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Applications and advantages of using sexed semen in dairy cattle

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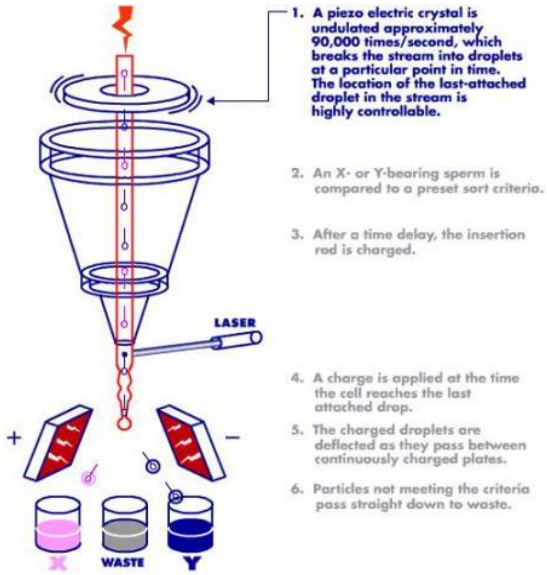
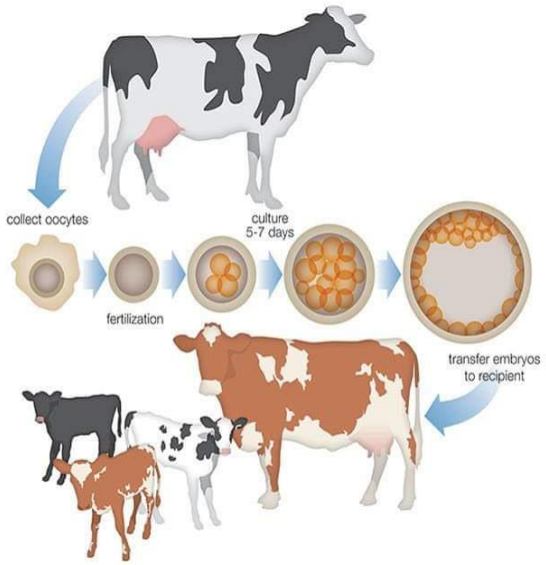
Sexed Semen:

Sexed semen refers to semen that has been processed to contain a higher proportion of either X or Y chromosome-bearing sperm, allowing the production of offspring of a desired sex, either male or female. Current technologies can achieve 80-90% accuracy in producing sexed semen. In bovines, the X chromosome is larger than the Y chromosome, so X chromosome-bearing sperm cells have about 3.8% more DNA content. By using a dye that binds proportionally to DNA, sperm cells can be differentiated based on whether they carry the X or Y chromosome. This difference in DNA content is the basis for the commercial methods used to create sexed semen. Dairy farmers can use this technology to produce offspring of a desired sex and reduce the issue of unwanted male animals. The full potential of this technology is realized when combined with in vitro fertilization (IVF), as oocytes from multiple donors can be fertilized with a single dose of sexed semen, facilitating the production of sexed embryos.





SexedULTRA 4M:

SexedULTRA and SexedULTRA 4M are trademarks of Inguran LLC and represent sexed semen produced through a USDA-developed and patented process now licensed to Sexing Technologies. This process uses flow cytometry-based sorting to effectively separate stained sperm. Over the past few decades, flow cytometry-based sperm sexing has seen several improvements, enhancing its efficiency and effectiveness. The sex-sorted semen produced with this technology is currently available and marketed under the name SexedULTRA 4M for both beef and dairy breeds. The "4M" designation indicates that each unit contains 4 million sperm cells, an increase from the previous standard of 2 million cells per unit.

Sexcel Sexed Genetics:

Sexcel is a newly developed sexing technology from ABS Global (Genus plc), utilizing their proprietary IntelliGen technology. This process involves staining sperm cells and distinguishing between X and Y chromosome-bearing sperm based on their DNA content. To produce the sexed product, the technology employs a laser ablation process to selectively eliminate sperm cells with the undesired chromosome. Currently, Sexcel is marketed for X-sorted semen across variety of breeds

Differences from Conventional Semen:

Due to the sexing procedure and subsequent cryopreservation, sexed semen can lead to lower pregnancy rates compared to conventional semen, with the reduction varying among different bulls. For some bulls, producing sexed semen may be unfeasible if their sperm cells do not remain viable after sorting, freezing, and thawing. Additionally, sexed sperm cells tend to have a shorter fertile lifespan post-insemination. Research suggests that more precise timing of insemination relative to ovulation is necessary when using sexed semen. Specifically, if artificial insemination (AI) is performed after heat detection, the optimal timing for AI is somewhat later after the onset of standing heat with sexed semen. When timed AI is used, females that do not show standing heat before AI tend to have particularly lower pregnancy rates with sexed semen. To address these challenges, strategies have been developed to improve pregnancy rates when using sexed semen for AI.

