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Popular Article

Sex sorted semen in Cattle

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Introduction

Sex-sorted semen is sorted semen contains either X or Y chromosome bearing sperms and the use of it would produce a desired sex i.e. male or female animal. In the dairy industry, a female calf is always preferred, hence using sperm having the X chromosome in semen will help in creating the greatest number of females possible.

Many traditional methods of sorting sperm have been employed frequently, such as swim-up, density gradient centrifugation, detection of the H-Y antigen, and free flow electrophoresis. A recently developed technique called flow cytometry increases the potential of commercial sperm sorting. But when sperm are sorted using flow cytometry, they go through a pressure-filled nozzle, DNA is dyed, they pass through an ultraviolet laser beam, they undergo electrostatic separation, centrifugation, and other processes that alter their membranes and cause additional changes like pre-capacitation in the sorted sperm, which lowers fertility. Despite these drawbacks, the commercial generation of sexed semen—typically succeeded by cryopreservation—is utilised in the cattle industry.

This method involves first staining sperm with Hoechst 33542, a non-toxic dye that binds DNA, and pumping the sperm in a stream in front of a UV laser beam with a wavelength of 351–364 nm. The strong blue fluorescence that is emitted is then detected and analysed (Johnson and Welch, 1999). A crystal vibrator divides this stream into discrete droplets to make it easier to analyse individual spermatozoa. As the sperm pass by in single file, a photomultiplier tube quickly measures the bright fluorescence that the lighted spermatozoa release (Garner and Seidel, 2008). The sperm stream is angled correctly to provide enough illumination, allowing for precise monitoring of a 4% variation in fluorescence (Sharpe and Evans, 2009). High-speed computers are used to analyse the relative fluorescence of the X and Y chromosome bearing sperm populations. The resulting droplets containing X chromosome bearing sperm are then sorted by DNA content by applying opposite charges to them compared to Y chromosome bearing sperm

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(Seidel Jr., 2007). These droplets land on deflector plates that have been charged beforehand, dividing them into two streams that are subsequently collected independently. Electrostatic deflection is used to separate streams of X and Y chromosome-bearing droplets, which are then collected independently for additional processing (Seidel Jr. and Garner, 2002). Uncharged droplets from a third-stream flow through as waste and are disposed of (Seidel Jr., 2007). Several larger studies have since confirmed many preliminary findings, showing CR with frozen-thawed sexed semen (2×106 sperm/straw), which were approximately 70–80% of the conception rate achieved with frozen-thawed conventional semen (15 to 20×106 sperm/straw) in both lactating cows and virgin heifers (DeJarnette et al., 2010)

Challenges of sex sorted semen by flow cytometry methods

1. The primary drawback of flow cytometry is its slow speed in comparison to the quantity of viable sperm needed for cow artificial insemination.
2. A significant percentage of sperm cells being lost. It has a detrimental impact on getting conception. Because the typical non-sexed semen straw has about 20 million sperm, whereas the concentration of sperm in sexed semen straw is only about 2 million, the sperm dosages per straw are lower (Sharpe and Evans, 2009).
3. It is not economical to produce sexed semen in all systems, especially in tropical regions.

Advantage of using sexed semen in dairy cattle

1. The main advantage of sexed semen is the ability to generate a calf of a particular sex.
2. Production of replacement heifers
3. Establishing a disease-free closed herd and optimising the enhancement of desired features.
4. Reduction in calving difficulties.

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