

Popular Article

Sex Sorted Semen in Farm Animals and Its Advantages

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Introduction

Selection is an important priority area in farm management which helps in improving the productivity. Pedigree breeding accompanied by newer technologies increase the efficiency and improve the productivity to a greater extent. Sex sorted semen is a revolutionary technology in animal breeding. It helps in increasing the efficiency of dairy and beef production thereby increase the profitability of farms. Use of sex sorted semen help in predetermination of sex with about 90% reliability. In cattle X chromosome bearing sperms contain 3.8% more DNA than Y chromosome bearing sperm which is utilized for the identification of X and Y chromosome bearing sperms. Flow cytometry-based techniques are mostly used for this purpose (Garner *et al.*,2013). Other than that, other methods like laser splitting of unwanted X and Y chromosomes also been reported (Faust *et al.*,2016). Flow cytometric separation of two sperm populations was found to be more accurate. In flow cytometry sperms are separated based on the difference in the DNA content for those sperms are labelled with DNA fluorescent dye. After identification and electric charging droplets with single sperm are transferred in to collecting media where it is further processed. Sex sorted semen is mostly used in dairy herds in which traditionally it was limited to heifers. Recent studies have demonstrated that it can be used in heifers and lactating cows (Butler *et al.*, 2014).

Need for the usage of sex sorted semen

The primary purpose of mating is to initiate lactation, produce replacement stock as well for meat purpose. Incorporation of sex sorted semen in breeding helps to obtain a desired sex bias in the resulting progeny. Sex of the calf is relatively important for reducing the possibilities of dystocia from male calves as compared to females. It was reported that use of sexed semen has reduced the occurrence of dystocia by 20% (Seidel *et al.*, 2003; Norman *et al.*, 2010).

It can also improve the milk production because reports suggest that gestation of the female calf can increase the milk production especially in the first lactation (Hinde *et al.*, 2014). In dairy farms heifer calves is needed for the production of replacement stock and in case of beef herds female calves with high maternal index are required for producing the replacement stock and males with high terminal index achieve greater growth rates and carcass price. Use of sexed semen can help to improve the genetic merit of breeding stock by increasing the rate of selection and reducing the cost of genetic improvement (Hohenboken, 1999). It also helps in minimizing the production of male dairy breed calves thereby help to avoid the welfare issues related with male dairy calves.

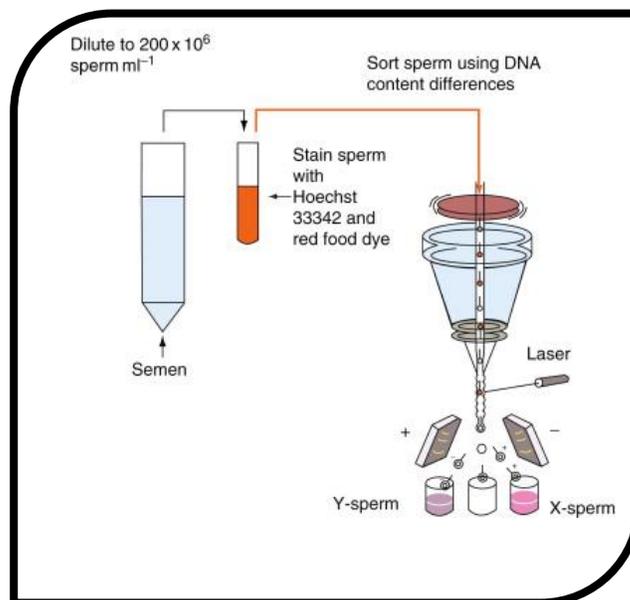
Benefits from sex sorted semen

Use of sex sorted semen help in accelerating the genetic gain. In case of non-sorted semen 90% of genetic gain is from sire selection. Sex sorted semen facilitate concurrent sire and dam selection. Reports suggest that sexed semen can increase the rate of genetic gain by 15% (Weigel *et al.*, 2004). Sexed semen also found to improve the fertility performance with an increase in the conception rate especially in the well managed farms. In most of the reports the conception rate in heifers after AI with sex sorted semen ranges between 70 to 90 %. On comparing the effect of sexed semen on heifers and genetically superior cows for the replacement followed by breeding with beef semen in remaining herd with that on conventional semen found that use of sexed semen is more profitable and resulted in faster genetic gain as well as increased the number of female calves (McCulloch *et al.*, 2013).

The use of sexed semen in beef herds is limited but it facilitate the generation of female offspring with strong maternal traits as well as male calves with better terminal traits. It can be utilized with different beef production systems like single sexed heifer breeding system and three bred terminal crossbreds. In the first system beef heifers are inseminated with X chromosome bearing sperm and thereby help in producing replacement stock and after first parturition usually sent for slaughter whereas in second system maternal crossbred is produced by using X chromosome bearing semen from a sire with excellent maternal traits and this maternal crossbred is inseminated with Y chromosome bearing semen from a sire with excellent meat production traits. This will help in utilizing the advantages of heterosis as well as utilize complementary traits from different breeds (Hohenboken, 1999).

Embryo transfer using sexed semen can help in producing multiple embryos with desired sex from a specific dam and sire coupling. it can be achieved by two different methods

either by collecting the blastomeres and PCR with Y chromosome specific primers helps in identification of sex or by using sexed semen. Reports suggest that combined use of ovum pick up and IVF with sexed semen can help in high rates of good quality blastocyst development (Matoba et al.,2014).



(Adopted from: Encyclopedia of Dairy Sciences (Second Edition) 2011, Pages 631-636)

Damage to sperms during sex sorting

The greatest challenge in sex sorting of sperm by flow cytometry is to maintain its fertilizing ability until it reaches the female reproductive tract. They are subjected to various stress factors during the process of sorting. First stress factor is labelling and incubation with fluorescent dye. It was found that Hoechst 33342 can affect mitochondrial function. Loss of mitochondrial membrane potential was observed in boar semen (Spinaci *et al.*,2016). Dye along with energy released from the UV laser could affect DNA integrity too. DNA damage is not only caused by this it can also be caused by various mechanical shearing forces. During the process of sorting the sperm may get affected by various mechanical forces when they come in contact with various sorting components. Charged droplets with individual sperms are mostly sorted in flow cytometry. Repeated electric charging and electrostatic deflection also can result in reduced life span of the sperms.

Alternatives to Flow cytometry

Development of alternative techniques for the sorting of the sperm also gained importance in the scientific community. In human and animal reproductive medicine microfluidics, nanotechnology and Di electrophoresis are being used as alternative and it was

found to improve the sperm quality enabling the sorting of the sperm population with intact sperm membrane, high DNA integrity and improved motility. Apart from this some studies even focused on the qualitative detection of sex related differences using gold nanoparticles. Sperm gene targeting based on the vital genetic sequence detection using laser generated gold particle bioconjugates also reported (Mancini *et al.*,2015).

Conclusion

Assisted reproduction with sexed semen had increased benefit in the fields of livestock production. Advent of new technologies in sexing of the sperm that do not require expensive equipment and specialized human resources can overcome the present the present challenges in the field of sex sorting.

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