Cloning in plants and animals

What is cloning? Cloning is a process carried out in a laboratory by which a genetically identical organism can be made through non-sexual means. How it started? In February 1997, when embryologist Ian Wilmut and his colleagues at Roslin Institute in Scotland were able to clone a lamb, named Dolly. Who are cloned? Both plants and animals can be cloned. Plant Cloning is an ancient form of producing desired outcomes in plant species. Animal Cloning is the process by which an entire organism is reproduced from a single cell taken from the parent organism and in a genetically identical manner. This simply means the cloned animal is an exact duplicate in every way of its parent; it has the same and exact DNA. What does it involve? For different purposes there exist different extents of cloning such a molecular cloning; the process of making multiple molecules, cellular cloning, which can be further divided into unicellular cloning; in which you derive a population of cells from a single cell, and Cloning in stem cell research; used to create embryos for research or therapeutic purposes, and the most complex type of cloning is organism cloning; it refers to the procedure of creating a new multicellular organism, genetically identical to another. Is cloning advantageous or disadvantageous? Cloning has both advantages and disadvantages to human beings. Advantages may include the creation of human beings that can be used to study human development and to potentially treat diseases. Disadvantages may include the lack of diversity of organisms and the hindrance of evolution. Why clone, and why not to clone? The ethics of cloning has become a great issue. Scientifically speaking, cloning can be the solution to problems associated with organ transplants that can benefit human health, and can also help in great yield production of healthy crops. But, ethically speaking the bible states that a new individual

should be born from a husband (which provides the sperm) and a wife (which provides the egg), therefore by cloning one will blunder the world of God for it involves asexual reproduction of organisms. Cloning has indeed been the subject of scientific experiments for years but it was first known to be successful in 1997 when, after about 277 eggs used, the first cloned mammal ‘ Dolly’ was born. In the United States, the human consumption of meat and other products from cloned animals was approved by the FDA on December 28, 2006, with no special labeling required.

CONCEPT AND SIGNIFICANCE

Cloning can have slightly different meanings depending of the specific field one is studying. In general Biology cloning refers to the process of production of similar populations of genetically identical individuals that occur in nature when organisms such as bacteria, insects or plants reproduce asexually. In Biotechnology cloning refers to the process used to create copies of DNA fragments, cells, or organisms. Cloning has two main branches. They are Plant Cloning and Animal Cloning. Plant Cloning is an ancient form of producing desired outcomes in plant species. For farmers plant cloning is used to duplicate the success of good plants, and rich crops with very high yields. Plant cloning is easier than using seeds to generate new plants because the duplication of desired genes is rapid and the grower knows the type and quality of plant he would be growing since the new plant can be created from just a twig. Animal Cloning is the process by which an entire organism is reproduced from a single cell taken from the parent organism. This new organism is genetically identical; the exact duplicate in every way including DNA, to the parent organism. Animal cloning can be done both for

reproductive and non-reproductive or therapeutic purposes. In the second case, cloning is done to produce stem cells or other such cells that can be used for therapeutic purposes, for example, for healing or recreating damaged organs. Cloning can happen both naturally and in the lab. Natural forms of cloning can include asexual reproduction in certain organisms such as bacteria and also in the development of twins from a single fertilized egg. Cloning can be done in the labs; an example would be the process of nuclear transfer of embryonic cells which leads to the production of cloned mammals. Cloning is divided into three major compartments, they are; molecular cloning, cellular cloning, and organism cloning. Molecular Cloning is the process of making multiple molecules. It is used to amplify DNA fragments containing whole genes, but can be used to amplify any DNA sequence such as promoters, non-coding sequence and randomly fragmented DNA. It is used for biological experiments and practical applications ranging from genetic fingerprinting to large scale protein production. Cellular Cloning has two subgroups; unicellular cloning and cloning in stem cell research. Unicellular cloning occurs in organisms such as bacteria and yeast; these processes are simple and only require inoculation of the appropriate medium for them to derive a population of cells from a single cell. For stem cell research, Somatic-cell nuclear transfer is used to create embryos for the research and therapeutic purposes. This is called research cloning and its goal is to harvest stem cells that can be used to study human development and to potentially treat diseases such as Diabetes and Alzheimer’s. Organism Cloning refers to the procedure of asexually creating a new multicellular organism, genetically identical to another. Successful animal cloning, in particular cloning from an adult animal, one

knows exactly how the clone is going to turn out. This becomes especially useful when the whole intention behind cloning is to save a certain endangered species from becoming totally extinct.

