RESEARCH ARTICLE

Fresh Seminal Attributes of Surti Bucks and their Interrelationships

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Abstract

The study was conducted to evaluate fresh seminal attributes of Surti bucks and their interrelationships. Fresh semen was collected from four Surti bucks twice a week for 8 weeks, *i.e.*, 64 ejaculates (16/buck). Ejaculates of 4 bucks were pooled and extended with TEYCG extender. Fresh semen was observed pale yellow having mean pH of 6.8. The overall mean semen volume, density, mass activity/motility, sperm concentration and total sperm count/ejaculate were 0.50±0.02 mL, 3.39±0.08, 3.45±0.09, 4032.81±34.00 millions/mL and 1986.25±86.03 million, respectively. Percentages of individual sperm motility, live sperms, abnormal sperms and HOST reacted sperms in pooled extended Surti bucks semen were 80.63±1.76, 83.06±1.64, 9.56±0.47 and 78.06±0.96. Ejaculate volume and total sperm count significantly ($p<0.05$) varied between bucks. Moreover, significant correlations were observed for volume with density (-0.281), sperm concentration (-0.247) and total sperm count (0.975) as well as density with sperm concentration (0.247) and total sperm count (-0.260). The coefficient of variation was minimum for sperm concentration and maximum for total sperm count. In pooled and extended semen, individual sperm motility was significantly and positively correlated only with live sperms % (r=0.899). The coefficient of variation (%) was highest for abnormal sperms and lowest for HOST reacted sperms. Conclusively the study established normal values of fresh semen of Surti bucks and their interrelationships.

Key words: Fresh seminal attributes, Interrelationships, Surti buck.

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Introduction

Goat rearing is vital in India due to its socio-economic impact as it provides livelihoods for rural communities through milk, meat and fibre production. Thus, it is also referred as "poor man's cow" (MacHugh and Bradley, 2001). Goat population in India stands at about 148.88 million (20th Livestock Census, 2019). Moreover, production invariably depends on reproduction performance. Successful reproduction itself depends on quality of fresh semen in both natural and using assisted reproductive technologies. Buck semen quality is crucial for effective breeding, genetic diversity, healthier offspring and improved production traits. It also impacts herd productivity, influencing overall success, viability and quality of future generations in goat rearing programs. Studying normal buck semen attributes such as colour, pH, density, mass activity, sperm concentration and total sperm count is vital for identifying any procedural lapse during semen collection as well as assessing reproductive health and overall breeding success. Surti goat breed is native to south Gujarat and its reproduction and production performance is crucial for local livestock owners, small unit holders as well as large scale industry. Considering all these aspects, this study was conducted to explore fresh semen attributes of Surti bucks and their interrelationships.

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Materials and Methods

The study was undertaken at Department of Veterinary Gynaecology and Obstetrics, College of Veterinary Science & Animal Husbandry, Kamdhenu University, Navsari (20°57'-20°95' North; 72°56'-72°93' East; 9m above MSL) located in coastal south Gujarat (India). A total of four bucks that were apparently healthy, more than one year of age as

well as previously dewormed and vaccinated for diseases such as Foot and Mouth Disease (FMD) and Peste des Petits Ruminants (PPR) were selected from AICRP-Goat under Livestock Farm Complex of Kamdhenu University, Navsari.

All the selected Surti bucks were trained for one and half month to ejaculate semen in artificial vagina (AV) for which dummy does were used. Different AVs of about size 8-inch were used for different bucks maintaining an optimum pressure as well as temperature (40°C to 42°C). In order to prevent thermal shock to the sperms, ejaculate tube and AVs were jacketed. All the materials used during collection were sterile and the procedure was conducted aseptically. A total of 64 ejaculates were collected (twice/buck/week for 8 weeks) from all the four bucks. Freshly ejaculated semen, immediately after collection was evaluated for volume, semen colour, pH, density, mass activity (score 0-5), sperm concentration (using haemocytometer method) and total sperm output per ejaculate using standard procedure.

Ejaculates from all the 4 bucks were pooled and extended with standard tris egg yolk citrate glycerol extender. Extended semen was evaluated for individual sperm motility, sperm viability, sperm morphology and functional membrane integrity (hypo-osmotic swelling test, HOST).

Descriptive analysis was used for calculating mean ± SE values of all semen parameters. Differences between means were analysed statistically by one way ANOVA and DNMRT at 5% level of significance (Snedecor and Cochran, 1994). Correlation matrix analysis was done among various seminal attributes.

