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A REVIEW ON USEFULNESS AND LIMITATIONS IN USE OF SEXED SEMEN IN DAIRY ANIMALS

S.K. Pandey

Professor and Director (LPM), Faculty of Agriculture Science and Technology AKS University, Satna 485001 MP

Abstract

The sexed semen is the result of recent technology. It is simple and relatively reliable as long as high quality semen is used. The basic concept of using sexed semen is to produce offspring of a particular gender. It is helpful in increasing the genetic gain through both sexes either female or male. The main objective of gender selection using sexed semen from genetically elite bulls is most important to meet the constant increasing demand of milk to feed the huge human population. The second most important use of sexed semen is in dairy animals to dispose of the large number of unproductive males. In India this technology is gradually implemented by many states like Kerala, Punjab, Haryana, West Bengal and several others. Despite its valuable contribution in increasing milk production it has certain limitations like high cost and lower fertility rates in Indian conditions. Poor animal management like nutrition, disease control, oestrus detection, semen handling, insemination techniques and indiscriminate breeding are some other barriers for obtaining higher efficiency. In the past sexed semen had lower success rates than conventional semen because of sperm damage during the sorting process and fewer sperm per dose.

Dairy farmers prefer sexed semen for the sustainability of milk production optimising the number of herds and weight gain for early sexual maturity. Manipulating the sex of the animals has become of great interest to the dairy industry, due to several sex related traits, like milking, herd replacement and growth rates. Sexed semen is being used in India but its cost is high. By using more than 90 % of calves born are females, in standard conditional it is good to use.

Key words: Sexed semen, Milk Production, Fertility, Stray cattle, Reproductive efficiency, Genetic improvement, Breeding , Dairy animals , Female calves, Artificial insemination

Introduction

Sexed semen or gender sorted semen is the result of recent technological evolution in Animal Science .Some breeding companies claim that sexed semen is up to 90 % as successful as conventional semen. Sexed semen is a biotechnological tool that has been used in commercial dairy herds in India for a few years to improve production efficiency, reproductive efficiency, and financial output of dairy farmers (Warriach et al . (2015). Latest technologies offer the opportunity to accelerate genetic gain in the livestock industry. The tremendous growth in milk

production has been achieved due to many technological and institutional interventions . Efforts are made for genetic enhancement of indigenous cows and buffalos through artificial insemination using the semen of high-producing exotic cattle and graded buffalo bulls. Over the last three decades cattle population has turned significantly with the rearing of more females. Furthermore, mechanization of agricultural farming has pushed away the male cattle from the fields, leaving them to become stray cattle. Nowadays farmers desire to have more females to meet rising demand for milk, increase their herd size and improve profitability (Boustan et al. 2014; Verma et al. 2020). Male cattle are at least demand as beef because their slaughter is illegal in most of the states in our country. According to a 2020 census India has over 5 million stray cattle mostly comprising of male and are in poor condition. Cattle are considered sacred in the Hindu religion, but stray cattle are causing many problems such as damaging crops, road accidents, attacking people, spreading disease and creating indiscriminate breeding. (Somagond et al. 2021). Male dairy calves increase the risk of dystocia compared with heifer calves, and nowadays considered as an unwanted by - product of breeding with conventional semen, they have a low economic value , and these facts also favours use of sexed semen to produce female calves.

About Sexed Semen

Sexed semen is semen that contains either X or Y chromosome bearing sperm to produce offspring of a desired sex. The process involves separating the X and Y chromosomes and using a laser to eliminate the Y chromosomes. Pinkel et al. (1982) first successfully separated mammalian sperm, but the methods were destructive because the sperm tail was removed leaving sperm unusable. Doyle et al. (1999) explained the reasons for lower success rates for sexed semen as compared to conventional semen and stated that because of sperm damage during the sorting process and also fewer sperm per dose are the major issues in lowering fertility rates.. However, precautions can be taken to maximize the chance of success, such as careful animal selection, appropriate timing of artificial insemination, and attention regarding straw handling during artificial insemination.. There have been a number of reviews on the topic of the use of sexed semen in cattle (Foote, 1996; Weigel , 2004 ; Matthew et al . 2006; Seidel, 2014) . Application of sexed semen technology for in vitro embryo production in cattle has been systematically elaborated by Matthew et al. (2006) , where they reviewed that livestock owners were curious to sexed sorted semen since thousands of years back to develop a methodology to predetermine the sex of offspring for their herd. Johson (1991) and Cran et al. (1995) visualized the ability to sort individual sperm cell in to viable X and Y chromosome bearing fractions made producers sex selection dream a reality in the 1990's. Lu et al. (2010) reported encouraging results from the use of sexed semen through artificial insemination in Murrah and Nili Ravi buffaloes where they obtained 90-94% accuracy of sorted X and Y sperm. Campanile et al. (2011), further reported that no difference was found between conception rates in heifers and parous buffaloes inseminated with sexed sorted semen. The sexed semen technology is being patented and used in the western countries, the standardization and production caters mainly to

