Seasonal effect on viability and morphology of spermatozoa in Karan Fries (Holstein Friesian×Tharparkar) bulls under tropical climatic condition

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ABSTRACT

Availability of morphologically normal and higher percentage of live spermatozoa throughout the year is highly demanded to fulfilment the demand of dairy cattle. There may be deterioration of semen quality during summer season in crossbred bulls in tropical climatic condition. Therefore the present study was designed to observe the seasonal effect on viability and morphology of spermatozoa in Karan Fries bulls. Five adult healthy bulls (n=5) were selected from Animal Breeding Research Centre (ABRC) of ICAR-NDRI, Karnal, Haryana (India). Six ejaculates from each bull were collected using artificial vagina (42-45 °C) during winter (December to Middle February), spring (Middle February to April), hot-dry (May to June) and hot-humid (July to August) seasons. Immediately of collection, the ejaculates were placed in a water bath (37 °C). Eosin-nigrosin vital stain was used for assessing live, dead and sperm abnormalities. The percentage of live spermatozoa were significantly (p<0.05) lowered during hot humid season and the major abnormalities were significantly (p<0.05) higher during hot-dry (8.66 ± 0.22 %) and hot-humid (10.74 ± 0.18 %) seasons. It can be concluded that hot-dry and hot-humid seasons are stressful to Karan Fries bulls. Therefore, sufficient measures should be taken to ameliorate the effect of heat stress on Karan Fries bulls.

Key words: Abnormalities, Heat stress, Karan Fries bulls, Season.

INTRODUCTION

Karan Fries (Crossbred) bulls are the combination of genetically superior exotic breeds of Bos taurus (Holstein Friesian) with better heat resistance of local Indian breed Bos indicus (Tharparkar). The objective of crossbreeding is to get early maturity, better milk production and adaptability (compared to temperate breed) to hot and humid environment. Studies revealed that crossbred having 50 % of exotic inheritance level have better productive and reproductive performances as compared to other level of inheritance (Chaudhry et al., 1990). Therefore, the availability of morphologically normal spermatozoa and live spermatozoa are much needed throughout the year for production of frozen semen. The productions of morphologically normal spermatozoa are affected by various factors, e.g. genetics, reactive oxygen species, temperature, hormonal modification, external chemicals and DNA modification etc. The crossbred animals are not properly adapted to tropical environment, mostly during summer season. There may be deterioration of semen quality of crossbred bulls during this season. When there is increase number of morphologically abnormal spermatozoa and reduction in live spermatozoa may lead to poor semen quality and reduce fertility. Therefore the present study was taken to observe the seasonal effect on sperm morphology and live spermatozoa in Karan Fries bulls under tropical environment.

MATERIALS AND METHODS

Experimental animals: Present study was conducted on five healthy (n=5) Karan Fries (Holstein-Friesian × Tharparkar) bulls from December, 2013 to August, 2014 maintained at Animal Breeding Research Centre (ABRC), Indian Council of Agricultural Research-National Dairy Research Institute (ICAR-NDRI), Karnal, Haryana (India), altitude 250m, 29° 423"N and 79° 543"E. The Ambient temperature ranges from near 0 °C in winter to 45 °C in summer, and the annual rainfall averages 700 mm. Five Karan Fries adult healthy bulls (4 to 6 years of age) with average body weight of 688.2 kilogram were selected from the herd (ABRC).

Feeding and maintenance of animals: The experimental bulls were maintained as per practices followed at the herd of ABRC, ICAR-NDRI, Karnal. The animals were offered roughages ad libitum and concentrate 2.5 kg per animal per day. Concentrate mixture consisted of Maize 28, Ground nut cake 10, Mustard cake 15, Wheat bran 15, Soyabean deoiled 15, Bajra 5, mineral mixture 2 and salt 1 % with 16 % CP and 70 % TDN. Water was made available all the day round.

Ethical permission: The experiment was approved by the Institutional Animal Ethics Committee (IAEC) constituted as per the article number 13 of the CPCSEA rules laid down by the Government of India.