Results and Discussion

Semen Colour and pH

Semen colour in bucks observed was pale yellow without variation, which was comparable with previous studies on Surti bucks (Kumar *et al*., 2022; Karthik, 2022). However, variations were reported from pale yellow to citrine yellow, cream or creamy white in different breeds of bucks (Hafez and Hafez, 2000; Ferdinand *et al*., 2012; Dias *et al*., 2017; Kumbhar *et al*., 2019; Sharma and Sood, 2021).

Average pH of Surti buck semen observed was 6.8 (6.2 to 7.0). Similar semen pH in Surti bucks has been reported by Karthik (2022) and Kumar *et al.* (2022). Moreover, other studies have recorded higher mean pH in breeding (6.81±0.03) and non-breeding (6.96±0.02) season in Markhoz (Farshad *et al*., 2012), Berari (6.78±0.20) (Patil *et al*. (2019) and West African Dwarf (6.73±0.25) bucks (Ferdinand *et al.* (2012). These colour and pH variations may depend on differences in bucks, ejaculates, breed, as well as health status of genitalia and contamination of ejaculated semen.

Semen Attributes

Fresh semen parameters, *viz*., semen volume, semen density, mass activity, sperm concentration and total sperm count of different Surti bucks, are presented in Table 1.

Overall mean ejaculate volume of Surti buck semen observed (0.50±0.02 mL) was comparable to 0.47±0.02 to 0.58±0.03 mL reported in Black Bengal and West African Dwarf bucks (Apu *et al*., 2008; Ferdinand *et al*., 2012; Ray *et al*., 2015; Kumar *et al*., 2022). However, it was lower than 0.61±0.01 to 0.97±0.02 mL reported in different breeds by others (Patel *et al*., 2020; Karthik, 2022; Atara *et al*., 2019; Kumbar *et al*., 2019; Gopinathan *et al*., 2021), while some workers recoded values from 1 to 3 mL in certain indigenous and exotic dairy breeds of goats (Dias *et al*., 2017; Narwade *et al*., 2018; Patil *et al*., 2019; Goswami *et al*., 2020). Semen volume can vary owing to age, breed, testicular biometry, atmospheric temperature, managemental conditions, methods and season of semen collection and nutritional status.

Overall mean semen density observed was 3.39±0.08 ranging from 3.31±0.18 to 3.50±0.16, which concurred well with many previous reports (Karthik, 2022; Kumar *et al.,* 2022), whereas higher mean semen density (3.83±0.03 to 3.91±0.03) was reported by Farshad *et al.* (2012), Atara *et al.* (2019), Patel *et al*. (2020) in Markhoz and Surti bucks, while lower score as 3.10±0.05 was reported in Osmanabadi bucks (Kumbhar *et al*., 2019).

The results of mass activity ranging from 3.38±0.18 to 3.50±0.18 with an overall value of 3.45±0.09 corroborated well with the scores recorded in several earlier studies (Kumbhar *et al*., 2019; Karthik, 2022; Kumar *et al.,* 2022). However, higher mass motility scores (3.90±0.60 to 4.84±0.04) have also been reported in Beetal and Sirohi bucks (Goswami *et al*., 2020), Black Bengal, Alpine, Berari and Surti bucks (Ray *et al*., 2015; Santos *et al*., 2006; Patil *et al*., 2019; Patel *et al*., 2020). Even lower mass activity score ranging from 2.5±0.2 to 3.17±0.04

Table 1: Fresh semen parameters (Mean ± SE) in different Surti bucks

Buck No.	N	Ejac. volume (mL)	Density	Mass motility (0-5 scale)	Sperm concentration ($\times10^6$/mL)	Total sperm count ($\times10^6$)
31	16	0.49^{ab}±0.04	3.31^{a}±0.18	3.44^{a}±0.18	4018.75^{a}±66.60	1944.38^{ab}±144.62
32	16	0.56^{a}±0.05	3.50^{a}±0.16	3.50^{a}±0.18	3993.75^{a}±73.30	2245.00^{a}±210.33
40	16	0.40^{b}±0.04	3.44^{a}±0.16	3.50^{a}±0.18	4068.75^{a}±73.44	1579.38^{b}±125.93
41	16	0.54^{a}±0.04	3.31^{a}±0.18	3.38^{a}±0.18	4050.00^{a}±63.25	2176.25^{a}±159.08
Overall	**64**	**0.50±0.02**	**3.39±0.08**	**3.45±0.09**	**4032.81±34.00**	**1986.25±86.03**
F value		3.42*	0.32	0.11	0.23	3.40*
P value		0.02	0.82	0.96	0.88	0.02

Means with different superscript within a column differ significantly at p<0.05.

have also been observed in Alpine (Dias *et al*., 2017), Saanen (Santos *et al*., 2006) and Alpine×Beetal buck (Narwade *et al*., 2018). These variations can also be attributed to different pattern and range of scale (0-4 or 0-5) adopted for studying mass activity in addition to individual differences between recorders.

