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Research Article

STUDIES ON CERTAIN PHYSICAL CHARACTERISTICS AND SPERM ABNORMALITIES OF SURTI BUCK SEMEN DURING DIFFERENT SEASONS AND SEMEN EJACULATION FREQUENCIES

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ABSTRACT

A study was designed to find out the effect of seasons and semen ejaculation frequencies on physical characteristics of Surti buck semen during the breeding and non-breeding seasons at LRS, KU, Navsari, Gujarat. Seven apparently healthy adult Surti bucks of 18-37 months age were selected and randomly divided in two groups: Group-I (n=3) where semen was collected once a day and pooled while in Group-II (n=4) semen was collected twice a day where the first and second ejaculates were pooled separately. The pH and mass motility of semen was not found to be affected due to season and collection frequency. However, sperm concentration and per cent live spermatozoa were significantly low during the non-breeding season (2644.28 ± 16.07 × 10^6 sperm/ml and 82.50 ± 0.33) than breeding season (2978.23 ± 24.54 × 10^6 sperm/ml and 87.08 ± 0.85). Similarly, the total spermatozoa abnormalities and head, mid-piece and tail defects were significantly higher during the non-breeding season. In relation to ejaculation frequency, the sperm concentration and live spermatozoa increased significantly in ejaculates obtained once daily (2908.20 ± 39.48 ×10^6 sperm/ml and 86.22 ± 0.58 %) than the second ejaculate (2618.33 ± 22.35 × 10^6 sperm/ml and 81.35 ± 0.36 %) whereas, the percentage of total sperm abnormalities and head and tail defects were significantly higher at the second ejaculate (10.24 ± 0.33, 4.82 ± 0.22 and 3.07 ± 0.28) than the ejaculate obtained once daily (8.20 ± 0.72, 3.54 ± 0.22 and 2.35 ± 0.24). The interaction of season × frequency of semen collection was apparent on the sperm concentration and live spermatozoa. Similar influence was observed on total sperm abnormalities and head and tail defects wherein seasonal influence was noted at second successive ejaculate.

Keywords: Abnormality, Buck, Semen, Sperm, Surti

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Rearing of goat (*Capra hircus*) is a source of livelihood for small and marginal farmers including landless laborers. It provides steady and substantial regular income through milk, meat and manure. In India, goat breeding is only based on natural service and therefore, it needs an immediate implementation of appropriate breeding strategies and breed improvement programs through conservation of potential animals. To improve the productivity potential of goats, the incorporation of superior germplasm is essential and it is possible only with the use of outstanding sires. Therefore, artificial insemination is the most valuable tool for the dissemination of superior germplasm and control of venereal diseases (Dalal *et al.*, 2018). The season of the year and frequency of semen collection are of concern with fertility traits of spermatozoa. These traits have been studied extensively in cow and buffalo bulls (Javed *et al.*, 2000; Shelke, 2000; Asadpour *et al.*, 2007) besides rams (Kaya *et al.*, 2002; Cardozo *et al.*, 2006). However such studies are meager in goats (Oyeyemi *et al.*, 2000; Srinivas *et al.*, 2002; Karagiannidis *et al.*, 2000). Therefore, the present investigation was undertaken to exploit the productive potential of Indian goat in view to amplify the economic returns to poor class of people and also to meet the requirements of researchers /scientists.

MATERIALS AND METHODS

The present work was conducted at the LRS, KU, Navsari for a period of 60 days during breeding and non-breeding seasons. Seven adult apparently healthy Surti bucks of 18-37 months of age were selected and divided randomly in two groups: Group-I (n=3) and Group-II (n=4). The semen was collected daily in morning at 7:30 to 8:30 hr using Artificial Vagina. 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 330 semen ejaculates were obtained from bucks during each season. Immediately after semen collection, the cups containing semen were placed in a beaker filled one fourth with water having 36-37º C temperature and maintained till processing for its physical studies. The pH was estimated using pH meter, mass motilityby placing a drop of semen on glass slide placed under microscope, sperm concentration using neubauer's chamber and live spermatozoa and sperm

