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A New Direction in Dairy Husbandry: Sexed Semen Technology That Increase Milk Production by Increasing the Number of Female Animals

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Introduction

India is an agriculture and livestock-based country where the dairy industry is considered the backbone of the rural economy. To meet the increasing demand for milk and milk products due to the growing population, simply increasing the total number of animals is not enough; it has become essential to increase the number of female animals with high milk production potential.

In dairy farming, a female calf becomes a future milk producer, playing a vital role in the farmer's income and economic stability. Conversely, since male calves do not contribute directly to milk production, they are often seen as an economic burden to farmers in this era of mechanization. Consequently, farmers prioritize the birth of female calves and view male calves as an additional expense.

In traditional artificial insemination (AI) methods, the birth ratio of male and female calves is approximately equal (50:50), which limits the pace of milk production growth. In this scenario, if it were possible to ensure a higher number of female calf births from every pregnancy, the number of milk-yielding cows and buffaloes in the herd could be increased rapidly, leading to a significant rise in milk production and farmer income.

In this regard, Sperm Sexing or Sexed Semen Technology has emerged as a revolutionary and promising scientific method for dairy husbandry. Through this technology, the sex of the future offspring can be largely controlled before conception, making the production of more female animals possible. This increases milk production, makes the herd more productive, and develops animal husbandry into a sustainable and profitable business.

Sexed Semen Technology

When an oocyte in the female animal's reproductive system is fertilized by a sperm carrying the 'X' chromosome, a female calf is born. When fertilized by a sperm carrying the 'Y' chromosome, a male calf is born. The process of separating sperm carrying the 'Y' chromosome from semen and preparing semen containing primarily 'X' chromosome sperm is known as Sexed Semen. If this semen is used for insemination, the probability of a female calf being born can reach approximately 90%.

Given the current need to increase the number of high-yielding cows and buffaloes to meet milk demand, the main objective of Sexed Semen Technology is to rapidly increase the number of productive female animals by producing more female calves. This facilitates a continuous increase in milk production and farmer's income.

History and Methods Development

The development of Sex Sorting Technology was carried out by scientists at the United States Department of Agriculture (USDA) in Livermore (California), Beltsville, and Maryland, and was patented as "Beltsville Sperm Sexing Technology". Subsequently, in the 1990s, George Seidel and his team at the Colorado State University Research Foundation developed a method for the successful sex sorting of bull semen.

Various methods have been researched for preparing sexed semen, such as albumin gradients, Percoll gradients, gradient swim-down, free-flow electrophoresis, H-Y antigen identification, centrifugal counter-current distribution, genetic approaches and flow cytometry. Among all these, Flow Cytometry Technology has been accepted as the most effective and practical method.

Based on decades of research, the Flow Cytometry method today makes it possible to separate 'X' and 'Y' chromosome-bearing sperm with nearly 90% accuracy. Scientifically, 'X' chromosome sperm contain approximately 3.8% to 4% more DNA than 'Y' chromosome sperm. Based on this DNA difference, Flow Cytometry technology separates the 'X' and 'Y' sperm, prioritizing the production of female calves. Methods other than Flow Cytometry still require further research for commercial use.

Major Benefits of Sexed Semen

- Increased Milk Production: The increase in the number of female calves leads to a higher number of milk-yielding cows/buffaloes in the future, resulting in increased milk production and strengthening the farmer's economic stability.

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- Easier Calving: Since the weight and size of female calves are generally less than that of male calves, difficulties during calving (dystocia) are reduced, and the mother's health is better maintained.
- Herd Improvement: The availability of more female animals makes selection and improvement possible, allowing farmers to maintain only animals with high milk production potential.
- Additional Income: Surplus female calves or cows can be made available for sale, becoming an additional source of income for the farmer.
- Cost Reduction: The unnecessary expense of rearing male calves is prevented, reducing the economic burden on the livestock owner.
- Better Nutrition: With a reduction in male animals, female animals receive adequate fodder and nutrition, which positively impacts their milk production.
- Social Benefits: Fewer male calves can lead to a reduction in the stray cattle problem, thereby controlling social and traffic-related issues.
- Genetic Progress: Using sexed semen from bulls/buffalo bulls with superior genetic traits improves the milk production capacity of the born females, helping to upgrade the quality of the herd in the long run.
- Quality Semen: During the process, dead and damaged sperm are separated, so only viable sperm capable of fertilization are placed in the uterus, potentially improving pregnancy possibilities.
- Economic Viability: The cost of a sexed semen dose is much lower compared to buying a new cow or calf, making this technology economically affordable for farmers.

Disadvantages of Sexed Semen

- Lack of Awareness: Currently, there is a lack of sufficient knowledge and understanding about sexed semen among many farmers.
- Lower Conception Rate: The probability of conception with sexed semen can be approximately 10% to 15% lower compared to conventional semen. Additionally, the price of the dose is higher.
- Lower Sperm Count: While a dose of conventional semen contains approximately 20 million sperm, a dose of sexed semen contains fewer sperm (approximately 2 million). This makes proper animal selection and timely insemination extremely necessary.

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- High Costs & Limited Supply: The high cost of the machines used for sex sorting limits the technology's reach. The sorting process is slow, leading to a production shortage relative to market demand, which keeps the price high.
- Sperm Wastage: During the separation of 'X' and 'Y' sperm, approximately 50% of the sperm are damaged. Consequently, only about 50% of the sperm remain available for making doses. Furthermore, operating the machines requires specially trained and skilled human resources.
- Critical Timing: Due to the high cost, performing insemination at the right time and on the right animal becomes extremely important.

Current Status and Future Direction

Currently, subsidies are being provided on sexed semen doses by the government and cooperative institutions, making these doses available to farmers at affordable prices. As a result, the rate of insemination using sexed semen in cows and buffaloes is gradually increasing.

In the future, as this technology develops further and sexed semen doses become available on a large scale, even economically weaker farmers will be able to benefit from this technology. Consequently, their economic condition will improve, and dairy husbandry will develop as a more sustainable and profitable business.

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