Overall mean sperm concentration 4032.81±34.00 million/mL (ranging from 3993.75±73.30 to 4068.75±73.44 million/mL) was comparable with earlier findings in Surti (Patel *et al*. (2020; Kumar *et al*. (2022) and Alpine X Beetal buck (Narwade *et al*., 2018). Further, lower sperm concentrations ranging from 1968.76±134.97 to 3401.00±247.20 million/mL have been reported in Surti (Atara *et al*., 2019; Karthik, 2022), Alpine (Dias *et al*., 2017), Sirohi (Khadse *et al*., 2019), Black Bengal (Apu *et al*., 2008; Ray *et al*., 2015), Malabari (Gopinathan *et al*., 2021), and Beetal, Sirohi bucks and Gaddi goats (Goswami *et al*., 2020; Sharma and Sood, 2021). The differences in the sperm concentration observed in different studies may be due to factors like age, nutrition, breed, collection method, season, technique of assessment of sperm concentration, frequency of collection apart from skill of person.

Total sperm output per ejaculate ranged between 1579.38±125.93 and 2245.00±210.33 million with overall mean of 1986.25±86.03 million. In Surti bucks, almost similar values have been reported by others (Atara *et al*., 2019; Patel *et al*., 2020; Karthik, 2022; Kumar *et al*., 2022), while higher values from 2260.00±0.81 to 4370.00±0.22 million have been reported in Alpine and Saanen (Santos *et al*., 2006), Markhoz (Farshad *et al*., 2012), Osmanabadi (Kumbhar *et al*., 2019), Berari (Patil *et al*., 2019), and Sirohi and Beetal (Goswami *et al*., 2020) bucks.

Percentages of individual sperm motility, live sperm, abnormal sperm and HOST reacted sperm in pooled and extended Surti buck semen were 80.63±1.76, 83.06±1.64, 9.56±0.47 and 78.06±0.96, respectively.

Correlation Coefficients between Seminal Parameters

The correlation coefficients (r) among various seminal attributes of Surti buck fresh semen as well as pooled and extended semen assessed (Fig. 1) revealed that the semen volume had significant ($p<0.05$) negative correlations with semen density (r= -0.281) and sperm concentration (r= -0.247) as well as non-significant ($p>0.05$) negative correlation with mass motility (r= -0.100) and significant ($p<0.01$) positive correlation with total sperm count (r= 0.975). In other studies, semen volume was significantly ($p<0.01$) negatively correlated with semen density (r= -0.779), sperm concentration (r= -0.901); non-significantly ($p>0.05$) negatively correlated with mass motility (r= -0.233) and significantly ($p<0.01$) positively correlated with total sperm count (r= 0.980) in Surti buck (Karthik, 2022). While, semen volume was non-significantly ($p>0.05$) negatively correlated with both mass motility (r= -0.075) and concentration (r= -0.161) in Gaddi bucks (Sharma and Sood, 2021). Additionally, non-significant ($p>0.05$) negative correlation of semen volume with sperm concentration (r= -0.302) and positive correlation with total sperm (r= 0.961) has been reported by Kumar *et al*. (2022) in Surti bucks. The ejaculate volume was also negatively (r= -0.18) correlated with the sperm concentration in Sirohi male goat (Khadse

