THE SCIENCE WORLD
A Monthly e Magazine
ISSN:2583-2212

Popular Article

Sept, 2023; 3(09), 2316-2321

Sex Sorted Semen Technology

Shiv K Tyagi, Sonal Sharma, Manoj Kumar, Ashwni K Pandey
Animal Genetics Division, ICAR-IVRI, Izatnagar, Bareilly-243-122, Uttar Pradesh, India
https://doi.org/10.5281/zenodo.8357834

Abstract

As farming has become more mechanized, male bovines have become less useful. Farmers don't want to keep bullocks for farming or any other kind of draught work. Because of this, male cows born at a farmer's house are now a problem. Farmers often let the male calves run free, which makes the number of wild animals grow. With more than 90% accuracy, new technologies like the Sex Sorted Semen in AI programme can be used to make only female calves. The use of sex-sorted sperm will be a game-changer for farms because 90% of the times, only female calves are born, instead of a 50:50 male to female sex ratio with normal semen. If it is used a lot, the number of female animals will go up. This will help farmers make more money by selling the female animals or milk. Using sex-sorted sperm will also lower the number of male cattle, which will cut down on the number of stray cattle in the country.

What is sex sorted semen?

Sex-sorted semen is a specialized form of semen used in artificial insemination in livestock, particularly in the dairy and beef cattle industry. It is also sometimes used in other species such as horses and swine. The primary purpose of sex-sorted semen is to increase the probability of producing offspring of a specific gender, typically female.

How sex sorting of semen is done?

The process of sex sorting semen involves separating sperm cells into two groups: one is containing sperm cells with X chromosomes (which will result in female offspring when they fertilize an egg) and the other containing sperm cells with Y chromosomes (which will result in male offspring when they fertilize an egg).

There are a few methods for sex sorting semen, but the most common one is flow cytometry. Flow cytometry uses lasers and detectors to differentiate between X and Y chromosome-bearing sperm based on their DNA content. Once the sperm are sorted, they can be stored and used for artificial insemination.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com

Published: **19.09.2023**

Methods of sex sorted semen-

Sex sorting semen is achieved through a process called flow cytometry, which separates sperm cells into two groups based on their DNA content, allowing for the selection of the desired gender of offspring. There are two main methods for sex sorting semen:

1. **Flow Cytometry**: Flow cytometry is the most common and widely used method for sex sorting semen. This technique relies on the differences in DNA content between sperm cells carrying X chromosomes (female-producing sperm) and those carrying Y chromosomes (male-producing sperm). Here's a simplified overview of the process:
    - **Sample Collection**: Semen is collected from the male animal, typically through artificial insemination techniques.
    - **Sperm Staining**: The collected semen is treated with a DNA-specific fluorescent dye that binds to the DNA in each sperm cell.
    - **Flow Cytometer**: The stained semen is then passed through a flow cytometer, which is a sophisticated machine that uses lasers and detectors to measure the fluorescence of each sperm cell. Based on the amount of DNA in each cell, the machine classifies them as X or Y chromosome-bearing sperm.
    - **Sorting**: After classification, an electrostatic charge is applied to the sperm cells as they pass through the machine. This charge causes the X and Y chromosome-bearing sperm to separate into different collection tubes or channels.
    - **Collection**: The sorted sperm are collected into separate containers and can be further processed, extended, and stored for artificial insemination.
2. **Magnetic-Activated Cell Sorting (MACS)**: While less common than flow cytometry, MACS is another method for sex sorting semen. MACS relies on the different surface charge and properties of X and Y chromosome-bearing sperm. The process involves the following steps:
    - **Sample Collection**: Semen is collected from the male animal.
    - **Sperm Separation**: The semen is processed and exposed to magnetic microbeads coated with antibodies that specifically bind to either X or Y chromosome-bearing sperm.
    - **Magnetic Field**: The treated sperm are then passed through a magnetic field. The microbeads attached to the sperm cells are affected by the magnetic field, causing the X and Y chromosome-bearing sperm to separate based on their surface properties.
    - **Collection**: The sorted sperm are collected and can be further processed, extended, and stored for artificial insemination.