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Major and minor abnormalities: The semen samples were collected using artificial vagina (42-45 °C) early in the morning and immediately, the ejaculates were placed in a water bath (37 °C). The eosin-nigrosin (EN) stain was used for evaluation of live, dead and sperm abnormalities (Figure 1). EN stain was prepared by proper mixing of 1:5 ratios of eosin and nigrosin in 10 mL of 2.9 % (pH 6.8) sodium citrate buffer with the help of a magnetic stirrer at 70-80 °C for 40-60 minutes. Then 2.5µL of neat semen and 20µL of EN stain was placed on clean pre warm glass slide and mixed properly. Approximately 5-8 µL of mixture was drawn in a clean pre- warm glass slide and immediately a thin smear was made and air dried. The partially and completely stained spermatozoa were considered as dead and without stained were as live spermatozoa. A total of 200 spermatozoa were counted under oil immersion (100X, LABOMAD) per slide.

Statistical analysis: All the data were analysed using SAS software, Version (9.1) of the SAS system for Window, Copyright© (2011) SAS Institute Inc., Cary, NC, USA and grapes were made by Prism 5 software, seasonal affect on live and abnormalities spermatozoa were determined by ANOVA.

RESULTS AND DISCUSSION

The live spermatozoa were significantly (p<0.05) lowered during hot humid season of the year. Major abnormalities were significantly (p<0.05) higher during hot-humid season (10.74 ± 0.18) compared to other seasons of the year (Table 1). The minor abnormalities were not significant (p<0.05) between the seasons (Table 1). The percentages of major abnormalities were significantly higher in summer (hot-dry & hot-humid) season as compare to winter and spring. Similar finding was also reported by Shukla et al (2010) in crossbred bulls; they noticed significantly (p<0.05) higher percentage of major (10.80%) abnormalities during hot-humid season of the year. Better spermatozoal morphology was reported in winter and spring season in cattle (Vilakazi and Webb, 2004; Salah et al., 1992). Bhakat et al (2014) reported a similar observation in crossbred animals, significantly higher percentage of total abnormalities (head, mid-piece and tail abnormalities) during hot-dry (16.86 ± 0.005) and hot-humid (13.03 ± 0.004) season compare to winter (9.47 ±0.003).

On contrary to the present findings, Chacur et al (2013) observed significantly higher percentage of major defects (12.18 ± 1.20) in winter compare to summer (8.00 ± 1.07), in Simmental breeds. This variation may due to the genetic background of the breed. The good quality of semen in Simmental breed during summer found to have relation with good nutritional support, which is a positive effect on spermatogenesis (Chacur et al., 2013). The higher percentage of morphologically abnormal spermatozoa during summer season might be the higher ambient temperature and humidity that have an adverse effect on spermatogenesis and a negative effect on LH secretion, ultimately causes poor quality semen in crossbred animals. This indicates a poor adaptability in tropical condition; they may be under heat stress during summer season.

The percentage of live spermatozoa were significantly (p<0.05) decreased during hot humid season
of the year. Similar observation also reported by Bhakat et al (2014) and Fiaz et al (2010) in cattle during summer season. The rise in temperature and humidity may have a negative consequence on sperm quality and subsequently to fertilization and conception rate through A.I. (Mieusset et al., 1992). Highest Conception rates were recorded during spring season when insemination with HF crossbred bulls (Miah et al., 2004). The crossbred inherited 50% of exotic breed (Bos taurus) which are sensitive to high ambient temperature and humidity. The summer season may not be comfortable for crossbred bulls in tropical region. They might be under heat stress in summer season and subsequently affected by reducing in eagerness of bulls, increase reaction time, reducing feed intake or impairing release of GnRH, increase release of ACTH that disturb the release of LH which is an important hormone of spermatogenesis and ultimately reduced morphologically normal spermatozoa production.

CONCLUSION

It can be concluded from the study that hot dry and hot humid seasons are stressful to Karan Fries bulls indicated by higher percentage of major abnormalities during hot dry (8.66 ± 0.22 %) and hot humid (10.74 ± 0.18 %) seasons and lowered live spermatozoa in hot humid (62.42 ± 0.75 %) season compared to other season of the year. Therefore, sufficient measures should be taken such as bulls should be kept under shed or in cooler areas, supplementation of antioxidant and feeding during the cooler hour of the day with adequate water supply to ameliorate the effect of heat stress.

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REFERENCES