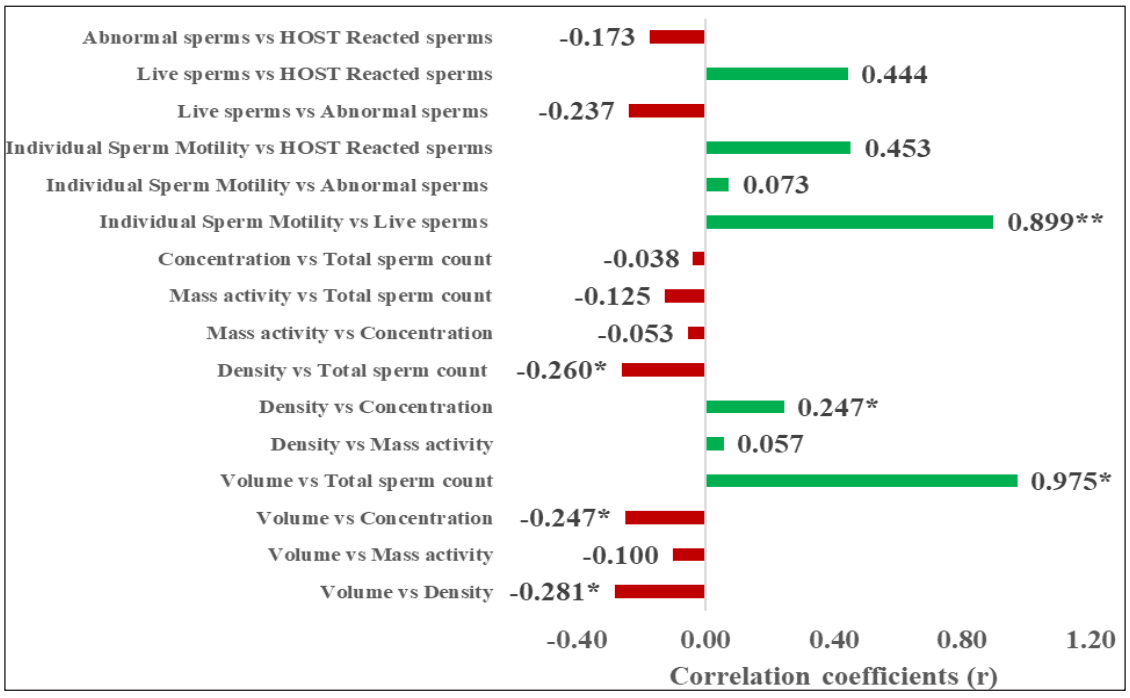

Fig. 1: Correlation coefficients (r) among various seminal attributes of Surti buck; *p<0.05, ** p<0.01.

et al., 2019), and was positively correlated with the mass motility in Osmanabadi bucks (Kumbhar *et al*., 2019).

The mass motility had non-significant (p>0.05) negative correlations with concentration (r= -0.053) and total sperm count (r= -0.125) in the present study. In earlier studiers, mass motility was positively correlated with sperm concentration (Karthik, 2022) and with total sperm count (Kumar *et al.,* 2022) in Surti bucks. Moreover, semen density had significant (p<0.05) positive correlation with sperm concentration (r= 0.247) and negative correlation with total sperm count (r= -0.260). The reason may be attributed to higher semen density observed in one Surti buck with significantly lower total sperm count, resulting in negative correlation between sperm concentration and total sperm count.

Among the parameters of pooled and extended buck semen, individual sperm motility was significantly and positively correlated with live sperm % (r=0.899), whereas non-significantly and positively correlated with abnormal sperm % (r=0.073) and HOST reacted sperm % (r=0.453). There was non-significant correlation between live sperm % and abnormal sperm % (r=-0.237) that was negative, and live sperm % and HOST reacted sperm % (r=0.444) that was positive. The correlation between abnormal sperm % and HOST reacted sperm % was negative and non-significant.

The coefficients of variation (CV%) for fresh semen parameters of Surti bucks, *viz,* volume, density, mass motility, sperm concentration and total sperm output were 34.40, 19.39, 20.59, 6.74 and 34.65, being highest for total sperm output and ejaculate volume, and lowest in density among bucks studied. Coefficients of variation (%) for pooled and extended Surti buck semen parameters, *viz,* individual sperm motility, live sperm, abnormal sperm and HOST reacted sperm were 8.73, 7.92, 19.46 and 4.94, respectively. All these were within normal limits of variations in buck semen.

Conclusions

The present study established normal values of fresh semen of Surti bucks and their interrelationships. Semen ejaculate volume and total sperm count varied significantly between bucks. Correlations were significantly positive between volume and total sperm count as well as density and sperm concentration, whereas significantly negative between volume and density, volume and sperm concentration as well as density and total sperm count. Significant and positive correlations were noted between individual sperm motility and live sperm %. Positive correlations were observed for individual sperm motility with abnormal sperm % and HOST reacted sperm, live sperms with HOST reacted sperm, and negative for abnormal sperm with live sperm and HOST reacted sperm.

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