

Reproductive Technology of the Future: Sexed Semen

How would you like to be able to choose which of your cows deliver replacement heifers and which produce bull calves? Livestock breeding programs of the near future may include your choice of the sex of the calf among the other characteristics for which you are selecting. This fall the first calves of predetermined sex from artificial insemination were born at CSU.

Investigations being conducted by Dr. George Seidel and his associates at Colorado State University's Animal Reproduction and Biotechnology Laboratory are bringing this technology closer to commercial application. If the studies continue successfully, semen that will result in a predetermined sex may be available in a few years for about \$10 more than a standard dose of semen.

An individual's sex is determined by X and Y chromosomes, which are part of the genetic material. The cells of females have two X chromosomes, while those of males have one X and one Y. Sex cells, sperm and egg, contain only half the normal chromosomes, and thus only one sex chromosome. The sex of a fetus is determined by the genetic material contributed by the sperm (X or Y) because the unfertilized egg will always contain only one X chromosome. When an egg is fertilized by a sperm containing an X chromosome the result is a heifer calf. Alternatively, a sperm with a Y and an egg with an X result in a bull calf. Half of the sperm a male makes will carry the X chromosome and yield females. The other half will carry the Y chromosome and yield males.

Recently a technique for separating X from Y sperm cells was developed and patented by the USDA. This technique relies on identifying a miniscule difference between X and Y sperm, namely that the X sperm have 4% more DNA, or genetic material, than their Y counterparts. A dye has been developed that binds to the DNA. A very sensitive device known as a flow cytometer uses lasers and a computer to measure the small difference in the amount of dye bound within the different types of sperm, and then sorts the sperm by sex. The technique is about 90% accurate, but slow (100 sperm/sec or 400,000 sperm per hour for each sex). It takes nearly 2 days to sort enough sperm to breed an individual cow by conventional methods. For sexed semen to be used commercially, breeding procedures have to be modified to be successful with a lower number of sperm.

Variations on conventional insemination techniques have been studied at CSU and DUO dairy, with the goal of achieving acceptable pregnancy rates while using only 1-2% of normal sperm numbers. One modification uses unfrozen semen, inseminated in a lower than usual volume of fluid, deep into the uterine horn adjacent to the ovary with the largest follicle as determined by ultrasound at the time of insemination. In the first study of artificial insemination using sexed semen, 12 of 15 calves were the predicted sex, a considerable improvement over nature's chances of a 50:50 female: male ratio. Pregnancy rates ranged from 0 to 45% depending on the time from sorting to insemination and the particular bull used.

Future studies prior to the practical use of sexed semen will investigate the pregnancy rate variation between bulls, develop viable freezing methods for sexed sperm, increase the speed of sorting sperm and study the resultant fetuses and calves for possible abnormalities.

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