Effect of management systems and seasons on sperm abnormalities in Jamunapari bucks semen

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Received: 09-01-2016 Accepted: 04-07-2016 DOI: 10.18805/ijar.v0iOF.7808

ABSTRACT
The sperm morphology of Jamunapari bucks reared under stall feeding (SF) and grazing cum supplementation (GS) systems was studied for continuous one year. The overall LSM for the head, midpiece, tail and total abnormal sperms were 0.95, 0.09, 0.41 and 1.97%, irrespective of management systems and seasons. The sperm head, midpiece, tail and total abnormality was significantly (P<0.01) higher in semen of GS bucks as compared to SF bucks. The mean head abnormal sperms irrespective of management systems were 0.71, 0.73 and 1.50% in rainy, winter and summer seasons, respectively. The respective values for midpiece, tail and total abnormality were observed to be 0.24, 0.04, 0.05%; 0.67, 0.32, 0.30% and 2.05, 1.53, 2.38%. Analysis of variance indicated that all the sperm abnormalities varied significantly (P<0.01) among seasons. The results suggest that stall feeding and winter season is superior for harvesting spermatozoa with lower sperm abnormalities than other seasons and GS systems.

Key words: Jamunapari bucks, Management systems, Seasons, Semen, Sperm abnormalities.

INTRODUCTION
Sperm morphology is one of the main seminal parameter while performing the routine semen evaluation in any andrology laboratory which is part of the breeding soundness evaluation of males. The morphology of spermatozoa is closely correlated with normality of genital organs as well as with fertilization rate than the other seminal parameters like sperm motility or concentration (Aziz et al., 1996). However, the sperm morphology could be influenced by genetic factors like breeds and non genetic factors such as nutrition, age, season, laboratory handling etc. Many research reports clearly indicated the effect of feed/nutrient intake on improvement of sperm morphology by secretion and maintenance of testicular fluids and hormones involved in spermatogenesis/sperm maturation, hence the function of the testicles and the male genital tract (Walkden-Brown and Bocquier 2000, Dana et al., 2000, Mekasha et al., 2008, Mellado et al. 2012). Therefore, a proper nutrient supply is basic to ensure optimum spermatogenesis and, indirectly, to normal sperm maturation in the epididymis. The availability and quality of feed/nutrient widely varies with season as well as management system in which males are reared. Similarly, the seasonal variations in semen quality is widely reported in bucks (Mohamed and Abdelatif 2010, Aguiar et al., 2013). Although the information pertaining to the semen quality especially total sperm morphology in particular season or management system is widely available, little is known about the detailed sperm morphology of bucks like head, midpiece and tail under different management systems and seasons. Therefore, the present study was aimed to determine the effect of two management systems and three seasons on sperm morphology in adult Jamunapari bucks.

MATERIALS AND METHODS
The present study was conducted at the ICAR-Central Institute for Research on Goats (CIRG), Makhdoom, Farah, Mathura. The mean monthly maximum and minimum temperature, relative humidity, vapor pressure and cumulative rainfall as well as duration of sunshine during the experiment ranged from 22.44 - 41.21°C, 4.18 - 26.16°C, 30.43 - 74.59%, 8.15 - 25.43 mmHg, 0 - 132.4 mm, 168.7 - 306.9 9hrs, respectively.

Twenty Jamunapari bucks of almost similar age (1.52 ± 0.01 years) and body weight (29.55 ± 0.67 kg) stationed at institute’s experimental farm were randomly allotted to stall feeding (SF) and grazing cum supplementation (GS) systems of 10 each under group feeding and management conditions. The bucks under SF system were offered 500 g/h/d pelleted concentrate mixture and 700 g/h/d green fodder besides available dry fodder ad lib while bucks under GS group were allowed for 4 to 6 hours daily grazing in the institute grazing area and supplemented with concentrate pellets @ 500 g/h/d. The trial continued for one year covering three seasons viz., Rainy (July-October), winter (November-February) and summer (March-June). Clean drinking water was made available round the clock in the open paddocks of the experimental
bucks of the both groups. Green fodders viz. berseem, cowpea, oats, barley, and the Dry fodders viz. gram, arhar, wheat, or barley straws were used for feeding the SF bucks. The grazing material available to the animals of the GS group varied according to the seasons. Bucks were managed and fed in two separate groups uniformly. The forage intake of the GS bucks from grazing area was estimated using lignin ratio technique and the faecal outgo using chromium oxide paper capsule indicator method (Shinde et al., 2000) and the total nutrient intake of bucks of both groups was calculated from the total quantity of feed consumed daily on dry matter basis. The intakes of dry matter (kg/d), metabolizable energy (MJ/d) and digestible crude protein (g/d) of bucks in SF and GS systems were calculated to be 1.31, 8.21, 107 and 1.40, 7.76, 126, respectively. Similarly the intake of nutrients in rainy, winter and summer seasons were calculated to be 1.43, 7.44, 107; 1.27, 8.45, 120 and 1.36, 8.07,122, respectively.

