Reproductive Cloning

Term Paper – Molecular Genetics

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Preface

First of all we were interested in the technology scientists use for cloning. We wanted to know more about how an organism can be copied in an unnatural way. But then we thought about the word unnatural.
We got interested in the ethical questions. Should we do research on the copying of DNA? Do humans have the right to reproduce organisms unnaturally? Isn't it, as it says, 'unnatural'? And when we started to read some articles, we realized that reproductive cloning brings great risks. Less than one of a hundred embryos survive. And the possibility that this single copied organism suffers from diseases is enormously high. The techniques aren't save but they think about cloning humans. Shouldn't we wait with these thoughts until the rate of surviving embryos increases to 99%? Isn't the risk to clone human beings still too high? Can't we compare the death of each embryo to an abortion? Once we read that it is forbidden to clone humans, we were relieved.
Now the only question left is: Why do humans clone? Is it just because biologists think this is interesting? Do they want to 'play God' or is it a symbol of power? Why should someone want to have identical people on earth? All those questions are very philosophical and difficult to answer.
We therefore focus on three main questions:

-How does cloning work?
-Is it ethically correct?
-Why do people clone?

Introduction:

In Biology a definition for cloning may be:
>>The process of producing similar populations of genetically identical individuals that occur in nature when organisms reproduce asexually.<< (Wikipedia: cloning)

In other words the goal of cloning is to get organisms which have the same DNA and therefor the same characteristics.
There're mainly two different types of cloning: reproductive and therapeutic cloning. Especially in medicine the therapeutic cloning is very important but also reproductive cloning may become as important as therapeutic cloning in the near future.
But at the moment, both methods are discussed quite frequently due to ethical issues and publications in the last years.
Our topic – reproductive cloning – is about copying a whole organism. With this process we can i.e. duplicate ourselves.
But clones seem to be not as healthy as we are. Most of them have a more malformed body or parts of the body than sexually produced organisms. And there's always a loss of gene variation that means that no evolution or development of this organism can occur no more.

Therapeutic cloning instead deals with the possibilities to produce specific parts of an organism by cultivating stem cells.
Cloning itself is very important at the moment. There are many current studies about stem cells and the best way to benefit from their ability to become a soma cell. But also discussions about cloned humans or embryos for research aims are up to date. Especially ethical problems with cloning humans are often discussed these days. And in many countries cloning of men is forbidden.

The most important events from sight of reproductive cloning are certainly

- The sheep Dolly that gave birth in July 1996.
- Two cloned claves in the USA in 1998
- In February in 2001 when an italian medicine announces the birth of the first cloned human baby
- In November in 2001 when the US-company “Advanced Cell Technology” clones human embryos

