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Studies on effect of season on semen characteristics of Hallikar bulls

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Abstract

Besides genetic factors, environmental factors have significant effect on the quality of the semen that affects productivity of bulls. To determine seasonal effects on semen characteristics, 11,008 ejaculates collected from 25 Hallikar bulls were analyzed over a period of 15 years. The semen characteristics of Hallikar bulls was analyzed with respect to four seasons among the experimental period i.e. winter (January-February), summer (March-May), South-West monsoon (June-September) and North-East monsoon (October-December). Results revealed that season have significant ($P < 0.05$) effect on spermiogram of Hallikar bulls but no significant seasonal variation on ejaculate volume, mass activity and post thaw motility of semen.

Keywords: Hallikar bulls, semen characteristics, season, spermiogram

1. Introduction

Hallikar cattle is one of the premier draught breed in India popularly known as 'Champion of draught breeds' due to their outstanding draught power capacity, endurance and trotting ability [1]. It is the pride cattle breed of Karnataka having home tract of Bangalore, Chitradurga, Mysore, Mandya, Hassan, Kolar and Tumkur districts of Karnataka [2]. It is also considered as the progenitor of most south Indian breeds like Amrithmahal, Khillari and Kangayam [1,2]. In the recent times, there is deterioration in the growth, reproduction and production potentialities of Hallikar cattle due to changes in the breeding objectives, utility and agro biodiversity of the breeding tract [1]. To face this challenge, genetic potential of the Hallikar bulls needs to be assessed for sustainable use of domestic animal genetic resources and to plan a suitable semen production regime to cover the breedable cows of Hallikar cattle in Karnataka.

Besides genetic factors, the ejaculate quality significantly influenced by season, environmental and management practices [3]. These factors by virtue of their effect on quantity and quality of semen ultimately determine the number of straws produced per ejaculate and the discard rate of semen during its process for preservation. Hence, clear understanding of seasonal influence on semen characteristics would help to know additional of management practices to improve efficient utilization of Hallikar bulls.

Though semen quality traits for many breeds have been reported, there is no scientific data available on semen quality traits of Hallikar bulls. Hence, the present study was undertaken to assess the effect of season on semen characteristics of Hallikar Bulls.

2. Materials and Methods

2.1 Study area

The present study was carried out by utilizing the recorded data, on semen production traits of 25 Hallikar bulls for a period of 15 years (January 1999 to December 2013) at State Semen collection centre, Department of Animal Husbandry and Veterinary Services, Government of Karnataka, Hesseraghatta, Bangalore.

2.2 Data collection

At the farm, all the bulls whose data utilized for the study were maintained under identical housing, feeding, management and health care according to minimum standard protocol (MSP) of Central Monitoring Unit, Government of India. A total of 11,008 ejaculates data were collected during the investigation period.

Records on semen production were obtained from the collection registers of individual bulls. The data on ejaculate volume, mass activity, sperm concentration, initial motility and post thaw motility were collected and analyzed to study the effect of season.

To study the effect of season on semen production traits, each year was divided into four seasons as per the classification of seasons made by the Department of Meteorology, Government of India, Bangalore. These four seasons were winter (January- February), summer (March-May), south-west monsoon (June-September) and north-east monsoon (October-December). The number of ejaculates available for winter, summer, south-west monsoon and north-east monsoon were 1955, 2506, 3760 and 2787 respectively, as per recorded data.

2.3 Statistical analysis

The data on 11,008 ejaculate samples from Hallikar bulls, during the period of investigation, were tabulated and analyzed for volume, mass activity, sperm concentration, initial motility, post thaw motility expressed as mean with standard error. The data were analyzed by the method of least square analysis of variance [4]. The six-way classification fixed model was assessed to know the effect of age. Wherever necessary the percentage data were subjected to arc sine transformation before subjecting for the statistical analysis. The least square means pair comparison between groups of means was tested by Duncan's multiple range tests (DMRT). DMRT was done to make specific treatment comparisons for values that were found significant by ANOVA according to procedure outlined by Steel and Torrie [5].

Table 2: Semen ejaculate volume (ml) in Hallikar bulls during different seasons (Mean±SE)

Season	Winter	Summer	South-West monsoon	North-East monsoon
Mean ±SE	4.67±0.04 ^a	4.64±0.04 ^a	4.67±0.03 ^a	4.65±0.03 ^a

Note: Means bearing any one common superscript do not differ significantly ($P \leq 0.05$)

3.2 Effect of season on mass activity (mass motility)

The mean mass activity of semen (0-5 scale) estimated in the present study was 4.32±0.0 (Table 1) with range of 0.50 to 4.50.

