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MODERN BIOTECHNOLOGIES APPLIED IN CATTLE PRODUCTION AND REPRODUCTION

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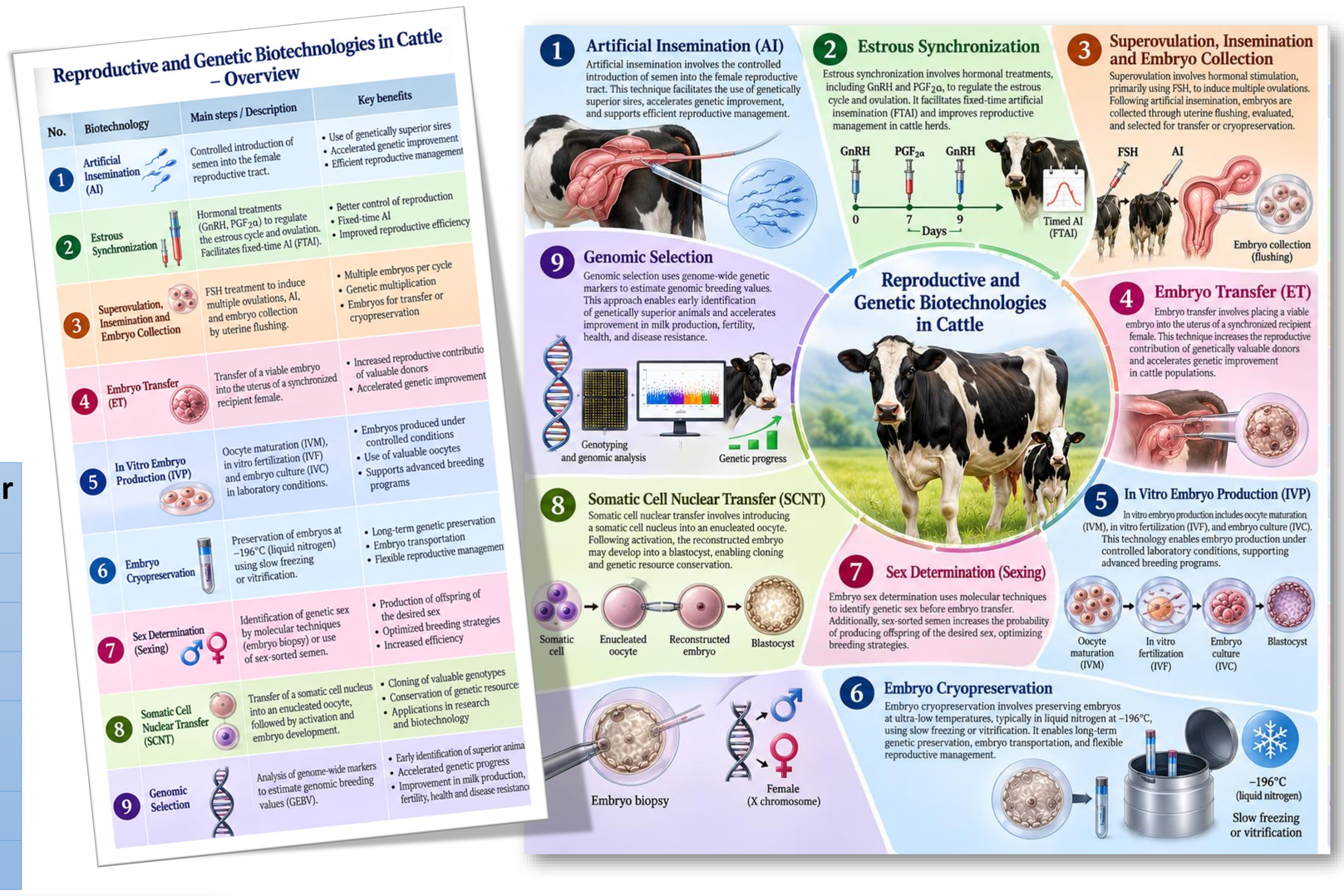
Abstract: *Modern biotechnologies represent an important tool for the development and improvement of cattle farming, contributing to enhanced reproductive performance, genetic improvement, and increased productivity. This review aims to highlight the main applications of biotechnologies in cattle production and reproduction, as well as their contribution to the development of efficient and sustainable animal production systems. Advances in reproductive biotechnology have enabled the development and refinement of techniques such as artificial insemination, estrus synchronization, in vitro fertilization, embryo transfer, and cryopreservation of biological material. The application of these techniques facilitates the exploitation of the genetic potential of breeding animals, optimization of reproductive management, and production of offspring with improved productive traits. Furthermore, the use of sex-sorted semen allows the production of offspring of the desired sex, according to the specific objectives of each farm. The cryopreservation of semen and embryos contributes to the preservation of genetic diversity and the conservation of valuable animal genetic resources. The integration of genetic diagnostic techniques enables the early detection of hereditary abnormalities, supporting breeding animal selection and reducing the transmission of genetic defects. Additionally, the use of cryopreserved embryos may reduce the need to transport breeding animals, thereby minimizing transportation-related stress and contributing to improved animal welfare. In conclusion, the integration of modern biotechnologies into cattle farm management represents an important approach to optimizing productive and reproductive performance, conserving genetic resources, and improving the sustainability of animal production.*

• Introduction

Modern biotechnologies are essential tools in animal reproduction and breeding, integrating techniques such as artificial insemination, embryo transfer, in vitro embryo production, cryopreservation, and cloning. The application of these methods, together with advances in genetic engineering and genomic selection, contributes to accelerating genetic progress and improving reproductive and productive performance in animals.

