A conversation with Steve Oh, October 7, 2015

Participants

- Steve Oh, Ph.D. – Principal Scientist, Bioprocessing Technology Institute
- Lily Kim, Ph.D. – Scientific Advisor, Open Philanthropy Project

Note: These notes were compiled by the Open Philanthropy Project and give an overview of the major points made by Dr. Oh.

Summary

The Open Philanthropy Project spoke with Dr. Oh as part of its investigation into animal product alternatives, specifically on in vitro culture of meat. The conversation focused on approaches to decreasing the cost of animal-free media and whether it would be feasible to decrease costs to around $1/L.

Feasibility of drastically reducing costs of animal-free media

Growing cells in a laboratory requires a media that contains everything the cells need to grow. The most commonly used media contains fetal bovine serum, which is a product of fetal calves.

Currently, a major cost of animal-free media is the cytokines (cell-signaling molecules) that encourage cell proliferation.

Dr. Oh is aware of two kinds of approaches to reducing the cost of cytokines:

1. **Finding small molecule replacements for cytokines.** While inexpensive small molecule replacements for a few cytokines (such as BMP4) have been discovered, it has proven challenging to find replacements for others (such as bFGF). Essentially all cell cultures need bFGF to grow. In Dr. Oh's lab, researchers grow embryonic stem cells and then find small molecules that induce them to become particular types of muscle cells. But once the stem cells are differentiated, they are unable to produce any additional cells without bFGF. At sufficient densities, these cells may be able to produce their own cytokines, but Dr. Oh has not investigated this possibility.
2. **Engineering host organisms that produce cytokines through synthetic biology.** This approach could involve using bioengineering techniques to put genes for cytokines into host cells, producing cytokines from the host cells, and then extracting the cytokines from the cell culture. A potential challenge with this approach is that some growth factors (e.g. VEGF) need glycosylation to work, and it may be hard to produce such growth factors using fermentation. Dr. Oh does not know of a host organism that could produce all the necessary growth factors.

In Dr. Oh's opinion, it is very unlikely that these approaches would succeed in decreasing the cost of animal-free media below $1/L. Dr. Oh also feels one of the biggest hurdles to advancing cultured meat would be the technical challenge of making a product that tastes good.

Scaffolding for cultured meat

To produce cultured meat, muscle cells must grow on a "scaffold" that provides a structure against which the muscle tissue can contract.

This may represent another substantial cost, particularly if the scaffolding is collagen-based. One approach to reducing cost might be to grow cultured meat on edible, animal-free scaffolding.

Researchers developing cultured meat will likely also need to experiment with different ways of packing cells onto scaffolds in order to find approaches that produce a desirable texture for consumers.

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