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“MEAT” THE FUTURE

In-Vitro-Meat: meat cultured in the lab

By Samuel Angst & Nicolas Gisler

1. Preface:

In our culture the consumption of meat plays a very big role. In Switzerland the average meat consumption per person in one year is approximately 51.4 kg. This is, if you think about it, quite a large amount. However, the livestock beef production causes a lot of damage to our environment and will by 2050 no longer match our ever increasing demand for meat on this planet. So what could be a solution for this problem? Well what about meat that doesn't come from a living animal but was produced in the laboratory! This idea may sound very weird at first, but test tube grown meat is a phenomenon that already exists.
When we came across this topic we immediately noticed that it is a topic that we want to take a closer look at. It is very controversial and can be looked at from many different angles. Another reason why we chose this topic is because we wanted to find out more about the biological background of meat culturing and how this process works in terms of cells, genetics etc.
With our research we want to find out what the advantages and disadvantages of in vitro meat are and if it may really be found in our supermarkets one day as an alternative to meat coming from a slaughtered animal. The opinion of others also interested us. That's why we went to the streets and asked people about their opinion on cultivated meat and if they would buy it if it would be available. (chart of our results to be found later in this paper)

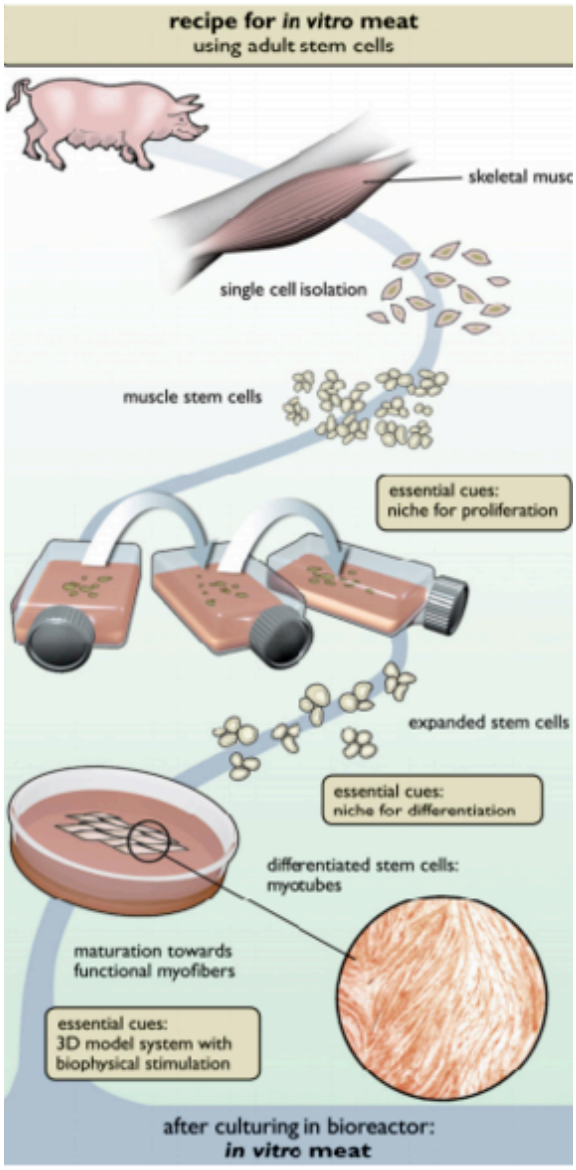
2. Introduction

The goal of in-vitro meat is to produce animal meat without actually needing a living animal. The term "In-Vitro" stands for a biological process which takes place outside of a living organism, for example in a petri dish. This way of manufacturing meat could have significant impacts on things like the environment, health, agriculture, economy and animal welfare.
The imagination of synthetic meat production has been around since quite a while actually. A famous quote underlining this fact came from Winston Churchill in 1931: "We shall escape the absurdity of growing a whole chicken in order to eat the breast or wing, by growing these parts separately under a suitable medium." (Churchill, 1931) In the last 10 years a lot of effort and money has been invested

in to research on synthetic meat. Governments all over the world show interest and support. In some cases even prize moneys we're offered for the scientists with the best results. This shows that the whole research on lab-grown meat is still quite new and is still in its development phase. The first ever lab-grown hamburger was publicly served in 2013.

3. Technique

The technique for making cultured meat is quite easy to understand. It is called "tissue engineering" which is an outgrowth of the field of biotechnology.