A total of 660 semen samples from all the breeding bucks of both groups in three seasons were collected continuously using Artificial Vagina (AV) method twice a week after giving one false mount and a single collection was taken from each buck. The mean volume (ml), mass activity (0-5 scale), initial progressive motility (%), sperm density (×10\(^{6}\)/ml) and live sperms (%) of the semen produced by SF bucks were 0.92 ± 0.01, 4.30 ± 0.07, 78.21 ± 0.01, 4317.41 ± 1.03, 82.96 ± 0.01, respectively. The respective values for the semen of GS bucks were 0.69 ± 0.02, 3.64 ± 0.07, 72.78 ± 0.01, 3183.14 ± 1.03 and 74.87 ± 0.01. Similarly, the respective seminal parameters during rainy, winter and summer season were 0.84, 0.67 and 0.90 ml, 3.92, 3.84 and 4.16 on 0–5 scale, 80.98, 68.93 and 76.22%, 3966.11, 3938.74 and 3261.34 million/ml, 79.39, 75.99 and 81.66%. After the initial semen evaluation, the abnormal sperms count was estimated (Bloom 1950). 10 µl of neat semen was mixed with 2 to 3 drops of Eosin-Nigrosin stain on a clean grease free slide and a thin smear was prepared with the help of another slide, then air-dried and observed under oil immersion lens (100x) under Phase Contrast Microscope (1000x magnification). Approximately 200 sperms were counted at different fields for enumerating head, mid piece, tail and total abnormal spermatozoa. The commonly observed abnormalities were detached head or tail, microhead, macrohead, bent tail, coiled tail etc. were noted (Fig 1). The percentage of the different sperm abnormalities in the semen of the bucks in both groups was calculated as proportion of number of abnormal (head, mid piece, tail and total) spermatozoa out of total number of counted spermatozoa.

The data generated on sperm abnormalities were analyzed using least squares means and analysis of variance (Harvey 1990). Arc sine transformation was carried out before analysis of the abnormal sperms percent values. Analysis of variance technique was used for finding the significance between the groups, seasons and its interaction, and the critical difference test was used to assess the significance difference among seasons.

**RESULTS AND DISCUSSION**

The overall LSM for the head, midpiece, tail and total abnormal sperms in the semen produced by the Jamunapari bucks were 0.95, 0.09, 0.41 and 1.97 %, irrespective of management systems and seasons. The overall per cent head abnormality of 0.95 in the present study corroborates the earlier findings of Saxena and Tripathi (1980) in Jamunapri bucks maintained in sub-Himalayan Tarai region. Out of total abnormal sperm morphology, the head abnormality was higher followed by tail and midpiece. However, Saxena and Tripathi (1980) reported higher abnormality in mid piece followed by tail and head though all the abnormalities (0.88, 4.83, 1.13, 6.84%) were much higher than the current study. Naing et al., (2011) observed higher mid-piece and tail abnormality in Boer buck semen as compared to the present study. Dorado et al., (2010) also recorded mean total abnormal sperms as high as 18.52 to 35.40 % in Florida bucks.

The sperm head, midpiece, tail and total abnormality was significantly (P<0.01) higher in semen of GS bucks (0.99, 0.12, 0.52 and 2.18 %) as compared to SF (0.90, 0.07, 0.32 and 1.77 %) bucks irrespective of seasons. The total abnormal sperms recorded in the current study were much lower than the other reports under intensive (Sundararaman and Edwin, 2003; Mekasha et al., 2008, Bucak and Uysal 2008; Mohamed and Abdelatif 2010, Mellado et al., 2012) and semi-intensive (Hassan et al., 2010) management system which may be attributed to better feeding management of the bucks. Fourie et al., (2004) reported significantly higher overall total abnormal sperms in young Dorper rams reared under intensive system than those under extensive system (17.2 vs 12.1 %) which contradict the present findings.

The LSM for head abnormal sperms irrespective of management systems was 0.71, 0.73 and 1.50 % in rainy, winter and summer seasons, respectively. The respective values for midpiece, tail and total abnormality were observed to be 0.24, 0.04, 0.05%; 0.67, 0.32, 0.30% and 2.05, 1.53, 2.38% (Fig 2). Analysis of variance indicated that all the sperm abnormalities varied significantly (P<0.01) seasons. The head and total abnormal sperms were significantly higher (P<0.01) in summer, and midpiece and tail abnormalities were significantly higher (P<0.05) in rainy season than other among seasons as revealed by critical difference test. The data obtained in the present study clearly indicated that the total morphological abnormality tends to be higher during breeding seasons i.e. first (summer) and second (rainy) peak breeding seasons existing in the semi-arid study area. However, previous studies have indicated that the higher total
Fig 1: Sperm abnormalities in Jamunapari bucks
sperm abnormality was observed during nonbreeding season (10 to 18%) than that in the breeding season (5 to 8%) in bucks (Tuli and Holtz 1992, Aguiar et al., 2013). Sailer et al., (1997) reported that the high abnormal sperms during summer could be accounted for high body temperature leading to testicular hyperthermia which results in disturbed spermatogenesis.