ACTUAL PROCESS

Animals: Molecular Cloning which is the cloning of any DNA fragment can be divided into the following different steps:

- Fragmentation – breaking apart a strand of DNA
- Ligation – gluing together pieces of DNA in a desired sequence
- Transfection – inserting the newly formed pieces of DNA into cells
- Screening/Selection – selecting out the cells that were successfully transfected with the new DNA.

Unicellular Cloning of organisms is performed using a culture technique which involves the use of cloning rings. In this technique:

A single-cell suspension of cells that have been exposed to a mutagenic agent or drug used to drive selection is plated at a high dilution to create isolated colonies; each arising from a single and potentially cloned distinct cell.

At an early growth stage when colonies consist of only a few of cells, sterile polystyrene rings (cloning rings), which have been dipped in grease are placed over an individual colony and a small amount of trypsin is added.

Cloned cells are collected from inside the ring and transferred to a new vessel for further growth.

Somatic-Cell Nuclear Transfer is used to create embryos for research and therapeutic purposes. The SCNT process to create embryos for stem cell research is:

First, the collection of cells from the organism that will be cloned, the cells can be used immediately or can be stored in the lab for later use.

The maternal DNA from an oocyte is removed at metaphase II.

The nucleus can then be inserted into an egg cytoplasm. This creates a one-cell embryo.

The grouped somatic cell and egg cytoplasm are then introduced to an electrical current. The sexual energy allows the cloned embryo to begin development.

The successfully developed embryos are then placed in surrogate recipients.

Organism Cloning the procedure of creating a new multicellular organism, genetically identical to another is achieved by:

The transfer of a nucleus from a donor adult cell (somatic cell) to an egg that has no nucleus.

When the egg begins to divide normally it is transferred into the uterus of the surrogate mother.

An example of the first mammal to be successfully cloned from an adult cell is Dolly, a Finn-Dorset ewe. She was cloned at the Roslin Institute in Scotland. Dolly was formed by taking a cell from the udder of her biological

mother. Her embryo was created by taking the cell and inserting it into a sheep ovum. The embryo was then placed inside a female sheep that went through normal pregnancy. She lived for 6 years, from 1996-2003. There were early claims that Dolly the Sheep had pathologies resembling accelerated aging, but other researchers, including Ian Wilmut who led the team that successfully cloned Dolly, argue that Dolly's early death due to respiratory infection was unrelated to deficiencies with the cloning process.

In amphibians the ultimate test of whether the nucleus of a differentiated cell has undergone any irreversible functional restriction is to have that nucleus generate every other type of differentiated cell in the body. If each cell's nucleus is identical to the zygote nucleus, then each cell's nucleus should be totipotent (capable of directing the entire development of the organism) when transplanted into an activated enucleated egg. Before such an experiment could be done, three techniques for transplanting nuclei into eggs had to be perfected: a method for enucleating host eggs without destroying them; a method for isolating intact donor nuclei; and a method for transferring such nuclei into the host egg without damaging either the nucleus or the oocyte.

Plants:

The process of cloning a plant is relatively easy compared to that of animals. Simply:

- Trim a piece of the root from a plant.
- Supply it with nutrients and plant it in soil.
- The resulting growth will be identical to the original plant.

BENEFITS TO HUMANITY

Economically, cultivating existing plants with good yields ensures that farmers will most likely get an identical yield from that new plant, providing similar situations are sustained. Through the process of cloning, the University of Arkansas states that a number of different varieties of foods, such as grapes and oranges without seeds, have been created that consumer prefer over traditional plants.

Cloning can save endangered species. On January 8, 2001, scientists at Advanced Cell Technology, Inc., announced the birth of the first clone of an endangered animal, a baby bull gaur (a large wild ox from India and Southeast Asia) named Noah. Noah died of an infection unrelated to the cloning procedure. But this experiment served as prove to show that they can bring back endangered species.

