea level. The bucks were maintained under uniform management and hygienic conditions. The breeding season was decided from the appearance of first estrous to the last estrous in the flock, i.e. march-may; whereas ceasation of estrous referred to non-breeding season. Eight adult and apparently healthy Surti bucks of 32-48 months age were selected on the basis of breed characteristics and sexual behavior. These bucks were divided randomly in two groups: Group-I (n=4) and Group-II (n=4). In Group-I, semen was collected once a day from all the three bucks, while in Group II; it was collected twice a day during the breeding and non-breeding seasons. The second successive ejaculate was collected with no predetermined time. Semen samples of each buck were pooled in Group-I whereas in Group-II, the first and second ejaculates were pooled separately. A total of 360 semen ejaculates were obtained from bucks during each season for semen studies.

Reproductive traits i.e. scrotal circumference, right and left testicular length, right and left testicular circumference and right and left testicular diameter were measured at every 10 days interval i.e. 1st, 10th, 20th, 30th, 40th, 50th and 60th day during both the seasons. Scrotal and testicular circumferences were measured at the widest point of the scrotum and testis using the thread and then thread was measured on a meter rule (Notter *et al*., 1981) whereas, the testicular length and diameter were measured at the highest length and width, respectively, for both the testicles as to that of the scrotal circumference. The testicular length measurements were taken by excluding epididymis and expressed in cm. The testicular diameter was measured with the help of the vernier caliper. The skin thickness was measured with the help of the vernier caliper and it was then deducted from the scrotal circumference, right and left testicular circumference and testicular diameter to obtain exact measurements. The reaction time of each buck was recorded as the time interval between the bucks released from the housing pen till ejaculation of semen daily throughout the study. The semen was collected daily in morning at 7:00 to 8:00 hr using Artificial Vagina specific for the bucks.

Data analysis was done by SPSS software (IBM® SPSS®, statistics, version 20.0) using Paired 't' test, one-way ANOVA and CRD methods. Differences of $p<0.05$ were considered significant as per Steel and Torrie (1981). Data were presented in Mean±SE and significance was considered at less than 0.05.

Results and discussion

Scrotal Circumference

The average values of scrotal circumference of individual bucks during the breeding and non-breeding seasons have been presented in Table-1, which differed significantly ($p<0.05$) among the bucks between two seasons. On the other hand, shorter values of 22.52 ± 3.61 cm (Sahi, *et al*., 2019) and

Table-1: Scrotal circumference (cm) of bucks during different seasons

Seasons	Buck Number								Pooled
	39-22	36-22	31-21	12-22	29-22	51-22	54-21	37-22	
Breeding	26.31±0.06^{a}	27.93±0.02^{a}	28.97±0.03^{a}	26.25±0.02^{a}	25.88±0.09^{a}	25.10±0.06^{a}	25.42±0.07^{a}	26.32±0.05^{a}	26.23±0.12^{a}
Non-breeding	24.89±0.06^{b}	27.15±0.04^{b}	28.11±0.07^{b}	24.44±0.05^{b}	25.41±0.07^{b}	24.06±0.05^{b}	24.66±0.05^{b}	25.77±0.07^{b}	25.55±0.15^{b}

Means with different superscripts in columns differ significantly ($p<0.05$)

Table-2: Scrotal circumference (cm) of bucks in relation to semen ejaculation frequency during different seasons

