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EMBRYO TRANSPLANTATION IN LIVESTOCK FARMING

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Abstract: This article provides a comprehensive overview of the history, development stages, and modern applications of embryo transplantation techniques in livestock farming.
Keywords: Embryo transplantation, donor and recipient animals, superovulation, genetic selection, FSH hormone, Rowson method.

History of Embryo Transplantation in Livestock

The development of this biotechnology dates back nearly 135 years. In 1890, scientist Walter Heap first performed and described embryo transplantation by transferring two Angora rabbit embryos into pregnant Belgian rabbits, producing offspring of both breeds [1]. Experiments with embryo transfer in large farm animals began in the 1930s with sheep and goats. The first successful embryo transfers in cattle and pigs were conducted in the 1950s by Jim Rowson in Cambridge, England [2].

The first commercial embryo transfers were implemented in the early 1970s. Initially, embryos were collected from donors and surgically implanted into recipients. This continued until the late 1970s when a non-surgical method was developed, significantly increasing the popularity of embryo transfer.

Introduction to Embryo Transplantation

Transplantation Technique – Embryo Transfer

A cow typically gives birth to one calf per year after reaching maturity, with nearly half of the calves being male. In contrast, a single bull can sire several thousand calves in its lifetime. By transferring embryos from genetically valuable cows, farmers can produce numerous offspring with identical genetic traits.

Embryo transplantation is an excellent method for improving livestock genetics. Successful embryo collection and transfer require specialized skills, and optimal results are achieved through experience. In Hungary and western Ukraine, the company "Karpatikum" LLC has successfully used embryo transplantation to propagate high-value dairy and beef cattle breeds. For various reasons, exporting and importing embryos is far easier than transporting pregnant cows of elite breeds [4].

Fertilized eggs (zygotes) or embryos are flushed seven days after insemination, just before they attach to the uterine wall. Once collected, the embryo is transferred into the uterus of a recipient cow, which serves as a surrogate mother without contributing genetically. If implantation occurs, the calf is born after nine months, exhibiting superior genetic traits compared to the recipient cow.

Donor Animals

Donor animals are elite cows or heifers from valuable breeds, capable of producing multiple calves with identical genetic traits.

- **Breed**: Donors can be cows or heifers of any high-value breed.

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- **Age**: Donors must be of breeding age, typically starting at 14 months for the first embryo flush.
- **Health and Care**: Donors must be healthy with regular estrous cycles. They require proper nutrition and stable living conditions without drastic changes before flushing.
- **Genetic Traits**: Only the most valuable breeding animals are selected as donors based on pedigree, milk production, and conformation.

Recipient Animals

Recipients are cows or heifers that receive the transplanted embryo.

- **Breed**: Recipients can be of any breed, though size compatibility matters (e.g., an Ayrshire heifer may struggle to deliver a large Holstein calf). Ideally, Hungarian Grey cattle are used.
- **Age**: Recipients must have regular estrous cycles. Embryos are not transferred during the first estrus.
- **Health and Care**: Recipients must be healthy and maintained for nine months post-transfer. Animals with mobility issues are excluded to avoid complications.
- **Genetic Role**: Recipients are typically low-value or non-breeding animals, such as Hungarian Grey cows or heifers.

Principles of Embryo Flushing and Transfer

What is an Embryo?

A newborn heifer's ovaries contain hundreds of thousands of follicles, each holding an egg. Only a few mature during her lifetime. Normally, one egg is released per cycle, though twins can occur if two eggs are released [3].

After ovulation, the egg enters the oviduct. During insemination, sperm travels through the uterus to the oviduct, where fertilization occurs. The embryo begins developing from the zygote, measuring just 0.15 mm after 24 hours. Cell division starts in the oviduct, and by day 5–6, the embryo enters the uterus.

At one week, the spherical embryo (0.15 mm) is encased in a protective membrane. By day 35, it grows to 1 cm in length. Implantation occurs around two weeks post-fertilization.

Superovulation and Embryo Transfer

The primary goal of embryo transfer is to maximize the number of genetically superior calves from a single donor.

- **Hormonal Stimulation**: Follicle-Stimulating Hormone (FSH) induces superovulation, producing multiple eggs per cycle instead of one.
- **Synchronization**: Successful transfer requires synchronized estrus in donors and recipients.
- **Corpus Luteum**: After fertilization, the corpus luteum forms, secreting progesterone to maintain pregnancy.

Conclusion

Embryo transplantation is a powerful tool for genetic improvement in livestock. Advances in non-surgical techniques and hormonal synchronization have enhanced its efficiency, enabling the rapid propagation of elite cattle breeds.

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