

Cloning



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And Teacher: Mr. Ruggle

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Preface

When the biology teacher Mr. Ruggle said to us that we will have to create a scientific paper on Genetic engineering we instantly thought about cloning. If the term cloning is heard or read somewhere, a lot of question come to our mind. Is it even possible, were there any creatures cloned so far, how the biological process works and so on. A lot of people know what is meant by cloning but only a few know exactly how the biological process works. So we decided to do further research about cloning, to answer our questions. When we found out that it is really possible and already has been practiced, a lot of new questions came to our mind. We found an article about food from cloned animals and we chose to get more information about this topic, because it seemed very interesting for us end everybody to know. In the following Paper you will receive information about the process of different cloning techniques, ethical reason, how useful cloning is and much more. At the end we came up with the following questions:

Questions:

How exactly does the process of cloning work?

Food from cloned animals?

What are the ethical reasons to clone or not clone animals/humans?

Introduction

In this paper we will focus on cloning of organisms. Clones are organisms which are exact genetic copies of each other. Every little piece of their DNA is identical. Clones can also happen naturally, for example identical twins. The other option, which most often comes first to mind, is to create clones in the lab.

The term clone was invented by J.B.S. Haldane and is derived from the Ancient Greek language. The word in Ancient Greek was referring to the process of creating a new plant from a twig. Until the twentieth century the term was without an e, but then got changed from clon to clone to indicate that it is pronounced with a long o instead of a short o. (utah)

Organism cloning, which is also called reproductive cloning, refers to the production of a new multicellular organism, which is genetically identical to another organism. Cloning happens asexually, as there is reproduction without fertilization or inter-gamete contact. Asexual reproduction is though nothing unnaturally, because it is happening in many species, including most of the plants on our planet and also some insects. Scientists have just made it also possible to reproduce cows and sheep asexually through cloning. The first ever sheep to be cloned, named Dolly the sheep (picture 1), was quite famous due to being cloned.



(Picture 1) Dolly the sheep.

Dolly the sheep was a female domestic sheep and was cloned from a somatic cell with the process of nuclear transfer. It was „born” in 1996 and died in 2003. Dolly was cloned by Scientists of the University of Edinburgh, Scotland, with support of the biotechnical company PPL Therapeutics, which are based near Edinburgh. The project was funded by the Ministry of Agriculture and PPL Therapeutics themselves. (wiki2)

Dolly had three mothers. One of them provided the egg, another it's DNA and the third mother carried the cloned embryo to its birth. Even though its birth was on 5 July in 1996, they didn't announce Dolly until 22 February 1997 in public. It instantly gained so much attention on media that even a Scottish commercial with cloned sheep's was aired on television and the magazine TIME featured a special article. The magazine Science said that Dolly was the breakthrough of the year, even though Dolly wasn't the first ever cloned animal, but only the first cloned mammal which was cloned from an adult cell. Her entire life Dolly lived in the Roslin Institute in Edinburgh, where she was bred with a ram and produced six lambs in total. At the age of 4, Dolly developed arthritis and started to walk stiffly. This was treated with many drugs. Even though a sheep such as Dolly was, should live up to 11 to 12 years, Dolly only lived for 6.5 years. She was killed by doctors because she had developed severe arthritis and a progressive lung disease. After her death, she was examined and was diagnosed with a form of lung cancer.

After the success of Dolly, many other large animals such as pigs, deer, horses and bulls were cloned with the same method. But many embryos of other cloning experiments by nuclear transfer showed abnormal development. Making clones was proved to be highly inefficient. Dolly was the only lamb that survived to adulthood from 277 attempts. Only in 2014 Chinese scientists reported to have around 70-80% cloning pigs. Soon afterwards, a Korean company was producing 500 cloned embryos a day. But they announced that the technique which also created Dolly will never be efficiently usable for use in humans. Cloning may have big uses in protecting endangered species and also may become a way to revive already extinct species in the future.

The children of Dolly however are not clones, because they were created by natural selection. They are genetically different from the brother and sisters and from their parents. (wiki1)

Cloned mammals can be very valuable breeding animals, because you can copy a specific property of the original animal, for example meat quality. But it isn't practiced for ethical reasons and for economic reasons, because the production of one cattle can cost up to many ten thousand Swiss francs. There haven't been any cloned animals yet in Switzerland. There also haven't been any imported clones in to Switzerland. But there are offspring's of cloned animals used in Switzerland and all around the world. They are globally traded in form of semen. There have been semen imported from the USA into Switzerland.