Days	Seasons	Once daily ejaculate	Twice daily	
			First ejaculate	Second ejaculate
1	Breeding (n=8)	27.41±1.09^{a}	26.11±0.33^{b}	26.11±0.33^{b}
	Non-breeding (n=8)	26.58±1.04^{a}	24.87±0.41^{b}	24.87±0.41^{b}
5	Breeding (n=8)	26.69±1.11^{a}	25.11±0.35^{b}	25.11±0.35^{b}
	Non-breeding (n=8)	26.49±1.03^{a}	24.92±0.39^{b}	24.92±0.39^{b}
10	Breeding (n=8)	26.96±1.09^{a}	25.23±0.28^{b}	25.23±0.28^{b}
	Non-breeding (n=8)	26.37±1.01^{a}	25.14±0.35^{b}	25.14±0.35^{b}
15	Breeding (n=8)	26.93±1.06^{a}	25.66±0.39^{b}	25.66±0.39^{b}
	Non-breeding (n=8)	26.70±1.04^{a}	25.22±0.39^{b}	25.22±0.39^{b}
20	Breeding (n=8)	27.00±1.10^{a}	25.68±0.37^{b}	25.68±0.37^{b}
	Non-breeding (n=8)	26.70±1.04^{a}	25.13±0.39^{b}	25.13±0.39^{b}
25	Breeding (n=8)	27.03±1.06^{a}	25.66±0.35^{b}	25.66±0.35^{b}
	Non-breeding (n=8)	26.73±1.01^{a}	25.14±0.33^{b}	25.14±0.33^{b}
30	Breeding (n=8)	27.10±1.10^{a}	25.69±0.34^{b}	25.69±0.34^{b}
	Non-breeding (n=8)	26.80±1.04^{a}	25.15±0.36^{b}	25.15±0.36^{b}

Means with different superscripts in rows differ significantly ($p<0.05$)

Table-3: Testicular biometry (cm) of buck during different seasons

Testicular biometry		seasons	Buck Number								Pooled
			39-22	36-22	31-21	12-22	29-22	51-22	54-21	37-22	
TL	Right	Breeding	12.40±0.04^{a}	13.98± 0.03^{a}	13.23±0.05^{a}	12.77±0.06^{a}	11.71±0.05^{a}	12.62±0.05^{a}	12.25±0.06^{a}	12.55±0.06^{a}	12.79±0.08^{a}
		Non-breeding	12.12±0.03^{b}	13.63± 0.02^{b}	13.10±0.04^{b}	12.59±0.03^{b}	11.58±0.04^{b}	12.24±0.04^{b}	11.79±0.05^{b}	12.21±0.06^{b}	12.38±0.07^{b}
	Left	Breeding	12.22±0.04^{a}	13.81± 0.05^{a}	13.44±0.05^{a}	13.16±0.06^{a}	12.17±0.05^{a}	12.54±0.05^{a}	12.23±0.05^{a}	12.71±0.06^{a}	12.98±0.09^{a}
		Non-breeding	12.24±0.03^{b}	13.81± 0.04^{b}	12.99±0.03^{b}	12.82±0.05^{b}	11.66±0.04^{b}	12.40±0.04^{b}	11.82±0.04^{b}	12.37±0.03^{b}	12.64±0.07^{b}
TC	Right	Breeding	15.09±0.04^{a}	15.19± 0.22^{a}	15.09±0.05^{a}	15.19±0.05^{a}	15.03±0.03^{a}	15.22±0.05^{a}	15.02±0.03^{a}	15.18±0.04^{a}	15.14±0.04^{a}
		Non-breeding	14.68±0.04^{b}	14.88± 0.03^{b}	14.77±0.04^{b}	14.84±0.03^{b}	14.69±0.05^{b}	14.79±0.05^{b}	14.80±0.05^{b}	14.97±0.04^{b}	14.85±0.03^{b}
	Left	Breeding	15.08±0.02^{a}	15.18± 0.03^{a}	15.17±0.03^{a}	14.98±0.02^{a}	15.21±0.03^{a}	15.17±0.03^{a}	15.13±0.03^{a}	15.47±0.02^{a}	15.22±0.01^{a}
		Non-breeding	14.97±0.03^{b}	14.89± 0.02^{b}	15.16±0.03^{b}	14.67±0.03^{b}	14.93±0.03^{b}	14.82±0.04^{b}	14.90±0.03^{b}	14.95±0.03^{b}	14.92±0.02^{b}
TD	Right	Breeding	5.09±0.02^{a}	5.02± 0.05^{a}	5.05±0.02^{a}	5.04±0.04^{a}	5.15±0.01^{a}	5.10±0.05^{a}	5.28±0.05^{a}	5.11±0.02^{a}	5.14±0.12^{a}
		Non-breeding	4.99±0.01^{b}	4.86±0.0^{b}	4.79±0.01^{b}	4.78±0.01^{b}	4.88±0.01^{b}	4.78±0.01^{b}	4.95±0.01^{b}	4.87±0.01^{b}	4.95±0.01^{b}
	Left	Breeding	5.09±0.02^{a}	5.11±0.01^{a}	4.80±0.01^{a}	5.19±0.01^{a}	4.94±0.01^{a}	5.18±0.02^{a}	5.46±0.01^{a}	5.12±0.01^{a}	5.11±0.01^{a}
		Non-breeding	4.85±0.01^{b}	4.96±0.01^{b}	4.67±0.02^{b}	4.98±0.02^{b}	4.77±0.02^{b}	4.88±0.02^{b}	5.27±0.01^{b}	4.85±0.02^{b}	4.80±0.01^{b}