The LSM for head, midpiece, tail and total abnormal sperms of GS bucks during summer and rainy seasons were significantly (P<0.05, P<0.01, P<0.01, P<0.01) higher than that of bucks under SF system, however, it followed the reverse trend between the two systems of management during winter season (Table 1, 2). The higher sperm abnormality in summer season was also reported in bucks reared under semi-intensive management system (Srinivas et al., 2002) and in rams under intensive rearing system (Fourie et al., 2004). However, Hassan et al., (2010) did not observe significant difference between seasons of the year in Jamunapari bucks managed under semi-intensive system. However in winter season in the present study, the total abnormal sperms count was significantly (P<0.01) higher under SF system than that under GS system (1.81 vs 1.27%). Singh and Sengar (1990) also reported that the total abnormal sperms counts, irrespective of the breed, were maximum in winter (7.90%) and minimum in autumn (2.50%) under intensive system. Similarly, Talebi et al., (2009) observed that the average sperm abnormalities in the semen produced by intensively reared Markhoz goat bucks during autumn and summer (5.0, 9.2%) were lower (P<0.05) than in spring and winter (12.9, 11.2%) seasons. The significantly lower sperm abnormality (1 to 2%) observed in breeding season in GS bucks could be due to the influence of intensive rearing system.
Table 2: Analysis of variance for sperm abnormalities (%) in semen of Jamunapari bucks under different management systems and seasons

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of Freedom</th>
<th>HAb</th>
<th>MAb</th>
<th>Tab</th>
<th>ToAb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>1</td>
<td>12.582**</td>
<td>44.121**</td>
<td>138.166**</td>
<td>112.627**</td>
</tr>
<tr>
<td>Season</td>
<td>2</td>
<td>340.534</td>
<td>195.461**</td>
<td>175.075**</td>
<td>161.95**</td>
</tr>
<tr>
<td>Group x Season</td>
<td>2</td>
<td>52.423*</td>
<td>34.589**</td>
<td>115.088**</td>
<td>196.413**</td>
</tr>
<tr>
<td>Error</td>
<td>654</td>
<td>11.496</td>
<td>5.8656</td>
<td>10.889</td>
<td>13.020</td>
</tr>
</tbody>
</table>

HAb- Head Abnormal Sperms
MAb- Mid piece Abnormal Sperms
Tab- Tail Abnormal Sperms
ToAb- Total Abnormal Sperms

**P<0.01  ** P<0.05

in the present study vis-à-vis the results of previous reports could mainly be due to the data transformation apart from the variation arising out of genetic and non-genetic factors like breed, age and semen collection, processing and evaluation procedures.

Nutrition improves sperm morphology by maintaining the secretion of gonadotropins, hence the function of the testicles and the male genital tract (Walkden-Brown and Bocquier 2000). Feeding rams on low quality feed has been shown to decrease the proportion of morphologically normal sperms and increase the proportion of immature sperms (Dana et al., 2000), which might be due to inadequate nutrient supply. In general, the sperm head defects are originated during spermiogenesis, which is related to nutrition, and sperm tail defects arise out of routine semen preparation as they can be easily induced by laboratory preparations like fixation, handling artefacts, cold and osmotic shock (Bissett and Bernard 2005). Hence in the present study, the largest proportion (>50%) of sperm abnormalities among the bucks, irrespective of seasons and management systems, was represented by head defects, which is related to nutrient intake/availability under the two management systems rather than laboratory mishandling of the semen samples.

The higher sperm abnormality in the present study in the semen of GS bucks could be due to higher energy expenditure during grazing which could have lead to lower nutrient availability for supply of the nutrients required for sperm production in testis and epididymal sperm maturation apart from the thermal stress during summer, although the ME and DCP intake are significantly higher in GS bucks than the bucks under SF system. The lower abnormality of head, mid-piece, tail and total sperms in winter under GS system than that under SF system could be explained partly by lower energy expenditure due to less movement of the bucks in winter for consuming wilted tree leaves and barks of the shrubs in specific points in the grazing fields. Thus supply of required nutrients is indispensable for the production of morphologically normal spermatozoa. The higher sperm abnormality in GS bucks could also be well correlated with thermoregulation of testicles in different seasons. i.e., the more loosely descended testicles due to relaxation of the tunica dartus muscle especially during summer season caused the testicles to vigorously sway between rear legs of the bucks while walking during grazing which nullifies the purpose of testicular decendancy and favors artificial testicular hyperthermia leading to altered spermatogenesis. This was reflected in the study as the total abnormality was significantly (P<0.01) higher under GS system than the SF system in the summer season even though the total sperm abnormality was higher in summer under both the systems of management. Sailer et al. (1997) reported that the high abnormal sperms during summer could be accounted for high body temperature leading to testicular hyperthermia which results in disturbed spermatogenesis. The results suggest that stall feeding and winter season is superior for harvesting spermatozoa with lower sperm abnormalities than other seasons and GS systems.

ACKNOWLEDGEMENT

Authors are thankful to the Director, CIRG, Makhdoom and Head PR&SM Division for providing all necessary facilities to conduct this experiment. The sincere technical help rendered by Shri Dori Lal Gupta and Shri Hari Om, Technical Officers for this study is also thankfully acknowledged.

REFERENCES