That's also the reason to why there may live many hundreds of cattle in Switzerland of which the parents or grandparents have been cloned animals. There isn't any food directly from cloned animals on any market, but if there would be some in the future, probably the first country would be the USA. There may be products of offspring's of cloned animals on the market, but there shouldn't be any concerns about the quality of these products. The Food and Drug Administration (FDA) even released a report on food from cloned animals and stated that there is no health risk in eating any foods from cloned animals. There isn't a way in a supermarket to distinguish between normal meat and meat from cloned animals because the composition of meat and the milk should be the same as of normal animals. Many scientists are trying to clone humans. But at the moment human cloning still appears to be fiction for the future. There has once been a try at cloning humans in South Korea, but was soon stopped. (EDI)

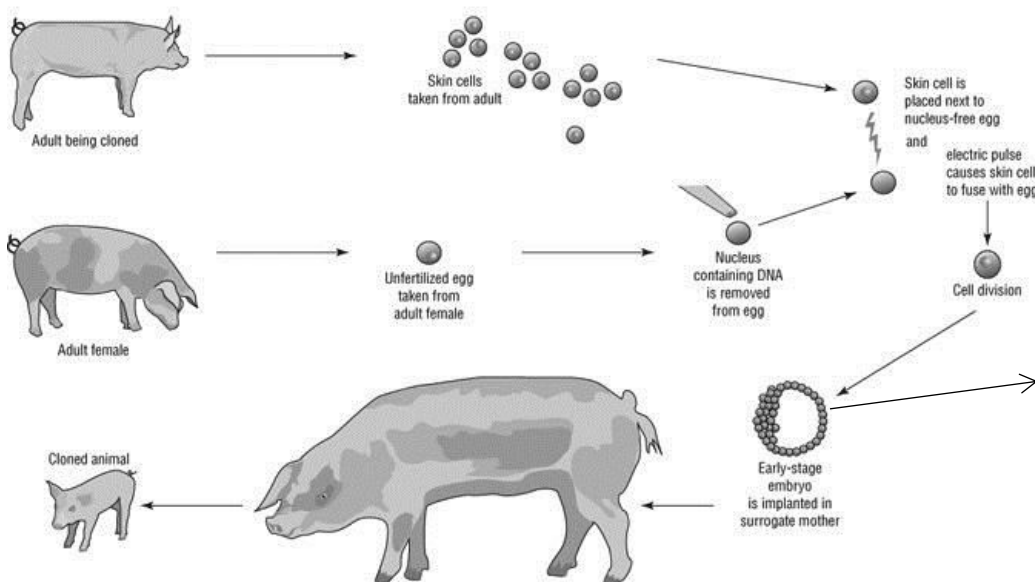
Description of engineering technique

The process of SCNT, or somatic cell nuclear transfer is done with two different cells. The first cell being a female egg cell, and the second one being a cell of the Organism you want to clone. Skin cells, fat cells are only two examples for this. The nucleus of the female egg cell is removed, but that is not as simple as it sounds, because the whole cell is held in place by the cytoplasm. To overcome this structure, the cells are stimulated with electronic shocks, which cause the structure to soften; or to “break”. The nucleus then can be taken out with a tiny needle.

This process is done with both cells. On the egg cell, or donor cell, the nucleus is the part which is thrown away. On the second cell, the taken out nucleus is the part that is kept and the empty shell is dumped. The Nucleus of the second cell now gets squeezed into the female egg cell. For this cell to start reproducing again, another time, electronic impulses are used to reshape and stabilize the cell so the new nucleus is moved in place. This newly generated complete cell now begins to divide and produces new cells, with given information from the nucleus, as a “normal”, living cell would do. However, to be able to develop all necessary traits as an embryo, the cell has to be able to differentiate into any of the three germ layers. So the nucleus has to be reprogrammed to become pluripotent. That is achieved by inducing the expression of transcription and epigenetic factors and of some genes.

This Cell now reproduces until a blastocyst is formed, that is an early state of an embryo containing only 100 cells. Then, this blastocyst is either transferred into a surrogate mother, which then carries out the embryo until it is a grown baby that can be born his would be called reproductive cloning (Picture 2) or the blastocyst is destroyed and the created stem cells of this embryo can then be used to treat patients, such as close wounds; this process would be called therapeutic cloning (Textbox). The whole process is shown again on the picture below. (Sources: Wiki 2,3,4)

Reproductive cloning



In the therapeutic cloning, this blastocyst will be destroyed and the stem cells inside will be used to help patients using f.e. blood cells, muscle cells, skin cells, or any other cells the patient might need.