The first step in the production of in vitro meat is getting the starting cells that you need from an animal (for example a pig). This can be done with simple biopsy. Having done biopsy you then have to isolate the muscle stem cells, which are the starting cells for the test tube growing. This extraction process is very important because you have to separate usable muscle cells from fat cells. Fat cells are not wanted for starting the production, that is why you have to get rid of them.
Once you have the individual starting cells that you need, you have to first let them proliferate and then put the expanded stem cell in a container (for example a petri dish) that has a tiny layer of nutrient gel inside it. In this suspension medium the cell can multiply and form a muscle cell culture, which will then create muscle tissue after a certain amount of time. The connection of different muscle tissues with each other happens with connective tissue. The connection of all the tissue with each other will then lead to an actual piece of meat. The connection process can only take place with the help of a bioreactor.

A bioreactor exposes the tissue with different heats.
This is very important as it causes the cells to move around.
During the whole process collagen and elastin as well as fat cells are produced, which are important for the taste of the end product.

It is very important to mention that during the whole process, the genetic information present in the starting cell is not changed! There is no engineering of DNA taking place when it comes to in vitro meat!

4. Interview

It was quite difficult for us to find someone who was ready to do an interview with us. Because we couldn't find any experts living in the region, we started contacting people all over the globe via e-mail and hoped that somebody would contact us back.
In the end **Jamie Purfeerst** came back to us and was kind enough to answer the four questions we prepared. She didn't have the time to answer the questions in written form, but she gave us the opportunity to interview her via a phone call. We used the most important answers and statements she gave us to write the answers given below.
She is the senior associate editor of BEEF Magazine in the U.S. She's responsible for online and digital communications of BEEF Magazine and has been confronted with the topic of in vitro meat many times. She majored in agriculture communications at North Dakota State University (NDSU) and has a lot of experiences, especially in the beef industry. (Unfortunately she couldn't supply us with any pictures of labs or biological procedures of in vitro meat. That's why we unfortunately have no images of these things included in our paper.)

Questions & answers

There is obviously still a lot of research going on when it comes to synthetic meat that is eatable for humans. In your opinion, what is the main problem that has to be solved before we can find in vitro meat in our shops?
"The main problem in vitro meat is facing at the moment is the so called "ick"-factor. The "ick"-factor is when people are grossed out by the idea of synthesized meat. There's also other factors that have to be

solved, for example the high costs, before in vitro meat can be found in our shops. But the main problem is definitely the people's mindset."

How long do you think will it go until we can buy that sort of meat in our supermarkets? Is it realistic to think that this could be the case in the next couple of years?
"No. That is not realistic. It will take at least another 20 years before in vitro meat products will hit our markets. Even today there is still scientific struggles with producing big pieces of meat, for example a steak. And even if mass production of in vitro meat would already exist, the products would have no chance on the market competing against regular meat products.

Genetically seen there is not a big difference between the meat coming from a cow or the meat synthesized in a laboratory. Is that really the case?
"The base of cultured meat is the stem cell coming directly from the animal. During the tissue engineering process the genetic information of the stem cell is not changed, so yes, genetically seen it's the same. However, there is other biological differences off course. One of the most important ones that I would like to mention quickly is, that in vitro meat doesn't contain any blood. In animals, the blood carries the most important nutrients. With in vitro meat, the nutrients have to be applied through other mechanisms.

Could in vitro meat be the solution for the ever increasing human demand for meat?
"In vitro meat would definitely has the potential to solve that problem. If mass production of synthesized meat would begin, it would change the whole agriculture system of today's world. But if we really want this to happen, then there is still many hurdles to be jumped and a lot of money and time to be invested. Nobody can look in to the future. We will have to wait and see if lab meat will really make a change. At the moment, nobody can tell a 100%."

Thanks a lot for this great interview and for taking time Ms Purfeerst!
"You are welcome! I wish you good luck with your paper!"

