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Animal cloning: State of ART

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Introduction

Reproductive cloning is defined as the deliberate production of genetically identical individuals, in simple terms creating an identical genetic copy of one organism like xerox copy.

How is reproductive cloning done?

The animal cloning process can occur via two separate methods: artificial twinning or somatic cell nuclear transfer. The process of artificial twinning is done in many labs in order to induce the birth of identical animal twins. The embryo to be transferred into the mother's womb is split into two, and each developing embryo is allowed to develop to form its own organisms. The resulting offspring would then form identical twins. Twinning can be used to increase livestock and produce more offspring than normal. The other process, somatic cell nuclear transfer, is more intricate and involves several steps that include:

- Enucleation: The host egg is enucleated. Its DNA is removed, and its genetic information is lost.
- Nucleus transfer: The nucleus of the animal to be cloned is removed.
- Insertion: The nucleus of the animal to be cloned is inserted into the enucleated host egg to produce a zygote.
- Stimulation: The zygote is stimulated to divide via electric current.
- Embryo transfer: The zygote is then transplanted into the surrogate mother's uterus.

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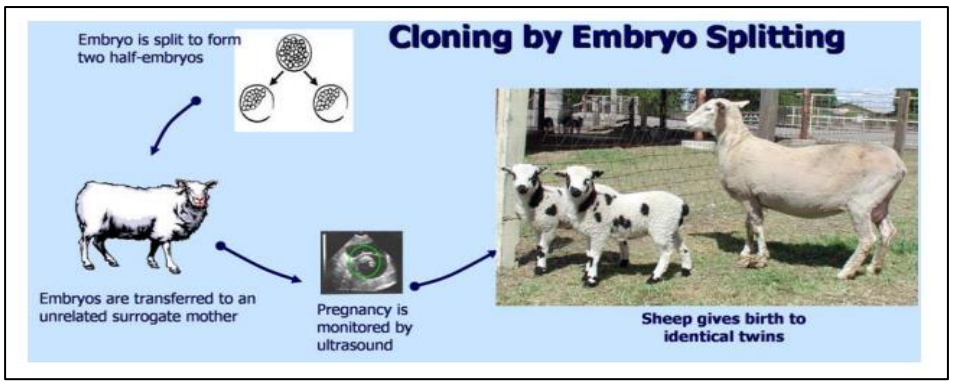

Figure 1: Embryo Splitting Method

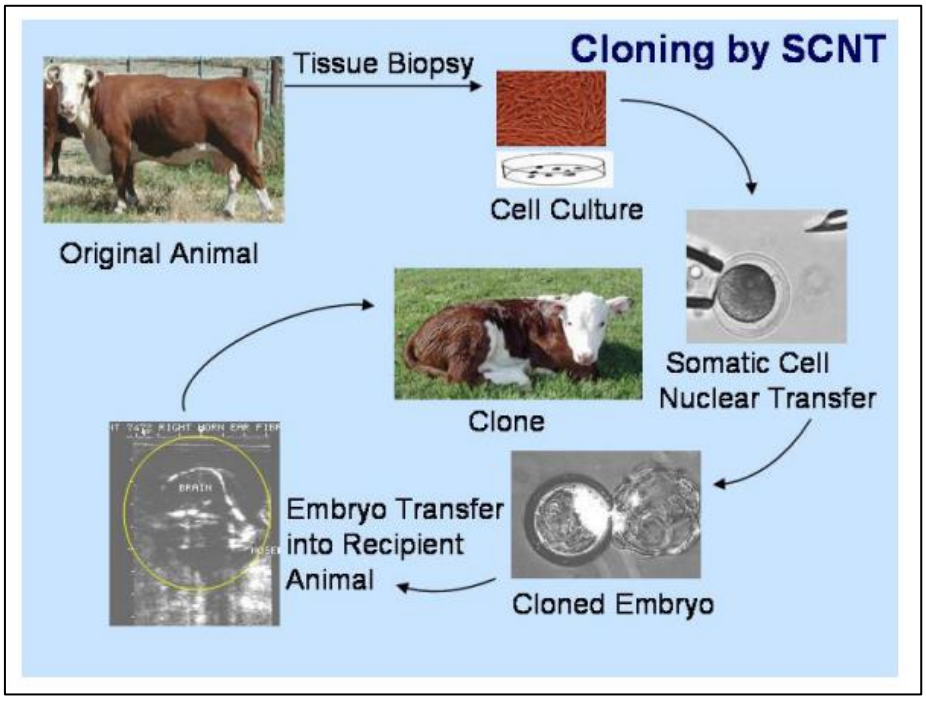

Figure 2: Somatic Cell Nuclear Transfer

Benefits of Cloning Animals

- Help balance ecosystems: With many species now considered endangered, animal cloning may eradicate that threat.
- Increase livestock output: This method could be used in farms in order to increase livestock. With the world population skyrocketing, it may be useful to increase output in order to avoid an increase of cost on meats. In addition, animals with desired traits may be cloned in order to increase quality.
- Research: Animal cloning can be used to study the physiology of certain diseases by cloning certain organs instead of entire animals. It can also be used to develop human drugs and medications, such as antithrombin. Moreover, animal cloning can also be used to produce and culture stem cells that can be used for the treatment of many human diseases.