Table 1. Efficiency of In Vitro Embryo Production (IVP) Following Ovum Pick-Up (OPU) in Cattle

Parameter	IVP Efficiency (%)	OPU/IVP per Animal
Oocyte maturation	90	7.2
Normal fertilization	75–80	6.4
Cleavage rate	60	4.8
Blastocyst development rate	20–40	2.4
Pregnancy rate	45–55	1.2
Live-born calves	70–90	1.0



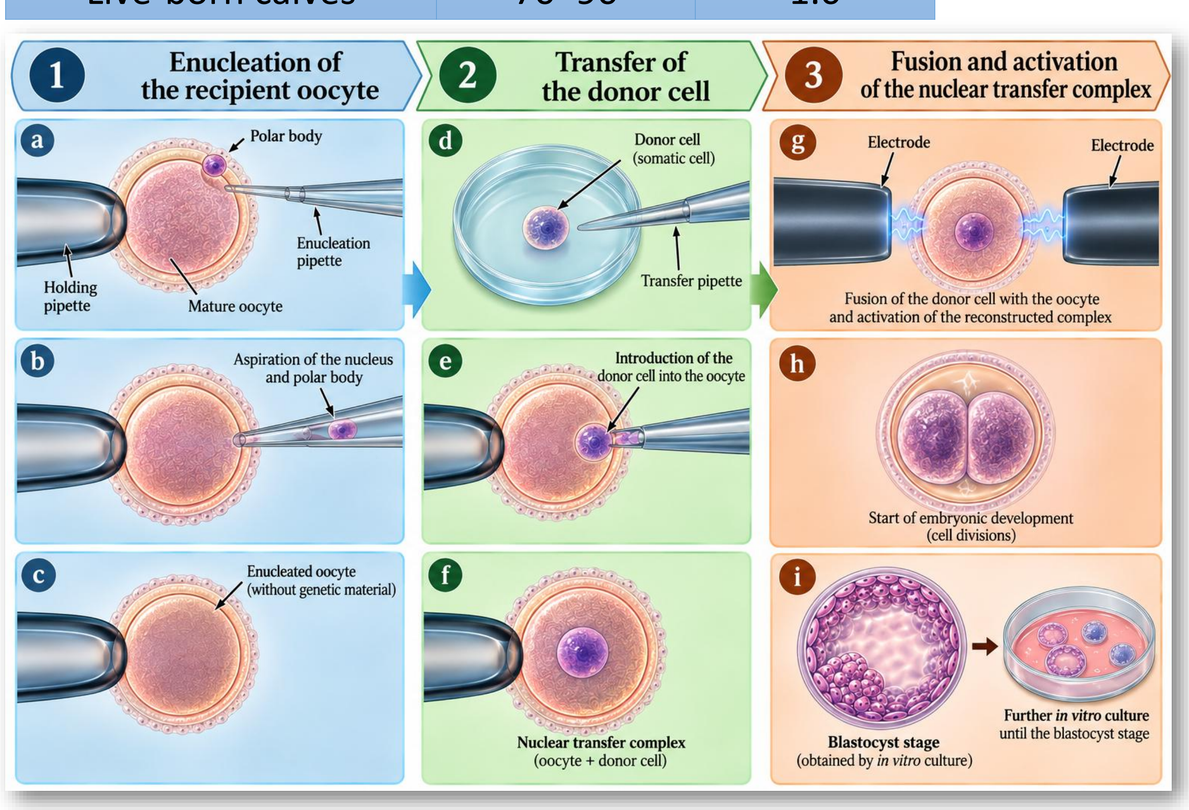


Table 2. Efficiency of Somatic Cell Nuclear Transfer (SCNT) and Associated Complications in Cattle

Parameter	Efficiency / Incidence (%)
Recipient oocyte enucleation	95–100%
Cell fusion	80–90%
Embryo activation	90–95%
Blastocyst development	20–30%
Live birth rate following embryo transfer	10–14%
Large Offspring Syndrome (LOS) incidence	25–35%

• Conclusions

Modern reproductive and genetic biotechnologies play a crucial role in improving reproductive efficiency, accelerating genetic progress, and enhancing productivity in cattle. The integration of artificial insemination, embryo transfer, in vitro embryo production, cryopreservation, and genomic selection enables the efficient use and conservation of valuable genetic resources. Despite certain technical limitations, these technologies offer promising opportunities for sustainable cattle breeding, improved animal health, and increased reproductive performance.