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A Study on Cloning and Its Applications

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Abstract – Cloning is defined as the different processes for duplicating biological materials such as tissues and new life forms. The cloning of human tissue should be allowed because the fields of medicine benefit from it; however, the full cloning of humans is a mockery of life because it creates a population of people who will not evolve or adapt to changes in the environment. Clones are organisms that are exact genetic copies. Every single bit of their DNA is identical. Clones can happen naturally - identical twins are just one of many examples. Or they can be made in the lab.

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INTRODUCTION

As the first mammal ever to be cloned, Dolly the sheep came to life in the 1990's. Dolly lived for a good six and a half years and died of a progressive lung disease. Dolly was the only success in 276 tries and Dolly was not exactly identical to her donor mother. Dolly was created by a research team managed by Ian Wilmut and Prof. Keith Campbell. Dolly was the longest living mammal clone to ever live on the earth. Cloning is a really controversial subject and today's society doesn't need to clone. Scientists have been cloning animals for years. In 1952, the first animal, a tadpole, was cloned. This was the start of the dilemma that is still with us today. Hundreds of clones exist today and scientists are going to clone many more cloning. The first idea of cloning was from a Nobel Prize winning biologist. His name was Hans Spemann. In the 1930's, he suggested a way that an animal could get cloned. This was his idea: A sperm cell and an egg cell combine together to form a zygote. The zygote begins dividing, forming an embryo. At this early stage of development the embryo's cells are still unspecialized, and each has the ability to develop an organism. Cell specialization begins when a cavity is formed and this cavity will eventually develop into the embryo's gut. An embryo's gut is the formation of the internal organs. As the embryo continues to develop, its cells become increasingly specialized and begin to form the organism's various parts, such as its skin and spinal cord. Then it grows inside of the mother a real life baby. This process is a lot like having a normal animal baby.

When scientists clone an organism, they are making an exact genetic copy of the whole organism. When scientists clone a gene, they isolate and make exact copies of just one of an organism's genes. Cloning a gene usually involves copying the DNA sequence of that gene into a smaller, more easily manipulated piece of DNA, such as a plasmid. This process makes it easier to study the function of the individual gene in the laboratory.

There are two ways to make an exact genetic copy of an organism in a lab: artificial embryo twinning and somatic cell nuclear transfer.

1. ARTIFICIAL EMBRYO TWINNING

Artificial embryo twinning is a relatively low-tech way to make clones. This technique mimics the natural process that creates identical twins.

In nature, twins form very early in development when the embryo splits in two. Twinning happens in the first days after egg and sperm join, while the embryo is made of just a small number of unspecialized cells. Each half of the embryo continues dividing on its own, ultimately developing into separate, complete individuals. Since they developed from the same fertilized egg, the resulting individuals are genetically identical.

Artificial embryo twinning uses the same approach, but it is carried out in a Petri dish instead of inside the mother. A very early embryo is separated into individual cells, which are allowed to divide and develop for a short time in the Petri dish. The embryos are then placed into a surrogate mother, where they finish developing. Again, since all the embryos came from the same fertilized egg, they are genetically identical.

2. SOMATIC CELL NUCLEAR TRANSFER

Somatic cell nuclear transfer (SCNT), also called nuclear transfer, uses a different approach than artificial embryo twinning, but it produces the same result: an exact genetic copy, or clone, of an individual. This was the method used to create Dolly the Sheep.

Somatic cell: A somatic cell is any cell in the body other than sperm and egg, the two types of reproductive cells. Reproductive cells are also called germ cells. In mammals, every somatic cell has two

complete sets of chromosomes, whereas the germ cells have only one complete set.

Nuclear: The nucleus is a compartment that holds the cell's DNA. The DNA is divided into packages called chromosomes, and it contains all the information needed to form an organism.

Transfer: To make Dolly, researchers isolated a somatic cell from an adult female sheep. Next they removed the nucleus and all of its DNA from an egg cell. Then they transferred the nucleus from the somatic cell to the egg cell. After a couple of chemical tweaks, the egg cell, with its new nucleus, was behaving just like a freshly fertilized egg. It developed into an embryo, which was implanted into a surrogate mother and carried to term. The lamb, Dolly, was an exact genetic replica of the adult female sheep that donated the somatic cell. She was the first-ever mammal to be cloned from an adult somatic cell.

SCNT VS NATURAL WAY OF MAKING AN EMBRYO

Natural fertilization, where egg and sperm join and SCNT both make the same thing: a dividing ball of cells, called an embryo. An embryo's cells all have two complete sets of chromosomes. The difference between fertilization and SCNT lies in where those two sets come from.

