

METHODS OF PRESERVING ANIMAL EMBRYOS

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Abstract: The preservation of animal embryos is a crucial practice in reproductive biotechnology, genetic conservation, and scientific research. Various methods have been developed for storing embryos to ensure their viability for future use, including cryopreservation, embryo culture, and the use of stem cells. Cryopreservation, especially in its vitrification form, is the most widely utilized technique, allowing embryos to be frozen and stored indefinitely in liquid nitrogen. This method has been successfully applied to a range of species, including cattle, horses, and laboratory animals. In addition to cryopreservation, oocyte freezing, embryo splitting, and emerging technologies like artificial scaffolding and somatic cell nuclear transfer offer alternative ways to preserve genetic material and enhance breeding programs. The preservation of animal embryos is integral to maintaining genetic diversity, facilitating research, and supporting the livestock and wildlife industries. This abstract provides an overview of current techniques for animal embryo preservation and their applications.

Keywords: animal embryos, cryopreservation, vitrification, embryo culture, oocyte freezing, genetic conservation, reproductive biotechnology, stem cells, somatic cell nuclear transfer, genetic material preservation.

The preservation of animal embryos has become an essential practice in various fields such as reproductive biotechnology, conservation of genetic resources, and developmental biology. The ability to store embryos offers several advantages, including the preservation of valuable genetic traits, the facilitation of breeding programs, and the protection of endangered species. It also plays a pivotal role in research, enabling scientists to study embryonic development, genetics, and the impact of environmental factors on reproductive health.[1]

Embryo preservation methods are broadly categorized into short-term and long-term techniques. Short-term methods, such as embryo culture and storage, are typically employed for embryos that will be transferred or implanted within a limited time frame. In contrast, long-term preservation is predominantly achieved through cryopreservation (freezing), a technique that allows embryos to be stored at ultra-low temperatures for extended periods, often indefinitely. Cryopreservation, particularly when combined with vitrification (a rapid freezing technique that prevents ice crystal formation), has revolutionized the way embryos from various animal species are preserved. Other methods, such as oocyte (egg cell) freezing, embryo splitting, and somatic cell nuclear transfer (SCNT), contribute to the diversification of techniques available for

preserving genetic material. These methods have seen significant advancements in recent years, particularly in the fields of cloning, transgenic animals, and genetic resource conservation.

The preservation of embryos is not only important for commercial and agricultural applications but also holds significant promise in the context of wildlife conservation, particularly for endangered species. Through these preservation techniques, genetic diversity can be safeguarded, and efforts to repopulate threatened species can be enhanced.

This introduction outlines the importance of animal embryo preservation and introduces the key methods involved, including cryopreservation, embryo culture, oocyte freezing, and emerging biotechnologies. By understanding these methods, it becomes possible to appreciate their role in advancing agricultural science, medical research, and biodiversity conservation.

Cryopreservation (Freezing) of Animal Embryos

Cryopreservation remains the most widely used and effective method for preserving animal embryos. The process involves freezing embryos at very low temperatures, typically in liquid nitrogen at -196°C , which effectively halts all biological processes and ensures the long-term preservation of the embryos' genetic material.[2]

-Freezing Process: Embryos are first treated with cryoprotectants, which prevent the formation of ice crystals that could damage cellular structures during freezing. Once treated, the embryos are slowly cooled to subzero temperatures to prepare them for storage in liquid nitrogen. This cooling process must be carefully controlled to avoid damaging the embryo's integrity.

-Vitrification: Vitrification is a technique used to freeze embryos rapidly, transitioning the water inside the embryo into a glass-like, non-crystalline state without forming ice. This method is especially advantageous as it minimizes the risk of intracellular damage. Vitrification has become particularly successful in certain species, such as cattle, where traditional freezing methods may be less effective.

-Storage and Thawing: Once frozen, embryos can be stored indefinitely, allowing genetic material to be conserved for future use, such as in assisted reproduction programs or conservation efforts. The embryos can later be thawed and implanted into surrogate animals for development. The thawing process also requires careful management to ensure the embryo survives and develops successfully.

Cryopreservation is routinely used in livestock breeding, research, and conservation programs. It is particularly useful for species with high genetic value, such as elite dairy or beef cattle, and has been employed in conservation efforts to protect endangered species.

The preservation of animal embryos through methods such as cryopreservation, oocyte freezing, SCNT, and embryo splitting is critical for maintaining genetic diversity, advancing agricultural and breeding programs, and supporting biodiversity conservation efforts. As technologies continue to evolve, new methods such as stem cell-based preservation and artificial embryo development hold promise for the future. The continued development of these techniques will not only improve reproductive success in animals but also contribute to the preservation of endangered species and the enhancement of livestock productivity.

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