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the Bos taurus dairy and beef breeds. In Brazil the technology is claimed to have been tried in Bos indicus breeds like Gir. Its use under Indian tropical conditions is still unpopular and underutilized and hence standardization and popularization of the technique with respect to different breeds of indigenous cattle and buffaloes is the need of time. Sexed semen can be produced using a flow cytometry and sorting process or by selectively destroying sperm cells. Prasad et al. (2010) explained potential differences between X and Y spermatozoa with regard to their size, motility, surface change, sperm surface and DNA content. The X spermatozoa tend to have larger size, slower motility and have more DNA contents as compared to Y spermatozoa.

Sexed semen Vs Conventional semen

Sexed semen is safe to use for artificial insemination, however, Norman et al. (2010) reported that conception rate is 10-15% less with sexed semen than conventional semen because the sperm concentration in sexed semen is less than conventional semen and the sorting causes damage to the sperms. Biswas et al. (2013) reported a relatively lower conception rate of 20.7% in cows and 35.3% in heifers using sexed semen. The purity of X- sorted semen was found to be higher compared to Y- sorted semen , sexed sperm cells often remain fertile for a shorter period of time in the female reproductive tract following insemination (Schenk, 1999) and therefore, artificial insemination with sexed semen should be performed closer to the timing of ovulation. According to the Agriculture and Food Development authority, the mean conception rate for sexed semen is 82-84% of that achieved with conventional semen, however, in 2018, the conception rate was 50.2% for sexed semen and in 2019 it was 50.1%, for sexed semen and 61.1% for conventional semen.

Sexed semen in Indian context

In India male cattle are gradually replaced by farm machineries . It is a right time when sexed semen should be used to increase the number of dairy female replacements born and to reduce the number of dairy male calves born. It can also be used to compact the birth of replacement heifers closer to the start of the calving season than when conventional semen is used. A review made by Anshuman et al.(2016) indicated that a Government of West Bengal organization namely Paschim Banga Go- Sampad Bikash Sanstha (PBGSBS) initiated sorting of semen using high speed semen sorter or flow cytometer installed in the year 2009 and they reported first male name Shreyas born on 1st January 2011. Kerala state also reported birth of two sexed semen calves to Jersey crossbred heifer under a pilot project jointly taken by Kerala Livestock Development Board and Department of Animal Husbandry. Haryana Livestock Development Board in collaboration with Navasota (USA) has introduced sexed semen technology in Murrah buffalo. The ABI India has started to provide Holstein and Jersey sexed semen. Now sexed semen of cattle is provided by NDRI Karnal also with the aim to multiply indigenous and cross breed cows in country by providing sexed semen at farmers door. The cost of one dose of sexed semen varies between Rs. 1000/- to Rs 1500/- and it assures about 90% female calves.

Jeyakumar et al. (2015) gathered the opinion of farmers regarding sexed semen. Their survey conducted at Pune and Ahamadnagar districts of Maharashtra, revealed that 88% of farmers favoured the use of sexed semen. The use of sexed semen dose was the important matter where two third of the farmers indicated the cost should be up to Rs. 500/- per insemination, Sachin et al. (2021) evaluated the performance of sex sorted semen at BAIF, Pune and highlighted the technical performance and merits of using sexed sorted semen in the Indian dairy sector as a way to increase the countries milk production and reduce the burden of maintaining unwanted male calves at farm level. Conducted a study to evaluate the performance of sexed semen in Tharparkar cows and reported that birth of female calf was 91.7% . They concluded a future promise of the sexed semen for the production of more female offsprings from cattle . Visualized rising demand for milk and declining utility of male cattle in India reinforces the need for the adoption of sexed semen technology.

Conclusion

Sexed semen is very useful in increasing the number of dairy female replacements and to reduce the unwanted number of male calves. Sexed semen technology is a reproductive technology that separates sperm cells that carry X and Y chromosomes allowing producers to choose whether a mating results in a female or male calf. The only commercially available method for separating X and Y chromosomes bearing sperm is fluorescence activated cell sorting (FACS). Manipulating the sex of the animals has become of great interest to the dairy industry, due to several sex related traits like milking herd replacement, growth rates and economic benefits. However, its popularization among livestock owners at reasonable cost is to be taken up as a campaign to exploit full advantage in the context of increasing demand of milk production as well as to combat problems/ nuisance of stray cattle in India.

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