(Picture 2) Reproductive and therapeutic cloning

Interview

We were able to do an Interview with Martin Schrott, who's working in the scientific evaluation in BLV (Federal Office of Food Safety and Veterinary Services) Bern. He has a doctor degree in Natural science with diplomas in agriculture and Engineering.

However, the answers we've received are not the way we wanted them to be, because Martin Schrott was only able to answer with short responses, maybe due to stress at work. Also, the answers are not very informative, if they give any Information. We mailed him the 3.4.16 and got a respond on the 16.4.16.

Since we've received his answer so late, we were not able to find another Interview partner in the available time. We wrote a mail to the Department of Biosystems Science and Engineering, but we didn't get a response.

1. What is being tested in the EDI BLV in general?

We are not actively dealing with the issue of cloned animals in food production.

2. Do you often do experiments or studies on the topic cloning?

No, our mentioned report is the most recent activity in this area.

3. Will the cloning of farm animals be a thing in the upcoming few years here in Switzerland?

As far as we can tell, no; but certainly not for the cloning of farm animals for food production.

4. What are the dangers of cloning farm animals?

As we already mentioned, our report corresponds to our current knowledge.

5. Is the cloning of large animals such as cows, more difficult than the cloning of smaller animals like sheep?

We cannot answer this question. A research in the scientific literature of recent years (e.g. With Google Scholar) could help you here.

6. Has the legislation on food from cloned animals changed since your report: Food from cloned animals?

Currently, the legislation has not changed. The Food Law was revised by the Parliament (voted on 20th June, 2014); but it is not inured yet. According to this revised law, the Federal Council could, if necessary, adjust biotechnological procedures.

It should be noted that the EU is discussing on cloned animals in the food industry (ban the production in the EU, labeling of imported food). Switzerland pursues this discussion.

7. What ethical objections can be raised against the cloning of farm animals?

Primarily, the question of whether and how much the animals suffer, including malformations in the cloned animals. The low efficiency of the methods is also considered critical.

Pros/Contra

Pros

It has opened up the field of reprogramming of a nucleus genetic material, which is now being evaluated for human medicine.

The cloning has brought biology into the everyday life of the public, so the society is more informed, has more opinions and has more influence on how science is done and applied. Dolly the sheep has also shown what is possible with the technical mechanics.

Probably being able to resurrect extinct species in the near future. (Roslin)

Contra

If humans get cloned they don't possess an own identity and no unique body. Which is one of the most important ethical reasons, which are against cloning.

A big fear is, that human clones could be treated inhuman. There are a lot of movies, which are about cloning. One of them is "the island" where human clones are used as organ donors. (MDR)

Cloned animals have, in some cases, displayed growth defects. The growth defects are probably a result of the in vitro culture conditions and due to changes in chromatin in the nucleus but further research would be required to know exactly why it can happen. (Roslin)

It's not worth to clone animals to produce food out of them, because cloning is very expensive and is therefore mainly used for research. (EDI)

Ethical Aspects

In the discussion of ethical aspects there are different attitudes to look at.

Nature aspect:

Contra: The cloning of a human being, is a radical intervention in nature of human reproduction and is therefore often referred to as unnatural and therefore considered inadmissible.

Pro: Against this argument says that man as a cultural being has already intervened in Nature, so the argument of being unnatural is not completely correct.

Individual aspect:

Contra: The cloned human does not own, but only has a borrowed, copied or shared identity. The human is not made by natural selection. It could also be possible, that the clones are not treated like normal humans, but rather get abused like material.

Pro: A clone of someone does never look exactly the same like its donor organism. But more important is, that human individuality is not linked to the genetic constitution. The environment always has influences into the development of a human. Therefore the expectations of being able to the copy someone's identity is wrong. An infertile couple could have a clone baby which gets treated like their own child. (UniSt)

Progress made through cloning:

The major advance was to show that cells could be reprogrammed to function as a different cell type. This provided an important impetus for stem cell research, which now can be used in human medicine. The research of cloning provides vital information about how to change the function of a cell. Dolly the Sheep probably was the most famous cloned animal and it was cloned using Somatic Cell Nuclear Transfer. This is still the foremost method of today. (Source: Roslin)

The SCNT brings a lot of hope in the future of medicine. Even if the cloning of Animals or humans would never happen, the knowledge about SCNT opens up the field of medicine. In the future there could be a chance to heal humans from illnesses like Parkinson or multiple sclerosis. (MDR)

Current cloning projects

One of the big questions scientist are working on is, the possibility of resurrecting extinct species. The most well-known project that's worked on right now, is the one with mammoths. Scientist groups hope to extract functional cells from a frozen mammoth and use the genetic material in those cells, to begin cloning. In the northern Hemisphere a lot of carcasses of mammoths were found, which are in an extremely good condition. Scientist can find out how it lived and died and were even able to sequence most of its genome.