Considerations for Using Sexed Semen:

In planned cattle mating, there is often a preference for one sex of calf over the other, depending on genetic traits or operational needs. For example, seedstock operations may use sexed semen to produce specific herd sires or breeding females from targeted matings. In the commercial sector, sexed semen can be valuable for skewing the sex ratio of the calf crop towards steer production or for selectively producing heifer calves from particular females or groups. This could be advantageous for increasing the number of high-quality replacement heifer candidates or for marketing uniform, high-quality feeder steers. However, sexed semen is more expensive per unit than conventional semen. The higher cost per unit, combined with a lower pregnancy rate, results in a higher cost per successful pregnancy. Additionally, the cost is further increased by the lost opportunity to achieve higher pregnancy rates earlier in the breeding season with conventional semen. Before choosing to use sexed semen, it's important to assess the value difference between the sexes of calves and determine whether this value justifies the higher costs and potentially lower pregnancy rates associated with sexed semen.

Sexed semen recommendations and AI approaches

Heat Detection:

Sexed sperm cells typically remain fertile for a shorter period in the female reproductive tract following insemination. Consequently, artificial insemination (AI) with sexed semen should be timed closer to ovulation. While the duration of standing heat in cattle can vary, ovulation generally occurs about 30 hours after the onset of standing heat behavior. To maximize pregnancy rates with sexed semen, AI should be performed approximately 18 to 24 hours after the start of standing heat. This timing is later than what is recommended for conventional semen. For the best results, it is highly recommended to use estrus detection aids and monitor heat activity at least three times daily (e.g., at dawn, noon, and dusk).

Fixed-Time AI:

Simply delaying fixed-time artificial insemination (AI) when using sexed semen is not advisable. Extending the interval to AI might result in insemination occurring too late for some females, potentially leading to similar or even lower pregnancy rates, as indicated by research trials. Instead, acceptable pregnancy rates with sexed semen are more achievable when AI is performed on females that show standing heat before the fixed-time AI. For fixed-time AI with sexed semen, it is important to choose a protocol that ensures a large number of females express standing heat within a narrow time frame. Recommended protocols for achieving this include the 14-Day CIDR-PG protocol for heifers and the 7 & 7 Synch protocol for cows. Additionally, use

estrus detection aids, such as Estrotect breeding indicators, during the last handling before fixed-time AI. For optimal results, limit the use of sexed semen to females with activated patches at the time of fixed-time AI. To improve pregnancy rates and control costs, use conventional semen for females with non-activated patches.

Split-Time AI:

Using a split-time AI approach can enhance the effectiveness of sexed semen for timed AI. In this method, animals without activated estrus detection aids at the initial timepoint for split-time AI are separated and receive timed AI approximately 24 hours later. Many of these females may subsequently exhibit standing heat. As a result, sexed semen can be successfully utilized in females whose estrus detection aids are activated either at the first timepoint or the delayed timepoint for AI.

