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INTERN RESOURCE: Cellular agriculture at a glance

Author:

OPMCSA - Intern - Olivia Ogilvie

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The following is a high-level overview of cellular agriculture. These topics are discussed in more depth within articles found on the Cellular Agriculture Resource Page.

What is cellular agriculture?

Cellular agriculture is an alternative farming method for products like meat, milk, eggs and raw ingredients. It differs from existing agricultural practices because it uses isolated cells rather than animals to produce food. There are two classes of cellular agriculture, both of which involve the culturing or growing of cells under controlled conditions. The first is acellular agriculture. Acellular goods do not contain cells within the final consumer product, but instead contain proteins, fats or flavour compounds that have been isolated from cultured cells. Examples of acellular agricultural products include milk, eggs, and vanilla. The second class is cell-based products; these contain cultured animal cells. Examples of cell-based products include meat-based foods like patties, sausages and steak. Food produced using cellular agriculture contains authentic animal proteins and cells. Because of this, these products fundamentally differ from those made using only plant-proteins, another emerging class of alternative protein.

Can I buy cellular agriculture products in the supermarket?

The availability of products produced using cellular agriculture depends on where you live. The technology is in its infancy stages of development. There are no products available within New Zealand and only two overseas. The first is an ice-cream that contains milk proteins produced using acellular agriculture. Perfect Day Foods and Brave Robot manufacture this ice cream which is only available in the US and online. The second product is a chicken nugget that contains plant-protein and chicken cells produced using cellular agriculture. JUST Meat makes this cell-based product which is currently available in one Singapore restaurant. Despite this, the technology is developing rapidly. Each week cellular agriculture start-ups announce significant technical and commercial milestones.

What are the perceived benefits of cellular agriculture?

Because cellular agriculture is still under development, we cannot thoroughly verify its benefits. Current predictions are based on models which compare the potential efficiency of this technology against animal farming systems. Notably for New Zealand, the current models compare the efficiency of cellular agriculture against feedlots and farming practices from the USA and Europe.

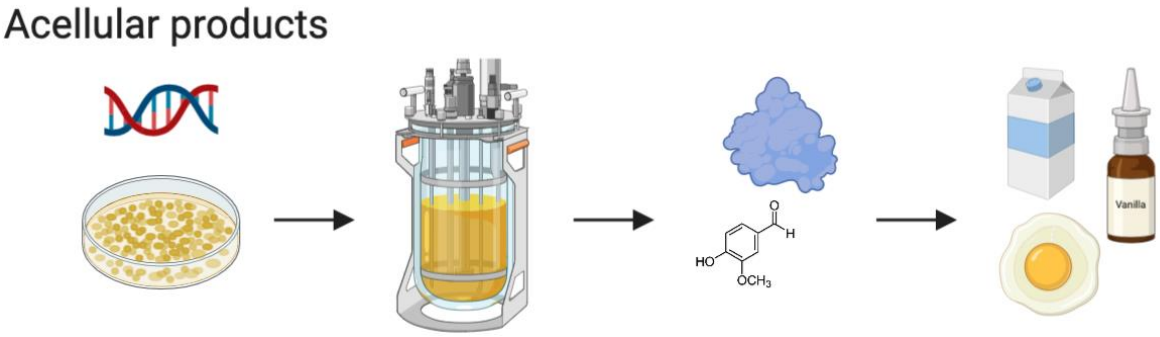
Some notable benefits include the ability of cellular agriculture to reduce our reliance on animals, improve animal welfare and reduce the effects of animal agriculture on the environment. Undoubtedly solving the current climate crisis while feeding the projected global population over the next 30-100 years requires innovation throughout the value chain. Cellular agriculture is just one example of how innovation may be introduced. The possible environmental benefits include decreasing land-use, water use and greenhouse gas emissions. The degree of these environmental benefits is significant, with estimates ranging

Dr. Olivia Ogilvie
The University of Canterbury

between 50 and 90%; this will be dependent on the power source for cellular agricultural plants (renewable energy). Other notable benefits include reducing the degree of antibiotic use and the chance of future zoonosis events like COVID-19.

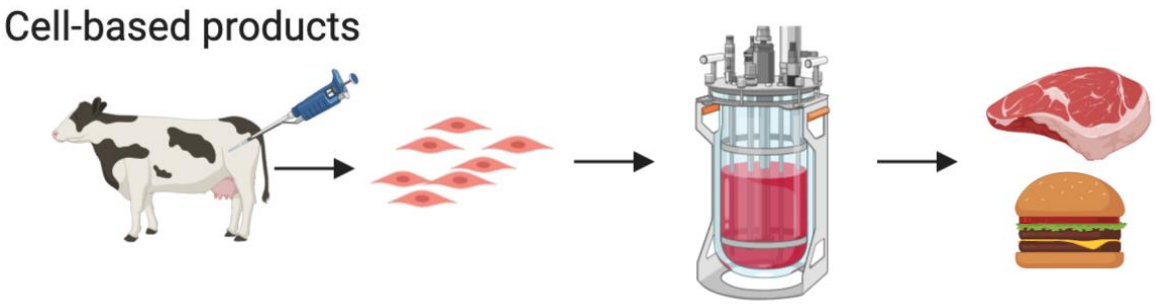
Cellular agriculture production processes in more depth

The processes used to produce acellular and cell-based products are significantly different. Acellular agriculture uses an established technique called recombinant protein expression. Recombinant protein expression is the process of hijacking (typically) bacteria or yeast cells to produce a target molecule, such as a milk protein. To hijack the cell, the DNA corresponding to the molecule is selected and added to the genetic make-up of the bacteria/yeast. The micro-organisms are then cultured, producing many copies of the target molecule which is isolated and purified from the micro-organisms then used to formulate a product. Recombinant protein expression has been used since the late-1970's to produce food ingredients, medicines and vaccines. The novelty of applying this process in cellular agriculture is the large-scale application of the technology.



Cell-based products are produced using an established technique called tissue-engineering. Tissue-engineering involves the culturing and control of animal cells using cell culture and can be used to create different end-products, such as organs and tissues (muscle). During tissue-engineering, cells are isolated from animal tissue, then feed specific nutrient mixes under controlled conditions. The most common cell type used to produce cell-based products are muscle-derived cells called myocytes. Cell culture is a well-established process in research laboratories around the world and is commonly used to study the efficacy of drugs and model disease development.

Dr. Olivia Ogilvie
The University of Canterbury



Are foods produced using cellular agriculture genetically modified?

There are different possible production processes for cellular agriculture, some use genetic modification while others don't. The production of acellular products involves genetic modification of yeast/bacterial cells; however, the target molecule is not genetically modified. Some of the production processes for cell-based meat involves genetic modification, while others don't. Both available cellular agriculture food products (ice-cream and chicken nugget) are not genetically modified.

Dr. Olivia Ogilvie
The University of Canterbury