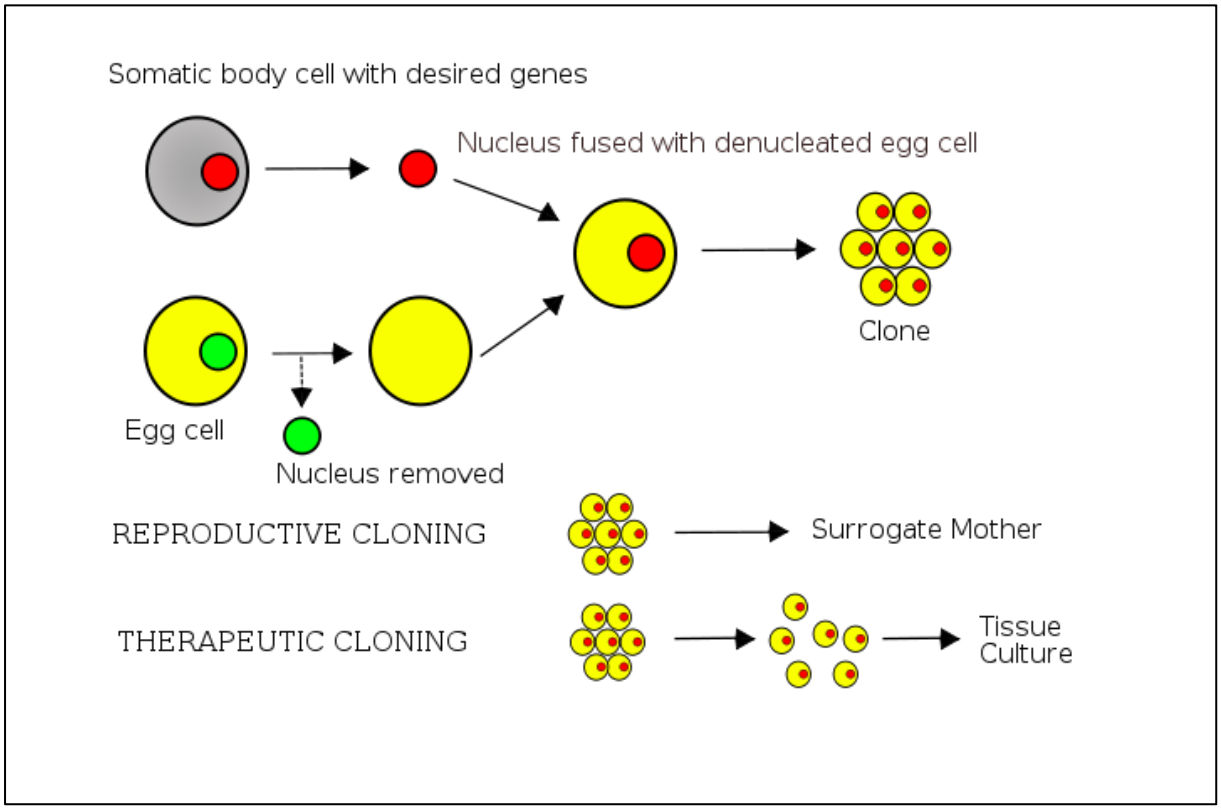
The German Nobelist Hans Spemann is responsible for the birth of the first cloned animal (1986). He’s technique is the base for the creation of the sheep Dolly.

Cloning today is actually used for studies and better usage of products of certain organisms.
With reproductive cloning it is possible to make an organism resistant against its environment. A cloned sheep can therefor be immune against some sicknesses while its mother isn’t.
Another reason is that with this technique we can help endangered animals to survive. With cloning it is possible to size a population.
A third reason why cloning is important is that when we clone human embryos we get stem cells. Thy help us understand our own development and help us to defend against diseases.
Reproductive cloning is also important for our everyday life. If a woman has to remove her ovaries she still has the change to have biological offspring.
An alternative to reproductive cloning is parthenogenesis. This process is only found in females and it is an asexual type of reproduction. The unfertilized egg cell is put in an environment that is similar to one of a fertilized egg cell. This leads the ovum to separate. In this process we can get either a half clone of the mother or a full clone. Normal egg cells are haploid but the number of chromosomes of the offspring is mostly diploid. The moment when the number is doubled is important because it determines the offspring to be a half clone or a full clone.
Half clone:
The chromosome number is doubled during development of the offspring.
Full cone:
If the egg cell was formed without meiosis we get a full clone.

Description of engineering techniques:

In reproductive cloning a copy of an organisms is produced. The process that takes place is called somatic cell nuclear transfer.
This technique is quite simple:

