

Description of 'in vitro meat' project

Mark Post, Professor of Vascular Physiology and Tissue Engineering at Maastricht University (Faculty of Health, Medicine and Life Sciences) is creating edible meat from stem cells ('in vitro meat'). In October 2011 he launched a new project with the aim of producing an edible hamburger.

The project is a continuation of a 2004 study funded by the Dutch government to the amount of 2 million euros. The study, initiated by mr. W. Van Eelen, was implemented by a consortium of three universities (UvA, UU and TU/e) and an industry representative (Meester Stegeman BV). The University of Amsterdam primarily focused on the development of efficient growth media, while the University of Utrecht focused on the isolation of stem cells and their proliferation in muscle cells. Post (then a part-time professor at the Eindhoven University of Technology) and his research team developed a method to 'train' the muscle cells (in terms of size, not number) through electrical stimulation. The study was finalised in 2009 with tangible results: the researchers were able to cultivate 8x22 mm pieces of meat of 0.5 mm thickness from the muscle stem cells of mice, consisting of millions of cells.

There are several crucial steps in the development of 'cultured meat':

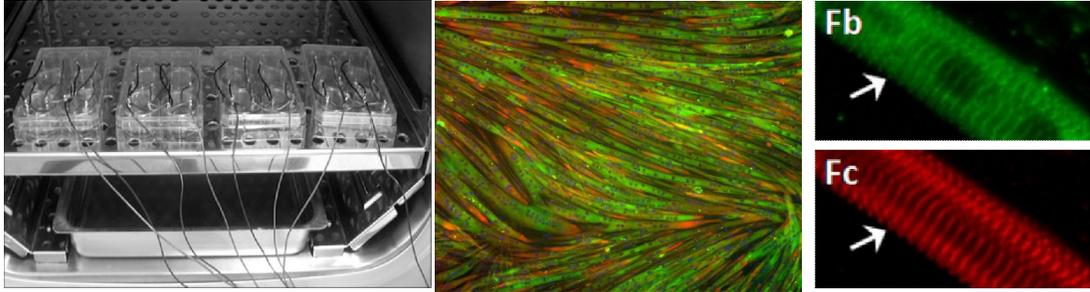
- The first step is to extract muscle stem cells from animals, usually cows, pigs or chickens. This project uses stem cells obtained from little pieces of fresh cow muscle for instance obtained through biopsy.
- The cells must then multiply, which requires a growth medium. This project uses/experiments with commercially available media, supplemented with calf serum. In the next stage, researchers at the University of Amsterdam work with synthetic mediums or simple and efficient nutrient sources such as algae extracts.
- The isolated stem cells must then develop into muscle cells. Because the stem cells are designated muscle precursor cells this process largely happens automatically.
- As with natural muscle cells, the cultivated muscle cells 'bulk up' into solid muscle fibres/bundles. To do so, they are affixed to a soluble polymeric sugar scaffold and trained by building tension between two anchor points in the bioreactor. This also largely occurs spontaneously.
- As soon as the muscle cells grow in size, it is important that the tissue is continuously supplied with nutrients. For the small, newly formed muscle strands, regularly changing the culture medium suffices. Creating larger slices of meat, however, requires the creation of soluble polymer (sugar chain) duct systems through which a medium can flow, similar to the way blood flows through our veins.
- To make the tissue edible, taste and texture must be just right. This should be achieved by recreating the natural consistency of meat (in terms of protein composition, fat tissue, etc.). If this does not produce the desired result, accepted food technology methods are used to improve the taste and texture of the meat.
- At the end of this process, the final result is edible muscle tissue that can be ground to create minced meat and, ultimately, a tasty hamburger!

Researchers are currently working on enhancing production using existing techniques. Two new projects will soon be launched to cultivate fat tissue and enhance the expression of myoglobin in meat (the oxygen-binding protein found in muscle tissue).

The 'in vitro meat project' team consists of professor Mark Post and two technicians. The project is fully financed by private funds to realize the first lab-grown hamburger.



3 culture dishes, each with a strip of muscle anchored between pentagonal anchors made of Velcro



Electrical stimulation of muscle cells (left panel) matures early muscle cells (middle panel) into mature skeletal muscle which shows typical transverse striations (right panel, arrows) based on abundance of contractile protein units.