



Signatures of Selection in Composite Vrindavani Cattle of India

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Vrindavani is an Indian composite cattle breed developed by crossbreeding taurine dairy breeds with native indicine cattle. The constituent breeds were selected for higher milk production and adaptation to the tropical climate. However, the selection response for production and adaptation traits in the Vrindavani genome is not explored. In this study, we provide the first overview of the selection signatures in the Vrindavani genome. A total of 96 Vrindavani cattle were genotyped using the BovineSNP50 BeadChip and the SNP genotype data of its constituent breeds were collected from a public database. Within-breed selection signatures in Vrindavani were investigated using the integrated haplotype score (iHS). The Vrindavani breed was also compared to each of its parental breeds to discover between-population signatures of selection using two approaches, cross-population extended haplotype homozygosity (XP-EHH) and fixation index (F_{ST}). We identified 11 common regions detected by more than one method harboring genes such as *LRP1B*, *TNNI3K*, *APOB*, *CACNA2D1*, *FAM110B*, and *SPATA17* associated with production and adaptation. Overall, our results suggested stronger selective pressure on regions responsible for adaptation compared to milk yield.

Keywords: crossbred cattle, F_{ST} , integrated haplotype score, selection signature, XP-EHH

INTRODUCTION

The benefits of crossbreeding between high yielding *Bos taurus* and environmentally resistant *Bos indicus* breeds in tropical production systems have been well-established over the last half-century. Crossbred cattle have played an important role in meeting India's rising demand for milk. Despite constituting only 20.7% of India's milch herd, the crossbreds contribute 26% of India's annual milk production of 187.75 metric tons (DAHDF, 2018-19; 20th Livestock Census, 2019).

A four breed crossing scheme was initiated at the Indian Veterinary Research Institute in 1968. Briefly, a foundation stock of 400 indigenous Haryana cattle was inseminated with Holstein Friesian (HF), Jersey and Brown Swiss (BSW) semen to produce three genetic groups *viz.*, 1/2 Haryana × 1/2 HF, 1/4 Haryana × 1/2 HF × 1/4 BSW, and 1/4 Haryana × 1/2 HF × 1/4 Jersey. These genetic groups were evaluated for production, reproduction and environmental adaptation for seven generations. This was followed by inter-mating and selection to create the present day composite breed Vrindavani, having 25–50% *Bos indicus* and 50–75% *Bos taurus* inheritance (Singh et al., 2011). From the records of the distribution of frozen semen straws of the superior Vrindavani bulls, and the cows auctioned to the farmer, it is estimated that presently about 50,000 Vrindavani cattle are in the field.