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Table 1. Physical and morphological characteristics of semen and spermatozoa during different seasons

Sr. No.	Seminal Characteristics	Seasons		Calculated 't' value
		Breeding (n=90)	Non-breeding (n=90)	
1	pH	6.80 ± 0.04	6.81 ± 0.06	1.33
2	Mass Motility	4.06 ± 0.08	4.06 ± 0.04	0
3	Sperm Concentration × 10^6/ml	2978.23 ± 24.54^a	2644.28 ± 16.07^b	16.41*
4	Live Spermatozoa (per cent)	87.08 ± 0.85^a	82.50 ± 0.33^b	9.01*
5	Total Abnormal Spermatozoa (per cent)	7.48 ± 0.18^a	10.70 ± 0.28^b	15.70*
	Head Abnormality (per cent)	3.20 ± 0.18^a	4.88 ± 0.22^b	7.42*
	Mid-piece Abnormality (per cent)	1.98 ± 0.14^a	3.10 ± 0.47^b	4.83*
	Tail Abnormality (per cent)	2.05 ± 0.12^a	2.98 ± 0.15^b	5.16*

Means with different superscripts in rows differ significantly (p<0.01) *Significant (p<0.01)

Table 2. Physical characteristics of semen and spermatozoa during different ejaculation frequencies

Sr. No.	Physical Characters	Group-I (n=60)	Group-II		Average (n=180)	F Value
			First Ejaculate (n=60)	Second Ejaculate (n=60)		
1	pH	6.83 ± 0.02	6.80 ± 0.05	6.80 ± 0.03	6.80±0.04	1.39
2	Mass Motility	4.06 ± 0.06	4.04 ± 0.06	4.06 ± 0.03	4.05±0.04	0.02
3	Sperm Concentration × 10^6/ml	2908.20 ± 39.48^a	2900.88 ± 32.09^a	2618.33 ± 22.35^b	2800.72±18.86	38.47*
4	Live Spermatozoa (per cent)	86.22 ± 0.58^a	85.66 ± 0.30^a	81.35 ± 0.36^b	84.80±0.27	48.52*

Mean with different superscripts in row differ significantly (p<0.01) *Significant (p<0.01)

Table 3. Physical characteristics of semen and spermatozoa in relation to ejaculation frequencies during different seasons

Physical characters	Seasons	Group-I Once daily (n=30)	Group-II		F Value
			First ejaculate (n=30)	Second ejaculate (n=30)	
pH	Breeding	6.83 ± 0.02	6.83 ± 0.01	6.83 ± 0.03	0.58
	Non-breeding	6.88 ± 0.02	6.80 ± 0.03	6.78 ± 0.02	
Mass motility	Breeding	4.07 ± 0.09	4.03 ± 0.11	4.07 ± 0.09	0.07
	Non-breeding	4.08 ± 0.09	4.08 ± 0.06	4.08 ± 0.08	
Sperm concentration×10^6/ml	Breeding	3077.38 ± 29.73^{aa}	3084.67 ± 32.95^{aa}	2785.67 ± 27.90^{ab}	3.38*
	Non-breeding	2748.62 ± 15.40^{ba}	2724.00 ± 19.85^{ba}	2484.08 ± 11.41^{bb}	
Live spermatozoa (per cent)	Breeding	87.98 ± 0.48^{aa}	87.83 ± 0.44^{aa}	83.96 ± 0.46^{ab}	0.20
	Non-breeding	84.18 ± 0.40^{ba}	83.90 ± 0.44^{ba}	79.60 ± 0.30^{bb}	

Means with different superscripts in rows differ significantly (p<0.01); Means with different subscripts in columns differ significantly (p<0.01); *Significant (p<0.01)

Table 4. Morphological abnormalities (per cent) of spermatozoa during different ejaculation frequencies