TL=Testicular Length, TC=Testicular circumference, TD= Testicular diameter Means with different superscripts in columns differ significantly ($p<0.05$)

Table-4: Reaction time (sec) of bucks during different seasons

Seasons		Buck Number							Pooled
	39-22	36-22	31-21	12-22	29-22	51-22	54-21	37-22	
Breeding (n=360)	22.86± 0.51^{a}	40.23± 0.88^{a}	25.44± 0.70^{a}	34.22± 0.87^{a}	26.31± 0.66^{a}	21.40± 0.58^{a}	9.11± 0.75^{a}	40.05± 1.11^{a}	25.15± 0.70^{a}
Non-breeding (n=360)	29.44± 1.24^{b}	60.05± 1.05^{b}	34.15± 0.60^{b}	42.30± 1.14^{b}	38.08± 1.14^{b}	32.45± 1.06^{b}	27.24± 0.58^{b}	52.24± 0.77^{b}	44.24± 0.68^{b}

Means with different superscripts in columns differ significantly ($p<0.05$)

Table-5: Reaction time (sec) of bucks in relation to semen ejaculation frequency during different seasons

Seasons	Once daily ejaculate	Twice daily	
		First ejaculate	Second ejaculate
Breeding (n=360)	19.28±0.58$_{a}$^{a}	28.92±0.69$_{a}$^{b}	42.38±1.24$_{a}$^{c}
Non-breeding (n=360)	32.32±1.12$_{b}$^{a}	39.25±1.31$_{b}$^{b}	65.15±1.83$_{b}$^{c}

Means with different superscripts in rows differ significantly ($p<0.05$); Means with different subscripts in columns differ significantly ($p<0.05$)

23.20±1.30 cm (El-Hamid *et al*., 2024) have also been reported in Algerian indigenous and Egyptian crossbred bucks which might be attributed to morpholigical genetic variations among the breeds. Table-2 depicts the scrotal circumference in relation to ejaculation frequency during breeding and non-breeding seasons at different intervals of experiment. The statistical analysis of data shows the non-significant seasonal variation in scrotal circumference within the groups of experiments. The average values were observed to tend between 26.58±1.04 to 27.21±1.09 and 24.87±0.41 to 25.69±0.34 cm in bucks ejaculated semen once and twice daily, respectively.

The findings of significant seasonal variation referred a demarkable decrease in scrotal size of individual buck and also in pooled data of experiment during the non-breeding season (25.55±0.15 cm) in comparison to breeding season (26.23±0.12 cm), which corroborated the earlier reports of Webb *et al*. (2004), Gundogan (2006).

The scrotal circumference was not found to be affected within the bucks ejaculated semen once daily, the first and second ejaculate between the seasons. It decreased statistically at second ejaculate in comparison to bucks ejaculated semen once daily throughout the entire experiment during the breeding and non-breeding seasons.