In fertilization, the sperm and egg have one set of chromosomes each. When the sperm and egg join, they grow into an embryo with two sets - one from the father's sperm and one from the mother's egg. In SCNT, the egg cell's single set of chromosomes is removed. It is replaced by the nucleus from a somatic cell, which already contains two complete sets of chromosomes. So, in the resulting embryo, both sets of chromosomes come from the somatic cell.

APPLICATIONS:

There are many options available for protein expression from cloned DNA. These include cell-free extracts in vitro expression systems and bacterial, yeast, insect and mammalian cell systems, each with its own advantages and drawbacks. Requirements for protein solubility, functionality, and yield are often the most important factors to consider when choosing an expression system, but the time and labor required for sub-cloning and optimizing expression can also have a significant impact. Use of recombinant proteins varies widely from functional studies in vivo to large-scale protein production for structural studies and therapeutics.

DNA LIBRARIES:

A DNA library is a collection of DNA fragments that have been cloned into vectors so that researchers can identify and isolate the DNA fragments that interest them for further study. There are basically two kinds of libraries: genomic DNA and c - DNA libraries. Genomic DNA libraries contain large fragments of DNA in either bacteria-phages or bacterial or P1-derived artificial chromosomes. c -DNA libraries are made with cloned, reverse-transcribed m-RNA and therefore lack DNA sequences corresponding to genomic regions that are not expressed such as 5′ and 3′ non-coding regions. C-DNA libraries generally contain much smaller fragments than genomic DNA libraries and are usually cloned into plasmid vectors.

Cloning has been an ethical and moral issue since the idea was first developed. There are many uses for investigating into this technology and many diseases that can be cured once the technology is understood. However, many of the methods in which the technology is developed and many of the uses of the technology destroy lives and only do harm. Much good can come from cloning and stem cell research but we must be careful as to how we use this powerful technology. A stem cell is an unspecified cell that can regenerate itself and also turn into more specific types of cells that do more specific functions in the body.

BENEFITES:

Cloning is the process of making a genetically identical organism through the use of a DNA sample. After the first cloned sheep dolly was created, many people were keen in knowing more about cloning and its benefit to society. There are three types of cloning, therapeutic, reproductive and embryonic cloning. These types of cloning are all ways of scientists trying to find ways to produce a living organism or organs.

Reproductive human cloning is a form of asexual reproduction done in a lab, not by a sperm fertilizing an egg. Michael Soules, a professor and director of the Division of Reproductive Endocrinology and Infertility at the University of Washington, concerns with the idea that reproductive human cloning is unethical. He further explains that the success of cloning depends on the species. Small animals and plants have already been cloned numerous times. Laboratory mice and apples from cloned fruit trees have been successfully cloned numerous times. Larger animals go through major problems during the cloning process.

PROS AND CONS OF HUMAN CLONING

Scientists had been working on cloning animals for years. When the breakthrough occurred, the entire medical world was turned on its head. The sea urchin that was cloned over a century ago in 1885 didn’t hit the headlines quite as hard as Dolly the sheep who was cloned in the 1990s. Maybe because Dolly is a mammal, her successful cloning seemed to open the Pandora’s Box of the potential for human cloning. Then in 2004 a team of South Korean and American scientists successfully cloned some human tissue.

The global population is divided on the issue of human cloning.

PROS TO HUMAN CLONING

- It is a solution to the problem of infertility. A woman who cannot conceive could have a cloned embryo implanted in her body. Many infertile couples hang their hopes and dreams on giving birth to an infant who is part of their DNA, just like natural birth couples do.

- Benefits in regenerative medicine. A person with a physical problem or disability could have a clone of themselves developed so that the stem cells from the embryo could be used to regenerate their own tissue, body parts, organs etc. These necessary portions are extracted from the embryo, destroying it in the process.

- Human cloning could be used to grow organs or repair damaged tissues and ultimately provide a cure for diseases that currently have no cure and affect millions of people annually.

- Clone organs for transplant; specifically livers, kidneys and even bone marrow. Cloning bone marrow would result in a cure for leukemia. Cloning organs for transplant is seen in the medical field as potentially the biggest benefit.

CONS TO HUMAN CLONING

- When gene diversity is lost, natural gene mutations which help a species survive new viruses are also lost. A new virus could effectively wipe out entire groups of clones.

- There are health risks due to poor cloning success rates. Clones have a 95% problem rate in miscarriage, debilitating conditions and deformities.

- Ethical risks and the abuse of this potentially powerful technology. Many groups of people still consider cloning to be playing with the powers of God.

- Wide acceptance and practice of cloning could cause upheavals, riots and violent acts by staunch religious groups. Whenever a potentially powerful technology is developed, people with evil plans will try to twist it to suit their evil desires.

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