Sr. No.	Type of abnormality	Group-I	Group-II		Average (n=180)	F Value
		Once daily (n=60)	First Ejaculate (n=60)	Second Ejaculate (n=60)		
1	Total abnormality	8.20 ± 0.72^a	8.49 ± 0.29^a	10.24 ± 0.33^b	9.12 ± 0.15	14.21*
2	Head abnormality	3.54 ± 0.22^a	3.65 ± 0.24^a	4.82 ± 0.22^b	4.09 ± 0.22	10.36*
3	Mid-piece abnormality	2.35 ± 0.13	2.67 ± 0.17	2.45 ± 0.23	2.55 ± 0.44	0.75
4	Tail abnormality	2.35 ± 0.24^a	2.15 ± 0.16^a	3.07 ± 0.28^b	2.49 ± 0.27	9.03*

Mean with different superscripts in row differ significantly (p<0.01); *Significant (p<0.01)

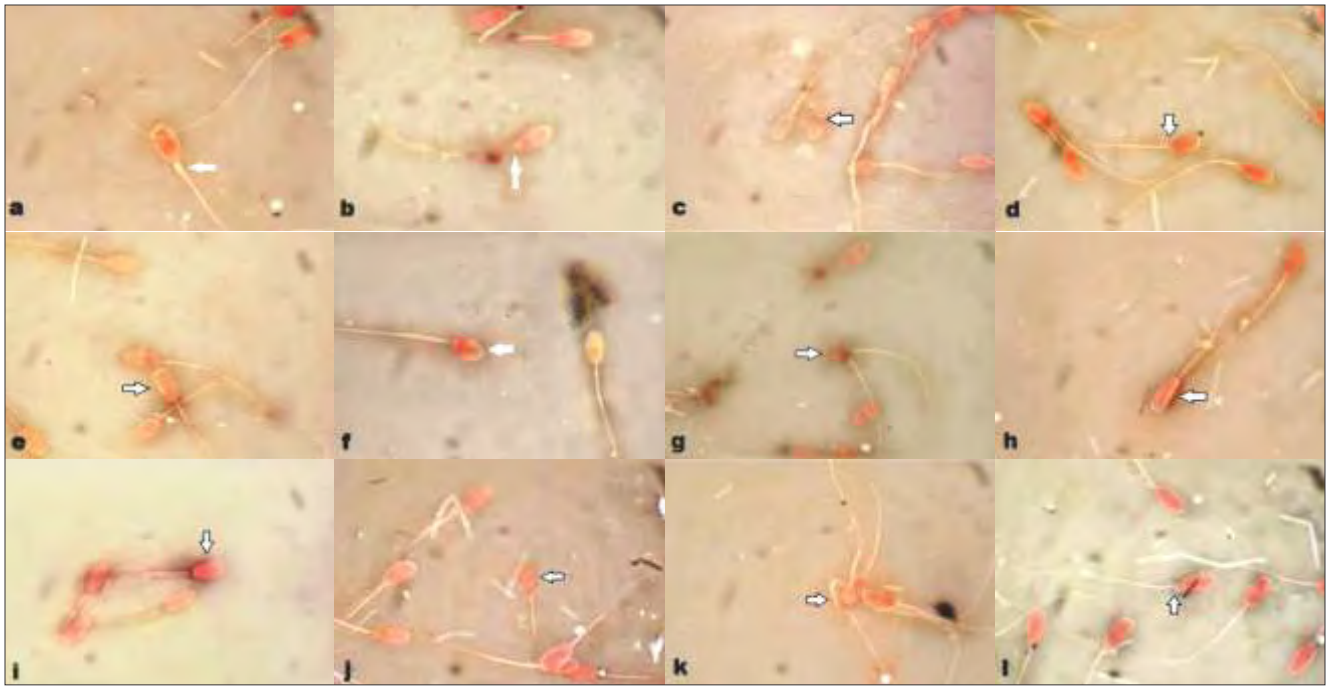

Plate 1: Different types of head abnormalities in spermatozoa (× 1000) (a. Abaxial attachment of head and swollen neck; b. Detached spermatozoa with ruptured post-nuclear capsule; c. Detached head; d. Elongated and pyriform head; e. Macrocephalic spermatozoa; f. Microcephalic spermatozoa with pyriform head; g. Microcephalic spermatozoa with double tail; h. Narrow broad head; i. Rounded Macrocephalic with swollen mid-piece; j. Ruptured head; k. Head with unilateral uneven boarder; l. Abaxial attachment of head)