Advantages of using sexed semen

- Only female calves will be produced which helps the farmers to save resources that would have been shared with unwanted males.
- Increasing the number of female calves boosts the supply of replacement heifers.
- Farmers have the opportunity to sell surplus heifers to other farms.
- It accelerates genetic improvement by enhancing the efficiency of progeny testing programs.
- It improves the effectiveness of embryo transfer and IVF programs.
- It offers a cost-effective way to strengthen the herd without the risk of introducing diseases from external sources, thereby improving biosecurity.
- The sorting process removes dead, dying, or damaged sperm cells, ensuring that only viable sperm are used, which makes sexed semen effective even at lower concentrations compared to conventional semen.
- Producing more female calves with sexed semen can lead to fewer difficult births (dystocia) compared to male calves, which is particularly beneficial for maiden heifers.
- **Cow welfare aspect:**
  Sexed semen can reduce the incidence of dystocia by approximately 20% (Seidel, 2003; Norman et al., 2010) since heifer calves are generally smaller and easier to deliver. Additionally, if dystocia does occur, male calves have a mortality rate about 57% higher than female calves (Dematawena and Berger, 1997). In seasonal-calving systems, whether dairy or beef, it is crucial for cows to quickly regain high fertility potential after calving to maintain a 365-day calving interval. Dystocia is known to increase the risk of retained fetal membranes, uterine disease, delayed resumption of estrous cyclicity, and conception failure. Therefore, reducing dystocia has significant immediate and long-term health and welfare benefits for dairy cows. Furthermore, using sexed semen to produce replacements can enhance biosecurity by enabling farms to generate replacements and expand their herd internally, rather than relying on external purchases of stock with unknown disease status. This allows for biosecure herd expansion from dams with known genetic merit (Weigel, 2004). Finally, to maximize the benefits of sex-sorted semen, proper animal management is essential, which also improves overall animal welfare.

Limitations of using sexed semen

- There are some limitations in terms of technology and implementation aspects of the sexed sorted semen.
- Technological limitations –
- High cost of sex sorting machine
- Low sorting efficiency and speed
- Require highly skilled person to operate sex sorting machines
- Damage to the sperm due to shear force, electrostatic charge, droplet formation and sudden stop.
- Waste of approximately 50% of sperm

- Reduced freezing potential of the sorted sperm

Implementation limitations

- High cost of the product which include the cost of the intellectual property right (Rs. 1500-4500/- dose as compared to Rs. 15-20/- dose for conventional semen)
- The conception rate with sex sorted semen is 10-15% less than the conventional semen. This factor will be more critical in Indian condition considering low artificial insemination coverage (20-25%) and low conception rate with artificial insemination (25-35%).
- There is no standard operating procedure to perform insemination with sexed semen. This is another area of concern as the sperm concentration of sexed semen ranges between 2 and 4 million/dose whereas it is 20 million/dose in conventional semen. Managing lower sperm concentration will be a challenge in the field under Indian condition.

Conclusion

Sexed semen offers numerous and diverse advantages over conventional semen. The most crucial factor for farmers is the relative conception rate of sexed semen compared to conventional semen. Recently, the fertility gap between these two types of semen has been reduced. High-fertility sexed semen provides significant flexibility in breeding management programs, including fewer low-value male dairy calves, which addresses potential welfare concerns; increased dairy beef production; reduced greenhouse gas (GHG) emissions from beef production; enhanced selection intensity on the dam line; fewer obstacles to crossbreeding with the Jersey breed; easier heifer rearing; and improved biosecurity. By adopting sexed semen more widely, societal concerns about animal welfare and GHG emissions can be partially alleviated. To maximize the benefits of sexed semen, it is essential to leverage its advantages to boost production efficiency and deliver economically and environmentally sustainable animal protein products.

References

Jordan Thomas, Ph.D., Assistant Professor and State Beef Reproduction Specialist • University of Missouri Division of Animal Sciences 573-882-1804

S. A. Holden and S. T. Butler. 2018. Applications and benefits of sexed semen in dairy and beef herds. Teagasc, Animal and Grassland Research and Innovation Centre, Moorepark, Fermoy, Co. Cork, P61 P302, Ireland

Cerchiaro I, Cassandro M, Dal Zotto R, Carnier P and Gallo L, 2007. A field study on fertility and purity of sex-sorted cattle sperm. J Dairy Sci, 90: 2538-2542

De Vries A, Overton M, Fetrow J, Leslie K and Eicker S et al., 2008. Exploring the impact of sexed semen on the structure of the dairy industry. J Dairy Sci, 91: 847-856

DeJarnette JM, Nebel RL and Marshall CE, 2009. Evaluating the success of sex sorted semen in US dairy herds from on farm records. Theriogen, 71(1): 4958

Khalajzadeh S, Nejati-Javaremi A and Yeganeh HM, 2012. Effect of widespread and limited use of sexed semen on genetic progress and reproductive performance of dairy cows. Animal, 6: 1398-1406

Sexed semen technology in cattle N. Kumar, B. Gebrekidan, T. T. Gebrewahd and B. Hadush. Indian J. Anim. Hlth. (2017), 56(2): 157-168