The season wise mean mass activity of semen ejaculates in Hallikar bulls presented in Table 3. The mean mass activity differed non significantly and the values recorded in winter,

Table 3: Semen mass activity in Hallikar bulls during different seasons (Mean±SE)

Season	Winter	Summer	South-West monsoon	North-East monsoon
Mean ±SE	4.32±0.01 ^a	4.30±0.01 ^a	4.34±0.01 ^a	4.29±0.01 ^a

Note: Means bearing any one common superscript do not differ significantly ($P \leq 0.05$)

3.3 Effect of season on sperm concentration

The mean sperm concentration for Hallikar bulls in the present study was 1048.55± 3.64 million per milliliter (Table 1) and it ranged from 500 to 2473 million per milliliter.

The mean sperm concentrations during different seasons in Hallikar bulls presented in Table 4. In the present study, highest sperm concentration of 1065.72±6.32 x 10⁶/ml was observed during south-west monsoon season followed by north-east monsoon (1056.36±7.27 x 10⁶/ml), summer (1031.58±7.50 x 10⁶/ ml) and lowest during winter (1025.86±8.57 x 10⁶/ ml). Significantly higher sperm concentration was observed during south-west monsoon season ($P < 0.05$) as compared to summer and winter season, but no significant difference was observed between the

3. Results and Discussion

The mean seminal attributes of 25 Hallikar bulls namely the volume, mass activity, sperm concentration, initial motility and post thaw motility are presented in Table 1.

Table 1: Spermogramin Hallikar bulls (N= 11008) (Mean±SE)

Sl. No	Semen attribute	Mean±SE
01	Volume (ml)	4.66±0.01
02	Mass activity (0-5 Scale)	4.32±0.01
03	Sperm concentration (10 ⁶ /ml)	1048.55±3.64
04	Initial motility (%)	80.26±0.11
05	Post-thaw motility (%)	49.36±0.07

3.1 Effect of season on volume of semen

The mean ejaculate volume of semen based on 11,008 ejaculates of 25 Hallikar bulls was 4.66±0.01 ml (Table 1) ranged between 0.40 ml to 13.00ml.

The mean ejaculate volume in Hallikar bulls recorded during different seasons is presented in Table 2. The mean ejaculate volume of 4.67±0.04, 4.64±0.04, 4.67±0.03 and 4.65±0.03 ml was recorded for winter, summer, south-west monsoon and north-east monsoon season, respectively and the variations in the ejaculate volume among different seasons were non-significant. The present results conforms the findings of Kodagali [6], Tomar *et al.* [7], Tomar and Gupta [8] who also reported no significant effect of season on the ejaculate volume in Khillari bull and Hariana bulls, respectively. The present study concludes that Hallikar bulls showed consistent ejaculate volume in different seasons, which indicates well adaptability of breed.

summer, south-west monsoon and north-east monsoon were 4.32±0.01, 4.30±0.01, 4.34±0.01 and 4.29±0.01 respectively. The variations among seasons were not significant. The finding were corroborates with Ahmad *et al.* [9] and Mandal *et al.* [10] where no significant effect observed on the mass activity in Sahiwal bulls.

winter, summer and north-east monsoon seasons and also between the south-west monsoon and north-east monsoon seasons respectively. These observations indicated that winter season has negative impact on sperm concentrations in Hallikar bulls. Our results were agreement with Farooq *et al.* [11], which reported significantly lower sperm concentration during winter season in Cholistani bulls. However, other studies in African zebu bulls reported that the sperm concentration decreased significantly during the hot season [12, 13].

In contrast to present study, several other investigators have reported significantly higher sperm concentration during the winter season [6, 8, 14-17]. In Khillari bulls significantly highest concentration in cold season (2079 million per ml) followed

by wet season (1872 million per ml) and hot season (1674 million per ml) was observed [6]. Similarly, significantly higher concentration of spermatozoa in Tharparkar bulls [8] during winter than in summer, during winter season and lowest in summer season [16] in Hariana bulls were reported. While in Red Sindhi bulls [17] reported higher in winter (1133.49±34.85 million/ml) and minimum (963.22±23.96 million/ml) during rainy season, in Sahiwal bulls, higher sperm concentrations in winter season (1030.80±19.05 x 10⁶/ml) than summer (1012.10±17.83 x 10⁶/ml) and monsoon seasons (944.45±20.25 x 10⁶/ml) was reported [14]. In contrast to the present finding as well as above reports, highest sperm concentration in summer in Sahiwal, Tharparkar, Gir, Red

Sindhi and Hariana bulls respectively was reported [18]. The plausible justification for significant decrease in sperm concentration as observed in the present study during winter could be due to the displacement of testes towards abdomen during winter, consequently raising the testicular temperature and thus, hampering spermatogenesis [18]. The variation in the sperm concentration recorded in the present study when compared to other reports may possibly due to variation in geographical area and degree of climatic stress.