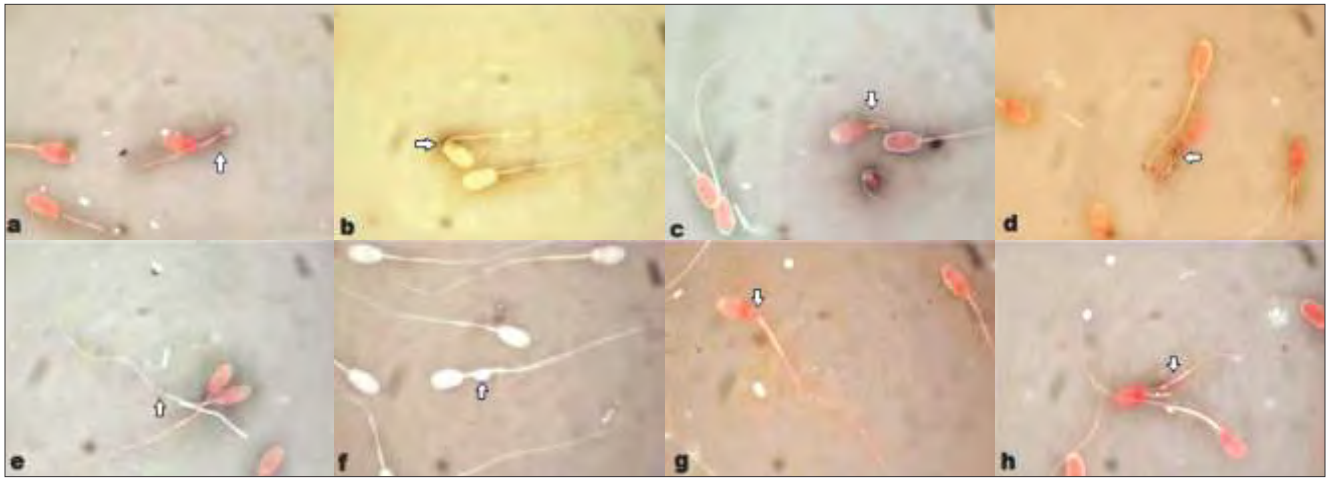

Plate 2: Different types of mid-piece abnormalities in spermatozoa (× 1000) (a. Bent and tortated mid-piece; b. Broken mid-piece; c. Curved mid-piece without tail; d. Double mid-piece with abaxial attachment; e. Distal protoplasmic droplet; f. Proximal protoplasmic droplet; g. Swollen mid-piece with broken neck; h. Uneven thickness of mid-piece)