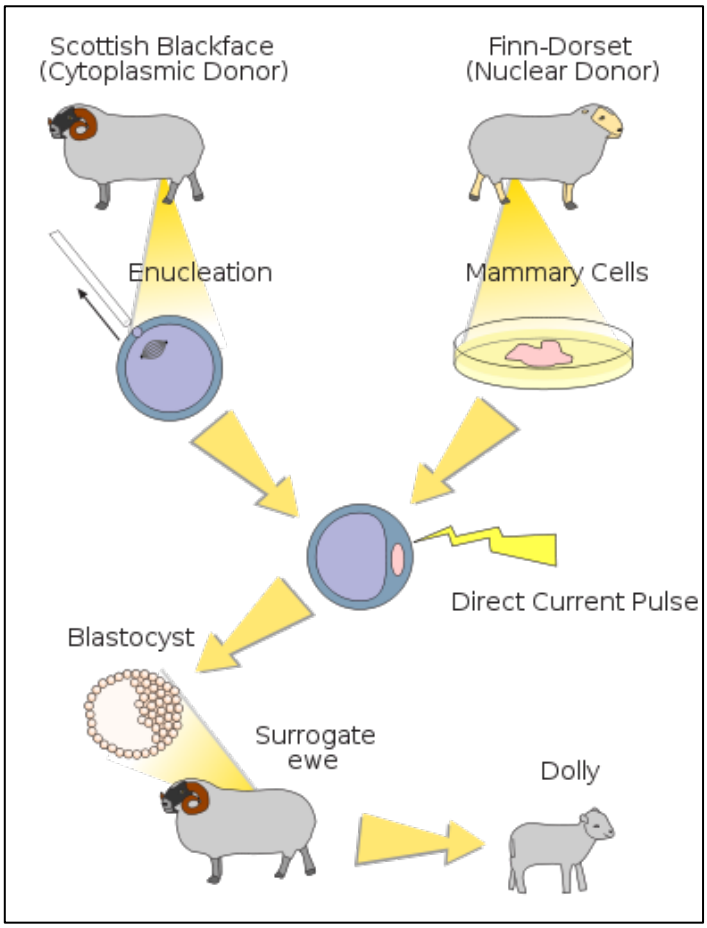
1. The nucleus of an egg cell is removed.
2. The nucleus of the donator-cell is also removed but instead of putting it away it is planted in the nucleus-free egg cell.
3. The egg cell is now fertilized.
4. The egg is transplanted into the surrogate mother.
5. A clone can grow up



As we can see in the picture the main difference between reproductive cloning and therapeutic cloning is that in reproductive cloning a whole organisms is copied while in therapeutic cloning only certain tissues are cultivated.
In all steps shown before the most important is number 4. The zygote needs to be implanted in its “normal” environment - in humans the uterus.
In therapeutic cloning the zygote is put in a test tube. After separating a few times the embryonic stem cells are collected and splitted from the other cells. These embryonic stem cells haven’t a specific assignment yet. This characteristic trait makes them especially interesting for the challenge of creating a certain type of cells which have a specific function. These cells can therefor still be programmed.
It is important to notice that in reproductive cloning the inserted nucleus arises from a adult cell which already has a function. That means that the egg cell is actually fertilized with a specialized nucleus. The challenge is to create an environment of a

sexually fertilized egg cell which will lead the state of the adult nucleus to become to an embryonic niveau. By achieving this conditions the newly formed zygote has now the potential to develop as a sexual fertilized egg cell.
But we have to consider the fact, that by removing only the nucleus of the egg cell all other cell organelles are still present. Especially the gene information of the mitochondria can influence the implanted nucleus. And today we know that this information makes up approximately 1% of the human genetic information. That is enough to make it unsure whether we can predict the final development of a cloned organism.
Therefor cloning isn't as efficient as we think. Most of the zygotes die or many of the organisms which survived are amorphic (missbuilded body parts).

A good example of a cloned animal is Dolly the Sheep.



Dolly was cloned at the Roslin Institute in Scotland. She was the first successfully copied animal. But to create her 277 egg cells were needed and at the end seventy calves were born and one third of them died young.

Documentation and pictures of research institutions visited:

Interview with Lorraine Young, professor of Molecular Embryology, Faculty of Medicine & Health Sciences .