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- Reproductive cloning may enable researchers to make copies of animals with the potential benefits for the fields of medicine and agriculture.
- For instance, the same Scottish researchers who cloned Dolly have cloned other sheep that have been genetically modified to produce milk that contains a human protein essential for blood clotting. The hope is that someday this protein can be purified from the milk and given to humans whose blood does not clot properly. Another possible use of cloned animals is for testing new drugs and treatment strategies. The great advantage of using cloned animals for drug testing is that they are all genetically identical, which means their responses to the drugs should be uniform rather than variable as seen in animals with different genetic make-ups.
- After consulting with many independent scientists and experts in cloning, the U.S. Food and Drug Administration (FDA) decided in January 2008 that meat and milk from cloned animals, such as cattle, pigs and goats, are as safe as those from non-cloned animals. The FDA action means that researchers are now free to using cloning methods to make copies of animals with desirable agricultural traits, such as high milk production or lean meat. However, because cloning is still very expensive, it will likely take many years until food products from cloned animals actually appear in supermarkets.
- Another application is to create clones to build populations of endangered, or possibly even extinct, species of animals. In 2001, researchers produced the first clone of an endangered species: a type of Asian ox known as a guar. Sadly, the baby guar, which had developed inside a surrogate cow mother, died just a few days after its birth. In 2003, another endangered type of ox, called the Banteg, was successfully cloned. Soon after, three African wildcats were cloned using frozen embryos as a source of DNA. Although some experts think cloning can save many species that would otherwise disappear, others argue that cloning produces a population of genetically identical individuals that lack the genetic variability necessary for species survival.
- Some people also have expressed interest in having their deceased pets cloned in the hope of getting a similar animal to replace the dead one. But as shown by Cc the cloned cat, a clone may not turn out exactly like the original pet whose DNA was used to make the clone.

Disadvantages of Cloning Animal

- Reproductive cloning is a very inefficient technique and most cloned animal embryos cannot develop into healthy individuals. For instance, Dolly was the only clone to be born live out of a total of 277 cloned embryos. This very low efficiency, combined with safety concerns, presents a serious obstacle to the application of reproductive cloning.

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- Researchers have observed some adverse health effects in sheep and other mammals that have been cloned. These include an increase in birth size and a variety of defects in vital organs, such as the liver, brain and heart. Other consequences include premature aging and problems with the immune system. Another potential problem centers on the relative age of the cloned cell's chromosomes. As cells go through their normal rounds of division, the tips of the chromosomes, called telomeres, shrink. Over time, the telomeres become so short that the cell can no longer divide and, consequently, the cell dies. This is part of the natural aging process that seems to happen in all cell types. As a consequence, clones created from a cell taken from an adult might have chromosomes that are already shorter than normal, which may condemn the clones' cells to a shorter life span. Indeed, Dolly, who was cloned from the cell of a 6-year-old sheep, had chromosomes that were shorter than those of other sheep her age. Dolly died when she was six years old, about half the average sheep's 12-year lifespan.

Work done at ICAR-NDRI, Karnal

By conventional micromanipulation- based SCNT, With the use of Handmade cloning NDRI has worked extensively on buffalo cloning which includes a major breakthrough in February 2009 by producing the world's first cloned buffalo calf

After the birth of the first cloned buffalo produced by conventional micromanipulation-based SCNT3, a major breakthrough was made in February 2009 by producing the world's first cloned buffalo calf through the handmade/hand guided cloning technique.

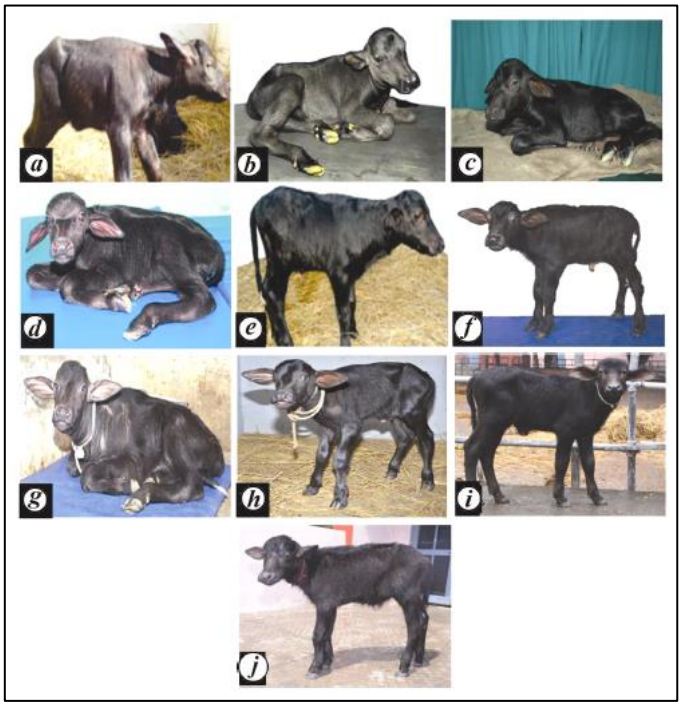

Figure 3: Clones that were born at the National Dairy Research Institute, Karnal (date of birth is indicated with in brackets). ***a***, Sammrupa (6 February 2009); ***b***, Garima (6 June 2009); ***c***, Garima-II (22 August 2010); ***d***, Shrestha (26 August 2010); ***e***, Swaran (18 March 2013); ***f***, Purnima (6 September 2013); ***g***, Lalima (2 May 2014); ***h***, Rajat (23 July 2014); ***i***, Wild buffalo Deepasha (12 December 2014); ***j***, Apurva (5 February 2015).

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