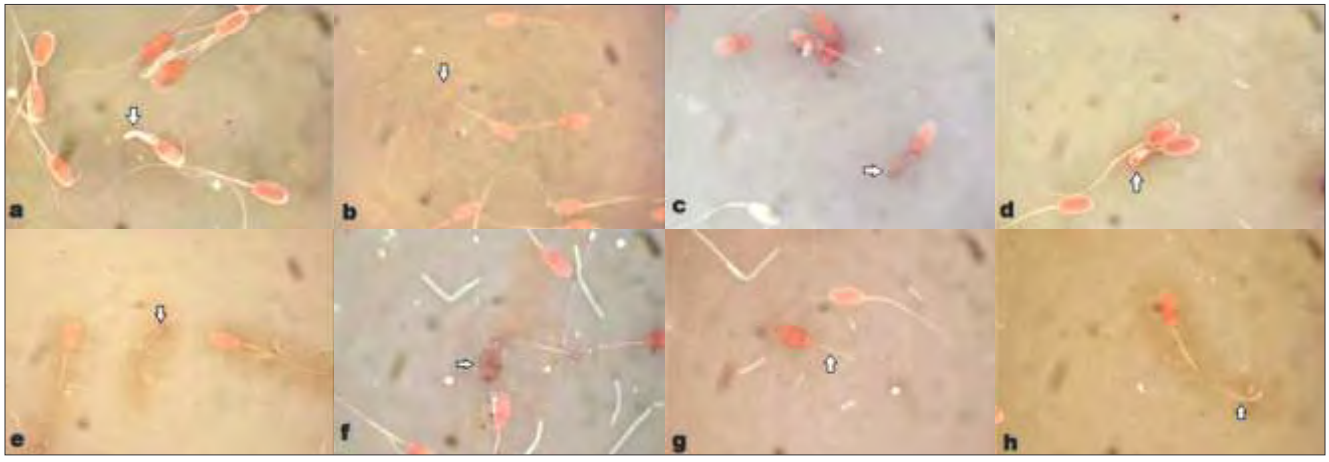

Plate 3: Different types of tail abnormalities in spermatozoa (× 1000) (a. Dag defect, Bent tail; b. Coiled tail with straight mid-piece; c. Coiled tail region; d. Dag defect; e. Detached tail; f. Detached tails; g. Short tailed spermatozoa; h. Swollen and short tailed spermatozoa)

Table 5. Morphological abnormalities (per cent) of spermatozoa in relation to ejaculation frequencies during different seasons

Abnormality	Seasons	Group-I Once daily (n=30)	Group-II		F Value
			First ejaculate (n=30)	Second ejaculate (n=30)	
Total abnormality	Breeding	5.72 ± 0.25^{aa}	7.24 ± 0.25^{aa}	9.88 ± 0.42^{ab}	0.44
	Non-breeding	10.35 ± 0.29^{ba}	10.08 ± 0.28^{ba}	12.24 ± 0.80^{bb}	
Head abnormality	Breeding	2.31 ± 0.11^{aa}	2.59 ± 0.27^{aa}	4.24 ± 0.18^{ab}	3.19*
	Non-breeding	4.58 ± 0.19^{ba}	4.62 ± 0.36^{ba}	5.31 ± 0.09^{bb}	
Mid-piece abnormality	Breeding	2.28 ± 0.22^{a}	2.32 ± 0.21^{a}	1.44 ± 0.28^{a}	5.72**
	Non-breeding	2.61 ± 0.22^{a}	3.20 ± 0.21^{b}	3.17 ± 0.27^{b}	
Tail abnormality	Breeding	1.83 ± 0.29^{aa}	1.97 ± 0.15^{aa}	2.73 ± 0.22^{ab}	1.11
	Non-breeding	3.19 ± 0.34^{ba}	2.62 ± 0.30^{bb}	3.28 ± 0.31^{bc}	

Means with different superscripts in rows differ significantly ($p<0.01$); Means with different subscripts in columns differ significantly ($p<0.01$); *Significant ($p<0.05$)**Significant ($p<0.01$)

abnormalities using H & E staining. Data were analyzed using SPSS software (v17.0; SPSS Inc.) using Paired 't' test, one-way ANOVA,CRD and factorial-CRD methods. Differences of $p<0.05$ were considered significant and $p<0.01$ as highly significant as per Steel and Torrie (1981).

RESULTS AND DISCUSSION

Hydrogen Ion Concentration (pH): The pH of Surti buck semen was observed to be 6.80±0.04 and 6.81±0.06 during the breeding and non-breeding seasons, respectively (Table 1). This corroborated with the findings of earlier studies in different breeds of bucks (Bhuskat *et al.*, 2000; Dogan *et al.*, 2005; Bhoi, 2010). The pH values also differed non-significantly between the semen ejaculation frequency and seasons within the groups (Table 3). El-Sharabassy *et al.* (1990) and Bhoi (2010) also reported non-significant variation on effect of season and successive ejaculation in Egyptian Baladi and Mehsanabucks, respectively.