Both flow cytometry and MACS have been used successfully to sort sperm by gender. However, flow cytometry is more widely adopted and tends to offer higher sorting accuracy and

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published: **19.09.2023**

efficiency. The choice of method often depends on the specific goals, resources, and equipment available to the producer or breeding program.

Advantages of sex sorted semen-

The use of sex-sorted semen in livestock breeding offers several advantages, which can be beneficial for producers and the industry as a whole. Some of the key advantages include:

1. **Gender Selection**: Sex-sorted semen offers higher accuracy in selecting offspring gender, benefiting producers with breeding goals related to desired animal gender.
2. **Strategic Breeding**: Sex-sorted semen can be strategically utilized by producers to achieve breeding objectives, such as dairy farmers preferring female offspring for milk production and beef producers seeking more male calves for meat production.
3. **Improved Genetics**: Gender selection in offspring breeding allows producers to make informed decisions, leading to improved genetics, increased productivity, efficiency, and market demand.
4. **Reduced Culling**: Sex-sorted semen can minimize the need for animal culling, saving time and resources, and addressing ethical issues associated with culling.
5. **Increased Herd Uniformity**: Sex-sorted semen provides precise genetic control, enhancing uniformity in desirable traits like milk production and meat quality in herds.
6. **Better Animal Welfare**: Reduced culling can enhance animal welfare practices, as fewer animals are born with the intention of culling, reducing stress and ethical challenges.
7. **Maximized Efficiency**: Sex-sorted semen improves breeding efficiency by increasing the likelihood of producing desired offspring gender, thereby reducing the number of matings needed to achieve breeding goals.
8. **Market Demand**: Sex-sorted semen aids producers in meeting market demand by producing animals of higher demand, particularly in industries with fluctuating market preferences.
9. **Reduced Environmental Impact**: Sex-sorted semen reduces environmental impact of livestock farming by producing only the necessary animal gender, reducing resources needed for surplus animal production and maintenance.
10. **Research and Genetic Improvement:** Sex-sorted semen in controlled breeding programs can enhance research on animal genetics and breeding practices, thereby promoting continuous industry improvements.
11. **Improved animal welfare**: By avoiding the need to cull unwanted animals, sex-sorted semen can contribute to better animal welfare practices.

Sex-sorted semen, though potentially more expensive and inaccurate than conventional semen, is a valuable tool in modern livestock breeding programs, enabling producers to make strategic decisions.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published: **19.09.2023**

Constraint of sex sorted semen-

Sex-sorted semen offers numerous benefits in livestock breeding, but also presents several constraints and challenges for producers, including:

1. **Reduced Fertility**: Sex-sorting semen can decrease fertility due to damage to sperm cells, reducing their effectiveness in fertilizing eggs, leading to lower conception rates and constraints for producers.
2. **Higher Cost**: Sex-sorted semen is expensive due to the high cost of technology, equipment, and additional costs passed on to the producer, potentially limiting its affordability for some operations.
3. **Lower Sperm Viability**: Sorting and processing sperm can decrease cell viability, limiting fertilization opportunities, and may necessitate precise timing for optimal conception rates.
4. **Accuracy Variability**: Sex-sorting technology has improved, but accuracy may vary, potentially leading to misclassified sperm cells, requiring producers to be aware of this variability when using sex-sorted semen for breeding.
5. **Decreased Sperm Quantity**: Sorting can decrease the number of viable sperm in a semen sample, posing challenges when inseminating multiple animals or dealing with low fertility animals.
6. **Limited Availability**: Sex-sorted semen may not be accessible for all livestock breeds or species, with availability varying by region and potentially limited for less common or specialized breeds.
7. **Special Handling Requirements**: Sex-sorted semen necessitates meticulous handling and storage to ensure sperm viability, necessitating specific protocols for producers to ensure its viability until insemination.
8. **Expertise Required**: Expertise in artificial insemination techniques and proper timing is crucial for effective use of sex-sorted semen, as inexperienced breeders may struggle to achieve high conception rates.
9. **Regulatory Considerations:** Some regions may have regulations regarding the use of sex-sorted semen in livestock breeding, and producers should be aware and comply with these regulations.
10. **Environmental Impact**: Sex-sorted semen can reduce unwanted male animals but can also cause gender imbalances in livestock populations, impacting herd dynamics and genetic diversity.