One team of scientist, which are trying to resurrect a mammoth since over a decade, is under the lead of Akira Iritani (picture 3). The team consists of Russian and Japanese scientists. They have tried to use tissue several frozen Siberian samples. Iritani himself told to reporters: "I think we have a reasonable chance of success and a healthy mammoth could be born in four or five years." (BBC)

Also a big question is the cloning of humans. The answer to this is pretty simple, because the science behind the idea is quite clear. With all research the practice is possible. There are scientists which were already able to clone human embryos. However they were not allowed to mature the embryos fully. So although the cloning of humans might be possible it won't happen, at least in the near future, mainly because of ethical reasons. (Medical)



(Picture 3) Project Mammoth leader

Professor Akira Iritani.

Summary

In short, cloning is a developing method in our near future and will be used to improve some aspects of our living on earth. There have been many steps to improve cloning and cloning may be the featured tool to stop endangered animals to die out and to resurrect already extinct animals such as mammoths or other animals. At the moment there are already benefits from cloning animals such as cattle, to gain better meat quality throughout many generations. Many experiments such as Dolly the sheep or other experiments with cows and pigs have shown that it is possible to clone big animals through SCNT (Somatic cell nuclear transfer). However, it may take many more years until there will be more experiments towards cloning humans, as many people find it unethical.

Sources

Wiki2: Author unknown, Date unknown, Cloning. <https://en.wikipedia.org/wiki/Cloning> [20.04.2016]

Rolsin: Author unknown (2015). Cloning. <http://www.roslin.ed.ac.uk/public-interest/cloning/> [26.4.16]

Wiki3: Author unknown (last revision 2016). Klonen. <https://de.wikipedia.org/wiki/Klonen> [26.04.16]

Wiki4: Author unknown (last revision 2016). Somatic cell nuclear transfer. https://en.wikipedia.org/wiki/Somatic_cell_nuclear_transfer [26.04.16]

Titlepic: Author unknown, Date unknown, Cloning Is Real. Celebrity Tells All. <http://www.secretsofthefed.com/cloning-is-real-celebrity-tells-all/> [25.04.2016]

Medical: Dovey, Dana (2015). The Science Of Human Cloning: How Far We've Come And How Far We're Capable Of Going. <http://www.medicaldaily.com/science-human-cloning-how-far-weve-come-and-how-far-were-capable-going-340006> [26.4.16]

EDI: EDI, 2007, Lebensmittel aus geklonten

Tieren? http://www.blv.admin.ch/themen/04678/04711/04732/index.html?lang=de&download=NHZLpZeg7t,Inp6l0NTU042l2Z6ln1acy4Zn4Z2qZpnO2Yuq2Z6gpJCFfXx7g2ym162epYbg2c_JjKbNoKSn6A-- [20.04.2016]

MRD: Author unknown (2016). Klonen von Stammzellen – Chance oder Gefahr? <http://www.mdr.de/nachrichten/klonen-klon-embryonale-stammzellen-haut-us-forscher100.html> [26.4.16]

Pic3: Macrae, Fiona (2011) Will the woolly mammoth be lumbering back? Japanese scientists 'to resurrect extinct giant from frozen DNA within five years'. <http://www.dailymail.co.uk/sciencetech/article-1348000/Woolly-mammoth-Japanese-scientists-resurrect-extinct-giant-fozen-DNA.html> [26.4.16]

Wiki1: Materials scientist (Wikipedia username), 2002, Dolly (sheep). [https://en.wikipedia.org/wiki/Dolly_\(sheep\)](https://en.wikipedia.org/wiki/Dolly_(sheep)) [24.04.2016]

Picture2: US Department of health and Human services (2009). Reproductive cloning. https://www.genome.gov/pages/education/illustration_of_cloning.htm [26.04.16]

UniSt: Wachlin, Klaus and Wochner, Michael (2002). Klonen Stand der Forschung, ethische Diskussion, rechtliche Aspekte. <http://elib.uni-stuttgart.de/bitstream/11682/8648/1/kiKlonen.pdf> [26.4.16]

Utah: Author unknown, Date unknown, What is Cloning?
<http://learn.genetics.utah.edu/content/cloning/whatiscloning/> [23.04.2016]

BBC: Yong, Ed (2012). Will we ever... clone a mammoth? <http://www.bbc.com/future/story/20120601-will-we-ever-clone-a-mammoth> [26.4.16]