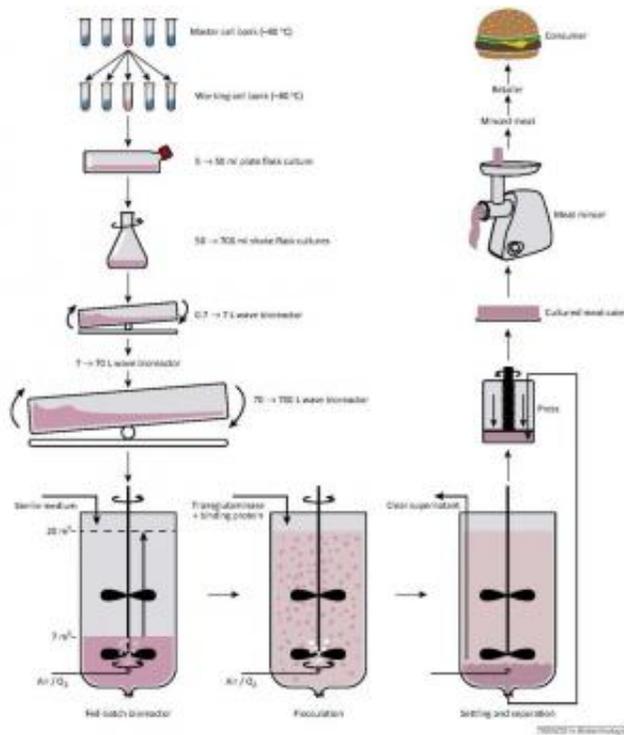


Stem cells as a future source for eco-friendly meat

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The left column shows the stepwise increase in cell-culture volume, starting with a vial from the working cell bank (note that a new working cell bank is made from a vial from the master cell bank). Exponentially growing cells from each step serve, after growing to a certain cell density, as the inoculum of the next culture vessel, which is an order of magnitude larger. The final bioreactor starts only partially filled and is fed with sterile medium at such a rate that the cells grow further under optimal conditions. When the bioreactor is full and the desired cell density is reached, the protein-crosslinking enzyme transglutaminase and binding protein are added to induce the formation of easily settling aggregates of cells, which quickly settle when stirring is stopped (bottom right). The harvested cells are pressed and the cake is extruded into retailer- and/or

consumer-size portions of minced meat (right column). Credit: Trends in Biotechnology, van der Weele et al.

The scientific progress that has made it possible to dream of a future in which faulty organs could be regrown from stem cells also holds potential as an ethical and greener source for meat. So say scientists who suggest in the Cell Press journal *Trends in Biotechnology* that every town or village could one day have its very own small-scale, cultured meat factory.

"We believe that cultured [meat](#) is part of the future," said Cor van der Weele of Wageningen University in The Netherlands. "Other parts of the future are partly substituting meat with vegetarian products, keeping fewer animals in better circumstances, perhaps eating insects, etc. This discussion is certainly part of the future in that it is part of the search for a 'protein transition.' It is highly effective in stimulating a growing awareness and discussion of the problems of [meat production](#) and consumption."

van der Weele and coauthor Johannes Tramper point out that the rising demand for meat around the world is unsustainable in terms of environmental pollution and energy consumption, not to mention the animal suffering associated with factory farming.

van der Weele said she first heard about cultured meat in 2004, when frog steaks were served at a French museum while the donor frog watched on (<http://tcaproject.org/projects/victimless/cuisine>). Tramper has studied the cultivation of [animal cells](#)—insect cells mostly—in the lab for almost 30 years. In 2007, he published a paper suggesting that [insect cells](#) might be useful as a food source.

It is already possible to make meat from [stem cells](#). To prove it, Mark Post, a professor of tissue engineering at Maastricht University, The Netherlands, presented the first lab-grown hamburger in 2013.

In the new *Science & Society* paper, van der Weele and Tramper outline a potential meat manufacturing process, starting with a vial of cells taken from a cell bank and ending with a pressed cake of minced meat. But there will be challenges when it comes to maintaining a continuous stem cell line and producing [cultured meat](#) that's cheaper than meat obtained in the usual way. Most likely, the price of "normal" meat would first have to rise considerably.

Still, the promise is too great to ignore.

"Cultured meat has great moral promise," write van der Weele and Tramper. "Worries about its unnaturalness might be met through small-scale production methods that allow close contact with cell-donor animals, thereby reversing feelings of alienation. From a technological perspective, 'village-scale' production is also a promising option."

More information: *Trends in Biotechnology*, van der Weele et al.:
"Cultured meat: every village its own factory?"

Provided by Cell Press

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