Sex-sorted semen is a valuable tool in livestock breeding, but producers must weigh its advantages and constraints, considering their specific breeding goals and resources.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published: **19.09.2023**

Future perspectives of sex sorted semen

Research and technological advancements are advancing the potential of sex-sorted semen in livestock breeding, shaping its future perspectives and developments:

1. **Improved Accuracy**: Research aims to enhance sex sorting accuracy using flow cytometry technology and sperm biology knowledge, potentially reducing gender misclassification.
2. **Enhanced Fertility:** Researchers are enhancing the fertility of sex-sorted sperm by improving its viability and longevity, thereby increasing the chances of successful fertilization and higher conception rates.
3. **Reduced Costs**: The increasing accessibility of technology could potentially lower the cost of sex-sorted semen, making it more affordable for a wider range of livestock producers.
4. **Expanded Availability**: Sex-sorted semen may become available for a broader range of livestock species and breeds, allowing more producers to benefit from gender selection.
5. **Customized Genetic Improvement**: Livestock producers can enhance their breeding programs by controlling the gender of offspring, thereby achieving specific genetic improvements and meeting market demands.
6. **Genetic Diversity Management**: Breeders can strategically utilize sex-sorted semen to manage genetic diversity in livestock populations, preventing genetic bottlenecks and ensuring healthy, diverse populations.
7. **Expanded Species**: Sex sorting, primarily used in cattle, and may expand to other livestock species like swine, sheep, and goats, offering new genetic improvement opportunities.
8. **Genomic Selection Integration**: Sex sorting technology and genomic selection methods can enhance breeding programs by allowing producers to select not only for gender but for specific genetic traits also.
9. **Customized Genetic Traits**: Advancements in technology may enable genetic traits like disease resistance, meat quality, or milk production to be selected for sperm sorting beyond gender.
10. **Consumer Preferences:** Consumer preferences for animal products can influence the use of sex-sorted semen, leading producers to adjust breeding strategies based on growing demand for specific meat or dairy products.
11. **Research Opportunities**: Sex-sorted semen in controlled breeding programs can offer valuable insights into animal genetics, reproductive biology, and breeding strategies, aiding ongoing research in the field.
12. **Environmental Sustainability:** Sex-sorted semen can enhance sustainable livestock farming by decreasing surplus animals and potentially reducing the environmental impact of animal agriculture.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published: **19.09.2023**

13. **Reduced Need for Hormonal Treatments**: Hormones are frequently used in sex sorting, but future advancements may aim to reduce or eliminate their use to address concerns in livestock production.
14. **Regulatory Considerations**: Future developments may lead to changes in regulatory frameworks related to sex-sorted semen, including guidelines on its use and safety.
15. **Integration with Other Technologies**: Sex sorting semen may be integrated with other network error

The adoption of sex-sorted semen depends on livestock producer goals, economics, and advanced technology. As factors evolve, it offers genetic improvement and sustainable livestock production.

Conclusion

There are a lot of different ways that sexed semen is better than regular semen. The most important thing for the farmer is how much more likely it is to get pregnant with sexed semen than with regular semen. This difference in birth rates seems to have gotten smaller over the past few years. A high fertility sexed semen product gives the breeding management programme a lot more flexibility. It reduces the number of low-value male dairy calves, which could be a concern for animal welfare. It also increases dairy beef production, reduces greenhouse gas emissions from beef production, allows for more intense selection on the dam line, makes it easier to crossbreed with Jersey breed, makes raising heifers easier and improves biosecurity.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published: **19.09.2023**