5. Discussion

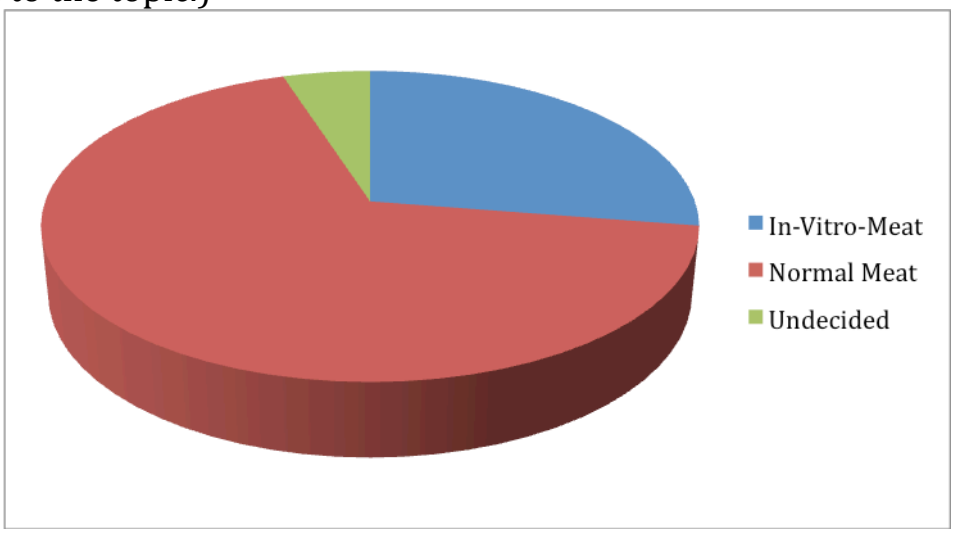
As said before, in vitro meat can be very controversial, especially the ethical aspects of the topic cause a lot of discussions and debates.
In vitro meat is still relatively unknown to a lot of people because we don't really get confronted with the topic quite yet. In a few years time though, we might be very confronted with it.
The big breakthrough of synthetic meat hasn't taken place yet and there is still a long path in front for this breakthrough to happen.
One of the biggest problems is an economic one. At the moment the prices for the production are way too high for the product to become commercially available. The production costs for the first ever in vitro burger in 2013 were $325'000, which is obviously extremely high for just one burger patty. For the production costs to sink, the technology has to be upgraded. For the technology to be upgraded though, enormous capital investments are required coming either from the government or from private donors. It is normal that costs for new technologies are high at first, but it is very likely that the prices will sink after a certain amount of time. All in all it would potentially be cheaper to produce in vitro than the regular way.
If our world really wants in vitro meat to make a change in the current agriculture or even wants to end meat production with livestock, then investments for further research and development are key. For an in-vitro-meat-market to develop, it is also very important that the public knows about the potential benefits of it. It is a fact that the current way of producing meat is one of the largest contributors to environmental damage and is one of the greatest problems our world is faced with at the moment. It is said that cows emit more greenhouse gases in to the atmosphere than all cars, airplanes & other transport methods combined. This is very unsustainable obviously and in vitro meat could potentially be a solution, as it barely produces any waste.

With in vitro meat you would no longer need to "grow" a whole animal but only the muscle. Therefore the huge food input that is needed to feed livestock wouldn't be needed anymore. You only need enough nutrients and calories to supply the muscle.
Also, the amount of land that is used for production would be much smaller and you could even think about making in vitro meat in skyscrapers or other big buildings.

As a result of this new technology of making meat loads of farmers would lose their job, which would be a disadvantage.

Another aspect is, that these days a lot of people are concerned about the wellbeing of animals and the way that they are held in farms. With "test tube meat" the problem of suffering animals would no longer exist. A lot of people would probably be very happy about that. Another very interesting thought is: If in vitro meat could be found in our supermarkets, would there be any vegetarians left on this planet? This question can't be answered unfortunately as nobody can look in to the future.

As we were also interested in what other people think about in vitro meat, we went to the streets of Basel and asked people the following question: **If you could decide between normal meat and in vitro meat, what would you rather buy?**
(If people didn't know what in vitro meat is, we quickly introduced them to the topic.)



We asked this question to **40** people. Out of these 40 people **70%** gave us the answer that they would rather buy normal meat.
This result shows us that the idea of in vitro meat hasn't quite yet reached the public the way it should and that a lot of people don't realize the huge advantages that would come with it.
Some of the people we asked said things like: *"That's not real meat." "It wouldn't taste as good." "I don't want to eat something that was made in a test tube. That's gross."*
The mentality of us people is one of the biggest hurdles for synthesized meat, as a lot of people will be opposed by the thought of eating something coming out of a petri dish. It will take a lot of time

and effort to change this human mentality. A meat-eater isn't easy to "convert".

6. Summary

In vitro meat is the synthesizing of meat through a technique called tissue engineering. The DNA is not changed during this process.
In theory, in vitro meat production is unlimited and could be the solution for meeting the global demand for meat. This would also contribute to stopping world hunger.
All in all the advantages outweigh the disadvantages. The world has to acknowledge this fact and has to try to change their mindset on the topic.

We as a group definitely think, that one day we will "meat" the future in our shops!

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