Testicular Length

The right and left testicular length of individual buck during breeding and non-breeding seasons have been shown in Table-3. It was found to differ significantly ($p<0.05$) between two seasons. The pooled values of right testicular length during breeding and non-breeding season were 12.79±0.08 and 12.38±0.07 cm, respectively. The corresponding values of left testicular length were 12.98±0.09 and 12.64±0.07 cm, respectively. These findings are almost similar to the earlier reports (Giri, *et al*., 1994). However, it differed from other studies on non-descript bucks wherein large size of right and left testicles have been reported by Khan, *et al*. (2007) whereas smaller measurements of right and left testicular length of 8.01 ±0.22 cm and 8.14±0.23 cm, respectively, during the period of growth and adolescence in Surti goats (Chaudhary *et al*., 2018) and 7.65±0.17 cm and 7.91±0.17 cm in right and left testis, respectively, in slaughtered mature bucks of different breeds (Patel *et al*., 2021).

Testicular Circumference

The right and left testicular circumference of individual buck during breeding and non-breeding seasons have been shown in Table-3. It was found to differ significantly ($p<0.05$) between two seasons. The pooled values of right testicular circumference during breeding and non-breeding season were 15.14±0.04 and 14.85±0.03 cm, respectively. The corresponding values of left testicular circumference were 15.22±0.01 and 14.92±0.02 cm, respectively. However, Patel *et al*. (2021) reported smaller right (10.41±0.18 cm) and left (10.83±0.20 cm) testicular circumference than present study in slaughtered bucks of different breeds. Singh *et al*. (2022) also reported smaller testicular circumference as 10.16±0.16 cm and 10.66±0.18 cm in right and left testis in slaughtered mature bucks irrespective of breed.

Testicular Diameter

The right and left testicular diameter of individual buck during breeding and non-breeding seasons have been shown in Table-3. It was found to differ significantly ($p<0.05$) between breeding and non-breeding seasons. The pooled values of right testicular diameter during breeding and non-breeding season were 5.14±0.12 and 4.95±0.01 cm, respectively. The corresponding values of left testicular diameter were 5.11±0.01 and 4.80±0.01 cm, respectively. The data showed the diameter of both testicles of individual bucks tended to be larger during breeding than non-breeding season. The larger testicular diameter during the breeding season might be associated with photoresponsiveness of bucks and nature of the photoperiodic signals required for gonadal hormonal release to determine testicular activity (Wildeus, 1995). However, Sahi, *et al*. (2019) reported higher values of testicular diameter (6.04±1.44 cm) in Algerian Indigenous bucks in comparison to present study. Whereas El-Hamid *et al*. (2024) have reported very high value of testicular diameter (12.9±0.7 cm) in Egyptian crossbred bucks which might be attributed due to morphometric genetic variations among these breeds. In contrary to this, smaller testicular diameters than present study were found as 3.31±0.05 and 3.43±0.06 cm in right and left testicle, respectively by Patel *et al*. (2021) and 3.23±0.05 and 3.39±0.06 cm in right and left testicle, respectively by Singh *et al*. (2022) in slaughtered bucks of different breeds. Simillarly, Chaudhary *et al*. (2018) have also reported smaller testicular width as 4.21±0.07 and 4.30±0.09 cm in right and left testicles, respectively in Surti bucks during the period of their growth and adolescence.

Reaction Time

The reaction time of individual bucks during breeding and non-breeding season as well as during various ejaculation frequencies is tabulated in Table-4 and 5. The average values ranged from 9.11±0.75 to 40.23±0.88 seconds and 27.24±0.58 to 60.05±1.05 seconds during breeding and non-breeding seasons, respectively. The differences were significant ($p<0.05$) between two seasons. The pooled values were observed to be 25.15±0.70 and 44.24±0.68 seconds during breeding and non-breeding seasons, respectively. The data pertained to reaction time revealed significant ($p<0.05$) variations among the bucks between two seasons; and prolonged interval was discernible during the non-breeding season in comparison to breeding season. Earlier studies also confirm the seasonal variation in reaction time, although, breed variations were documented both in bucks and rams (Singh and Purbey, 1994, Kamal, *et al*., 2005) but longer reaction time was recorded during non-breeding season by these authors.

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Conflict of interest All authors declare that they do not have conflict of interest.

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