What if we didn't need cows for our beef?

With the help of cells from a single cow, scientists can produce 175 million hamburgers. When fully commercialised, this type of technology could greatly impact the way we produce and consume meat.

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Today, meat is produced in an inefficient way. A whole living, breathing, feeling, moving animal is grown and only a fraction of the energy given through food is recovered in edible body parts. From an evolutionary point of view, the animal is intent on reproduction, not meat production. Scientists are working to avoid this detour in order to increase efficiency and improve animal welfare. The idea is to grow the meat directly in a petri dish or bio-reactor.

Scientists start by taking special cells from the animal of interest, suspend them in an adequate growth medium in which they can divide and grow, and provide a scaffold to which the cells can attach and the cell culture can take structure. The type of starter cells is important because they determine on the one hand how fast the cells divide, and on the other hand how similar they are to a muscle cell, which is what meat mainly consists of. Stem cells divide rapidly but must be induced to differentiate into muscle cells, whereas muscle cells are already differentiated but hardly proliferate at all. The solution is to start with 'in-between' cell types such as myoblasts, which are acceptable on both fronts. These starter cells can be extracted from animals painlessly. The growth medium needs to contain all nutrients the myoblast cells require to grow, while being cost-effective and without animal ingredients. So far, scientists use foetal calf serum for research purposes only, and are still investigating ethical substitutes to be used for commercial purposes. The scaffold needs to be edible and flexible enough to move and provide the muscle cells with periodic contractions, providing a 'workout' of sorts. Alginate, chitosan or collagen derived from non-animal sources fulfil these requirements, periodically stretching under changes in temperature and acidity. Globally, several companies have plans to enter the market (Finless Foods, Mosa Meats, Memphis Meats). The first cultured meat products are expected to appear in supermarkets as early as 2021.

A joint Oxford and Amsterdam University study shows that, compared to conventional meat, the environmental impact of cultured meat is potentially very small, with 'up to 96 % lower greenhouse gas emissions, 45 % less energy, 99 % lower land use, and 96 % lower water use'. Taking into account that the Food and Agriculture Organization of the United Nations (FAO) estimates global meat demand will increase by 73 % by 2050, and that livestock farming is responsible for 18 % of all greenhouse emissions, 30 % of land use, and 8 % of water use, efficiency increases could be crucial for achieving sustainable meat production.

Potential impacts and developments

The obstacle to rolling out cultured meat production is the price – in 2008, it was speculated that 250 grammes would cost about US$1 million. However, this cost is rapidly decreasing. In 2015, Mark Post,

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Lead Researcher at Maastricht University, said the marginal cost could fall to about €8 for one burger. When the technology of large-scale production in bioreactors is mature, prices should decline even further. It is estimated that such burgers could eventually be produced for €3 500 euro per tonne, which is around 1.5 times the current cost of conventional European beef production.

Additional advantages of cultured meat include the possibility of adding nutritional value, omega-3 fatty acids for example, less exposure to pathogens and chemicals such as pesticides, and reduced use of antibiotics. This latter point is important, considering that 70 % of all antibiotics are used in agriculture, which causes antibiotic resistance in human pathogens.

While cultured meat can be used for making processed meat products such as sausages, burgers and nuggets, creating meats with a lot of structure, such as steak, is not yet in sight. In order to acquire the appearance, taste, smell and texture, cultured meat must consist of both small and large muscle fibres with connective tissue and fat cells. This will to a large extent determine whether cultured meat is commercially viable. On the other hand, the possibility of engineering meat for optimal nutrition, or even customisation on an individual basis, may prove to be a large advantage – especially considering that the consumption of processed meat is linked to heart disease, digestive tract cancer, and type-2 diabetes.

The artificiality of cultured meat, as well as the high price, is certain to deter some consumers. But it is conceivable that lower prices and consumer environmental and health concerns could arguably eventually win out. A market for high-quality animal meat that is difficult to culture will probably be around for longer. Religious dietary restrictions will also determine the popularity of cultured meat in large parts of the world: religious scholars continue to disagree on whether it is kosher, halal, or violates the position of cows in Hindu culture.

If cultured meats were to take over the market, general tolerance for animal suffering might decrease, and any suffering might be seen as unnecessary, even to meat-eaters.

It is likely that, if cultured meat were to become the future standard, dairy and egg prices would increase, because the meat produced as a by-product would be less profitable. However, substitutes are also being researched for all these products; in the future, cultured dairy and eggs could be more cost-effective and cheaper.

Anticipatory policy-making

Once cultured meat companies wish to enter the EU market, they will have to comply with the Novel Food Regulation. This defines novel foods as those that had not been consumed to a significant degree by humans in the EU before 15 May 1997, and lays down that novel foods must undergo pre-market authorisation evaluating the food as safe for consumers, that their consumption is not nutritionally disadvantageous, and that they are properly labelled, so as not to mislead consumers. The labelling of cultured meat therefore also needs to be investigated, as well as the question as to whether cultured meat can be considered 'meat' according to the EU definition of meat as 'edible parts of the animals [...], including blood'.

Finally, cultured meat will inevitably have an impact on the meat market, with consequences for conventional meat producers. However, as even conventional farming increasingly involves the use of new technologies, some farmers might be able to reorient their businesses to also incorporate this type of food production. To apply this new technology for the production of cultured meat, guidelines for best practices in its production and the processing will certainly be required.