‘ Research Cloning’ or ‘ Therapeutic Cloning’ can harvest stem cells that can be used to study human development and to potentially treat diseases such as Diabetes and Alzheimer’s. In the case of the Alzheimer’s disease, the nucleus from a skin cell of the patient is placed into an empty egg. The reprogrammed cell begins to develop into an embryo because the egg reacts with the transferred nucleus. The embryo will become genetically identical to the patient. The embryo will then form a blastocyst which has the potential to become any cell in the body.

Other Potential Medical Benefits of cloning include: the possibility that we will learn to renew activity of damaged cells by growing new cells and replacing them, the creation of humans with identical genetic makeup to act

as organ donors for each other, cloning allows the study of cell differentiation, and cloning also gives sterile couples the ability to have offspring that will have either the mother’s or father’s genetic pattern.

DISADVANTAGES OF CLONING

In a large percentage of cases, the cloning process fails in the course of pregnancy or some sort of birth defects occur, for example, as in a recent case, a calf born with two faces. Sometimes the defects manifest themselves later and kill the clone. This long lasting process before the success of cloning can lead to the extinction of little remains of DNA from extinct species if it is used with no successive results.

Changes in genomes may not only result in changes in appearance, but in psychological and personality changes as well.

In plants; cloning limits diversity which makes the plants more susceptible to diseases and pests.

Possible potential harms and disadvantages are: the possibility of compromising individualities, the loss of genetic variation, technology is not well developed; it has low fertility rate; in cloning Dolly, 277 eggs were used, 30 started to divide, nine induced pregnancy, and only one survived.

ETHICAL ISSUES

Although most scientists consider the process of animal cloning as a major breakthrough and see many beneficial possibilities in it, many people are uncomfortable with the idea, they say it is ‘ against nature’ and it is ethically damning, particularly in the instance of cloning human beings.

One of the main goals of the government is to protect human life. Some people want the government to regulate cloning and not allow it. Producing clones for research or to use their parts is unethical. It would be against the code of ethics of a doctor to harm a clone (i. e., use it for an organ transplant). The clone would be a human being and deserve all the rights and privileges that a non-cloned human has. A clone should not be a second-class citizen. It is speculated that clones would be considered as such.

The American Medical Association holds four points of reason why cloning should not take place. They are: there are unknown physical harms introduced by cloning, unknown psychosocial harms introduced by cloning, including violations of autonomy and privacy,

impacts on familial and societal relations, and potential effects on the human gene pool. Serious ethical concerns arise by the future possibility of only harvesting organs from clones. Some people have considered the idea of growing organs separately from a human organism – in doing this; a new organ supply could be established without the moral implications of harvesting them from humans. Research is also being done on the idea of growing organs that are biologically acceptable to the human body inside of other organisms, such as pigs or cows, then transplanting them to humans, a form of Xeno-transplantation.

From a Latter-day Saint point of view, the Proclamation on the Family clearly does not agree with cloning. The Proclamation states: “ We . . . declare that God has commanded that the sacred powers of procreation are to be

employed only between man and woman, lawfully wedded as husband and wife. We declare the means by which mortal life is created to be divinely appointed. We affirm the sanctity of life and of its importance in God's plan." In other words, the power to create humans is only to be used in a marriage between husband and wife. Cloning only involves one parent, therefore it is not following God's plan in which a man's sperm and a woman's egg are needed to create life.

CONCLUSION

Cloning is the process of creating a copy of a biological entity. In genetics, cloning refers to the process of making an identical copy of the DNA of an organism.

Cloning is an established process today, which holds the promise of repopulating endangered and even extinct animals.

Cloning can revolutionize the world and the way we live.

Animal cloning has been one of the greatest frontiers scientists have conquered. However, there are various ethical and scientific issues related to cloning that have been debated.

Foods from healthy cloned animals are deemed safe to eat.

In recent years, there has been a shoot of new laws banning or regulating cloning around the world. In some countries, animal cloning is allowed, but not human cloning. Some advocacy groups are seeking to ban therapeutic cloning, even if this could potentially save people from many debilitating illnesses.