Mass Motility: The mass motility of spermatozoa in our experiment did not show any discernible variation between the breeding and non-breeding seasons (Table 1); which agreed to the earlier report of Srinivas *et al.* (2002). The mass motility differed non-significantly between Group-I and Group-II (Table 2). Similar non-significant variations were also documented in cross breed bucks (Joseph and Nair, 1991).

Sperm Concentration: The perusal of data revealed a highly significant increase ($p<0.01$) in sperm concentration during the breeding season compared to non-breeding (Table 1). The values are in close approximity to the earlier reports in Osmanabadi crossbreds (Puranik *et al.*, 1993) and Damascus bucks (Ahmed *et al.*, 2004). The findings on seasonal variations in sperm concentration are comparable to Karagiannidis *et al.* (2000) and Bhoi (2010) in Damascus and Mehsana bucks who have documented higher sperm concentration during the breeding season. The sperm concentration in Group-I and Group-II differed significantly ($p<0.01$) (Table 2).

The sperm concentration at once daily collection in Group-I and second ejaculate in Group-II, during breeding and non-breeding breeding seasons differed significantly ($p<0.01$). The differences in sperm concentration were also significant between first and second ejaculate in Group-II but non-significant between Group-I and first ejaculate of Group-II (Table 3). Earlier studies also reflected a considerable reduction in sperm concentration as the frequency of successive ejaculation increased (Prado *et al.*, 2003). The findings are corroborated with the earlier studies in Native bucks of Andhra Pradesh (Srinivas *et al.*, 2002) and Mehsana bucks (Bhoi, 2010).

Live Spermatozoa: The live spermatozoa were found to be significantly higher ($p<0.01$) during the breeding season than non-breeding season. The findings are in agreement with earlier study in native breeds of Andhra Pradesh (Srinivas *et al.*, 2002). The reduction in live spermatozoa during the non-breeding season might be attributed to high environmental temperature leading to disturbed spermatogenesis. The live spermatozoa count differed significantly ($p<0.01$) between bucks ejaculated semen once daily in Group-I and second ejaculate in Group-II (Table 2). Joseph and Nair (1991) and Bhoi (2010) also reported similar reducing trend as the semen collection frequency increased. However, Oyeyemi *et al.* (2000) did not observe any variation in West African Dwarf bucks. The per cent live spermatozoa in relation to ejaculation frequency during breeding and non-breeding season differed significantly ($p<0.01$). However, no significant difference due to frequency of ejaculation

while significant effects of seasons were noticed in Egyptian Baladi bucks (El-Sharabassy *et al.*, 1990).

Abnormal Spermatozoa: The percentage of average total abnormal spermatozoa and morphological defects of head, mid-piece and tail during breeding and non-breeding seasons are presented in Table 1. The types of abnormalities have also been shown (Plate 1, 2 and 3). The results shows significantly ($p<0.01$) lower abnormalities during breeding season than the non-breeding season. These findings are in agreement with the earlier reports of Karagiannidis *et al.* (2000) and Bhoi (2010) in Damascus and Nubian and Mehsana bucks. The overall sperm abnormalities vis-à-vis head and tail except mid-piece defects increased at second ejaculate during the non-breeding season (Table 5). Previous workers have also reported higher spermatozoa abnormalities with increased number of sperm/ejaculation (Joseph and Nair, 1989 and Bhoi, 2010). Among total sperm defects, only head and tail defects were increased significantly at second ejaculate in Group-II compared to Group-I whereas, mid-piece abnormalities did not show any demarkable variation (Table 4). These findings are in agreement with the earlier reports of Bhoi (2010) in Mehsana buck.

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