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Popular Article

Exploring the Use of Sexed Semen in Dairy Industry

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Sexed semen is carefully processed bull semen in which 'Y' chromosomes in sperm cells that result in the birth of a male calf are either removed through a sorting process and Semen with only 'X' chromosomes can ensure the delivery of a female calf. The goal of sexed sperm is to generate a calf of the desired sex, either male or female. Because of the economic benefits, predetermining the sex has a significant impact on the livestock business. Females are necessary for milk production and calves; however, males are mainly required for meat production due to higher feed conversion efficiency and lean-to-fat ratio.

In dairy farming with use of conventional semen unwanted production of male calves, which are having greater body weight at birth and then increases risk of dystocia compared to female calves. Incorporation of sex semen in dairy industry reduces the incidences of dystocia, unwanted production of male calf and increase the production female calf. Sex semen can be used to generate more number of female with in short period and it bring rapid herd expansion.

The sexed sperm increases genetic development in a herd by boosting the proportion of excellent heifers and good male germplasm from elite bulls that may be employed in future breeding programs. Flow cytometry or cell sorting is the only approach that has shown to be economically feasible with promising outcomes to date. Gledhill (1976) made the first attempt to differentiate X and Y sperm using analytical flow cytometry. The researcher Pinkel isolate the mammalian sperm for the first time. The only commercially viable method currently available to the dairy industry for sperm sexing appears to be based on flow cytometry cell sorting of DNA content of sperm.

Table 1: Potential differences between X and Y Spermatozoa

Sr. No.	Parameter	X Spermatozoa	Y spermatozoa
1.	Size	Larger	Relatively Smaller
2.	Motility	Swim Slower	Swim Faster
3.	Surface Charges	Migrate to cathode Fast	Migrate to cathode slow
4.	Sperm Surface	H-Y antigen absent	H-Y antigen present
5.	DNA content	4.2 % more	Less than 4.2%

Sperm Sorting by Flow Cytometry

Flow cytometry is an important technique in sperm sorting because X-bearing (female) sperm contains 3.8 percent more DNA than Y-bearing (male) sperm. Fluorescent dyes are used in flow cytometry to stain DNA in sperm sorting. The sex of future progeny can be predicted by examining the DNA content of individual sperm cells to see if they have the bigger X chromosome or the smaller Y chromosome.

Initially, sperm are stained with a non-toxic, DNA-binding dye (Hoechst 33342) and then pumped in a stream in front of a UV laser beam with a wavelength of 351 - 364 nm, where the vivid blue fluorescence is detected and analysed. Individual spermatozoa in a stream of individual droplets are broken up by a crystal vibrator, and lighted spermatozoa emit strong fluorescence that is promptly recorded by a photomultiplier tube as the sperm flow by in single file.

The relative fluorescence of the X and Y chromosome bearing sperm populations is analysed using a high-speed computer and then sorted by DNA content by placing opposite charges on droplets containing X chromosome bearing sperm vs Y chromosome bearing sperm. These droplets hit already charged deflectors or plates, separating them into two streams that are subsequently collected separately in three containers.

Technique:

I. The sperm cell stain with fluorescent dye enters into sorter.
II. A piezo electrical crystal undulates which breaks the stream in 90,000 droplets/second.
III. A laser beam blue light focus on sperm cell.
IV. X- chromosome bearing sperm cell fluoresce with 4% more intensity than Y- chromosome-bearing
V. A computer processor detects the fluorescence and categorise the sperm as X, Y or uncertain.
VI. The charge droplets are deflected as they pass between continuously charged plates.
VII. The samples are collected in three chamber X, Y-chromosome bearing and unsorted.

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Advantages

i. This also enables rapid herd expansion without the risk of introducing diseases that occur with purchased animals
ii. Female to male ratio with 90:10 or vice-versa is ensured
iii. Reduced dystocia by preventing production of male calves
iv. The Production of superior bulls
v. The cost of progeny testing programs is lowers and enhances the value of genetic markers of embryo transfer
vi. Selective culling
vii. By using sexed semen, selection intensity can be increased by choosing genetically superior dams of replacements which accelerate the rate of genetic gain in dairy herds
viii. The principal benefit of using sexed semen is production of calves of desired sex
ix. It is possible to reduce the incidence of Dystocia

Limitation

I. Some of the spermatozoa remain unsorted
II. Technique is costly
III. Some of the spermatozoa are damaged
IV. Conception rate is lower than unsorted sperm because during the sorting process sperm are exposed to number of potential hazards such as DNA staining, dilution, centrifugation in vitro incubation, high pressure and laser light. These could affect sperm integrity, membrane structure, the cytoskeleton, sperm morphology and other aspect of sperm.

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