The significantly lower sperm concentration of ejaculates observed during summer season in the present study may possibly due to stress of the high ambient temperature besides concomitant poor quality fodder available in summer.

Table 4: Sperm concentration (10⁶/ml) of Hallikar bulls in different seasons (Mean±SE)

Season	Winter	Summer	South-West monsoon	North-East monsoon
Mean ±SE	1025.86±8.57 ^a	1031.58±7.50 ^a	1065.72±6.31 ^b	1056.36±7.27 ^{ab}

Note: Means bearing any one common superscript do not differ significantly ($P \leq 0.05$)

3.4 Effect of season on Initial motility (Pre-freeze motility)

The overall mean initial motility recorded for Hallikar bulls in the present study was 80.26±0.11 percent (Table 1) and ranged from 70.00 to 90.00 per cent.

The mean percent initial motility recorded during different seasons for Hallikar bulls presented in Table 5. Significantly higher initial sperm motility (81.60±0.25 per cent) was recorded during summer as compared to winter (80.20±0.33 per cent), south-west monsoon (80.12±0.17 per cent) and north-east monsoon (79.20±0.24 per cent) seasons. There was no significant difference in the initial motility observed between the winter and south-west monsoon. Significantly

lower mean per cent initial motility of 79.20 ±0.24 per cent was recorded in north-east monsoon as compared to winter, summer and south-west monsoon. While the highest mean per cent initial motility of 81.60±0.25 was registered in summer season.

However, no significant difference in the initial motility observed between the winter and south-west monsoon (Table 5). The present findings are in accordance with observations of Farooq *et al.* [11] in Cholistani bulls, who also reported highest initial motility of 68.75±1.37 per cent during dry summer as compared to 62.66±2.19 and 59.33±2.66 per cent respectively during autumn and wet summer.

Table 5: Initial motility (%) in Hallikar bulls of different age groups (Mean±SE)

Season	Winter	Summer	South-West monsoon	North-East monsoon
Mean ±SE	80.20±0.33 ^a	81.60±0.25 ^b	80.12±0.17 ^a	79.20±0.24 ^c

Note: Means bearing any one common superscript do not differ significantly ($P \leq 0.05$)

3.5 Effect of season on postthaw motility (Post freeze motility)

The mean post thaw motility recorded in Hallikar bulls was 49.36±0.07 per cent (Table 1) with a range of 30.00 to 60.00 per cent.

The season wise post thaw motility recorded in Hallikar bulls are presented in Table 6. The mean post thaw motility of 49.29±0.20, 49.33±0.13, 49.52±0.12 and 49.22±0.14 per cent,

respectively were recorded for winter, summer, south-west monsoon and north-east monsoon seasons. The mean post thaw motility observed for different seasons was not significant. The findings were in par with the observations of Ahmad *et al.* [9], Tiwari *et al.* [16], Tiwari *et al.* [17] who have also found no seasonal variation in percent post thaw motility in Sahiwal, Red Sindhi and Sahiwal bulls respectively during winter, summer and rainy seasons.

Table 6: Percent Initial motility (%) in Hallikar bulls during different seasons (Mean±SE)

Season	Winter	Summer	South-West monsoon	North-East monsoon
Mean ±SE	49.29±0.20 ^a	49.33±0.13 ^a	49.52±0.12 ^a	49.22±0.14 ^a

Note: Means bearing any one common superscript do not differ significantly ($P \leq 0.05$).

4. Conclusion

The present study has revealed significant ($P < 0.05$) effect of season on spermogram (except ejaculate volume, mass activity, post thaw motility). The mean sperm concentration was highest during south-west monsoon and winter seasons, respectively. Whereas per cent initial motility recorded highest during summer season. The ejaculate volume, mass activity and post thaw motility that has showed no significant seasonal variation and was apparently normal during all the seasons. The results obtained from present study revealed that the performance of bulls above average during south-west monsoon and winter and below average during north-east monsoon and summer season.

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