Today, is it possible to differentiate between a clone and its donator? Everyone states that it is possible to clone whole organisms but they often aren't perfect copies.

Quite a number of cloned animals have been found to have a lot of abnormalities. Some of them are very large can be twice normal birth weight. Other problems that have been found are problems with their lungs, they found it very difficult to breathe and many of them die soon after birth. There are also problems at the blood vessels, the heart and the lymphatic system which responsible for our immunity.

You say that the problem lies in the cloning technique itself. So do scientist already know what exactly is going wrong?

Another problem such as when the lungs don't function properly or the blood vessels and the heart aren't formed properly we don't really understand what genes are going wrong. And we probably have many years of research before we fully comprehend the problems with cloned animals.

Is there a possibility that we can use cloning in the future?

There are people who for example have taken particular nerve cells from fetuses and showed that you could transplant them into the brain of Parkinson patients. So I'm sure that one day we'll transplant cloned human tissue with stem cells.

What is the important thing about cloning for you?

I think that cloning is a very good scientific tool for understanding how the nucleus is reprogrammed. So in cloning one is taking an adult cell and putting it in an embryonic environment and having it reprogrammed to take all those new developmental potentials. We really need to know how that works and how efficiently it works. And much of what we've learned from that will help us understand how we can reprogram an adult stem cell safely.

Discussion:

The research of reproductive cloning ends with the complete and successful cloning of a mammal. Until today the duplication of a primate or a dog not to mention of a human being hasn't been achieved. But which progress has been made concerning reproductive cloning?
Scientists have one simple goal: Knowing as much as possible about everything.
The cloning of a mammal means to know a lot about the secret of reproduction and how to disturb and change it. A lot of scientists are looking forward to the moment it is possible to clone a human being without any risk. We could make a thousand copies of George Clooney, Megan Fox or any other idol we have through reproductive cloning. But is this what everyone wants, that everyone should be perfect? There also is a medically useful aspect. We could clone ourselves and if we get problems with our liver or our heart we could take the organs of our clones. We would use them as organ donors. This thought is very morbid. We would kill our unnatural 'twin' to survive. Therefore there is also another technique of cloning which is called therapeutic cloning. The goal of this process is not to create human beings, but rather to achieve stem cells that can be used to treat diseases.
The probability that we will stay alive until the cloning of the first human being is very low at the moment. Reproductive cloning of humans is forbidden in most countries.
Many people say cloning is 'unnatural'. In literal sense this is true. People would never reproduce this way naturally. It's not a reproduction, it's a duplication, and this works only in the lab.
Copying a human being is a weird thought, therefore cloning has become a high political issue and most people are against it. Even though duplicating organisms is kind of unnatural, this is not the only issue why cloning isn't accepted today. Many religions are against it because we should let God create new life and nobody should interbreed this action.
If one day someone makes it possible to clone a human he would be a hero. Although almost everyone declines cloning, everybody would be fascinated to see the first unnaturally cloned human. An unnatural twin; how great would that be?
One problem is the question if humans have the right to interbreed the natural procedures. Nobody can answer this with yes or no and the answer can neither be correct nor incorrect. But what we can say truly against cloning is that the way to the top brings many victims. This means that until someone achieves cloning a human being a lot of embryos and many babies will die. Cloning works in theory but at the moment it doesn't yet work the way scientists want it to in praxis. This is a really big disadvantage.
At the moment cloning has more disadvantages and therefore most people are very critical towards it.
As we mentioned before reproductive cloning is forbidden in most countries and we think it is good the way it is today.

Summary:

The goal of cloning is to produce organisms or tissues with certain specific functions and characteristics. In reproductive cloning a nucleus is inserted in an egg cell that has undergone a denucleation. The zygote is now replaced in an environment of a normal fertilized egg cell. This leads to the development of an embryo.
There are also many ethical problems and cloning itself has much debility such as malformations or death.
And what might be very important in future: the normal gene exchange is stopped.

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