



# The Economics of Cellular Agriculture

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## What Is the Issue?

Meat, seafood, milk, eggs, and other animal products are a significant source of protein in the diets of U.S. consumers and the foundation of important revenue streams for U.S. farmers, the food processing sector, and other food businesses. However, some consumers in the United States and abroad are increasingly purchasing alternatives to conventional animal-sourced foods that involve minimal or no use of animals. These dietary changes have been partly facilitated by the increased availability and variety of plant-based substitutes for animal products, such as soy patties as an alternative for hamburger meat and nut-based dairy alternatives.

However, a set of novel technologies allows animal products to be made largely without livestock that are biologically similar (either at the cellular or protein-based level) to their conventional counterparts. Cell-cultured meats and seafood are created by using a sample of animal cells without the need for animal slaughter. Precision fermentation can be used to produce conventional proteins and fats by encoding genetic material into an organism like yeast or bacteria. Although the sector is in its infancy, investments in cell-cultured and precision-fermented food companies have increased substantially. USDA's Food Safety and Inspection Service (FSIS) and the U.S. Food and Drug Administration (FDA) have implemented processes to ensure the safety of these foods. To date, little has been written about the economics of cellular agriculture. This report fills that void by providing an overview of the policy-relevant economic dimensions of this sector, detailing market drivers, current industry structure, government regulation and investment, and market challenges.



## What Did the Study Find?

While having similar end-product goals, the production process is significantly different between cell-cultured and precision fermentation-based technologies.

- Precision fermentation uses bioengineering techniques by using genetically engineered microbes as a platform to express specific products, such as proteins and fats, that are molecularly similar to animal products.
- Cellular-cultured food production relies on animal cells as a starting point. These cells divide, form cell lines, and progress through a series of bioreactors to continue multiplying until they are harvested and further developed into a final meat product.

ERS is a primary source of economic research and analysis from the U.S. Department of Agriculture, providing timely information on economic and policy issues related to agriculture, food, the environment, and rural America.

There are at least four major drivers of the cellular agriculture industry: consumer concerns surrounding environmental considerations, animal welfare, public health and food safety, and food access.

Investments, firms, and patented methods and products have increased substantially in recent years.

- Between 2015 and 2023, cumulative invested capital in cell-cultured meat and seafood reached \$3.1 billion. During the same period, invested capital in precision fermentation reached \$2.1 billion.
- As of 2023, more than 200 companies had major commercial interest in cellular agriculture.
- As of 2024, more than 100 patents had been filed in this sector.

Federal regulatory changes and Federal funding, in addition to the actions of foreign governments, are accommodating growth in the sector.

- Under the current U.S. regulatory framework, the FDA conducts a voluntary scientific and regulatory consultation for companies producing cultured animal cell foods for human consumption and oversees all food facilities culturing animal cells. At harvest, oversight of foods comprised of cell-cultured livestock, poultry, and/or certain types of fish is transferred to USDA, FSIS, which regulates and inspects facilities under its purview.
- Foods produced using precision fermentation are regulated exclusively by the FDA.
- The authors' analysis of comments to a USDA, FSIS-issued Advance Notice of Proposed Rulemaking (ANPR) suggests that 83 percent of respondents believed cellular meat and poultry should be labeled differently from their conventional counterparts. The most suggested phrase by respondents for labels of foods containing cultured animal cells was "lab-raised." To date, several Government agencies have provided several million dollars in research funding.

Multiple market challenges are currently limiting product commercialization and production at scale.

- Life-cycle analyses suggest a wide range of minimum per-unit production costs of cell-cultured products.
- Economic evidence indicates a range of consumer attitudes about these products. While some consumers have negative perceptions related to naturalness, others view the animal welfare dimensions positively.
- The extent of the products' environmental impacts and their effects on consumer demand remain to be seen.

## **How Was the Study Conducted?**

The authors analyzed data from four sources: (1) literature reviews, (2) the Good Food Institute, (3) the U.S. Patent and Trademark Office via Google Patents, and (4) Federal regulatory websites. The examination of technological capacities/functioning and market determinants drew on a review and synthesis of multiple studies. Information about private investment, number of firms, and animal product analogs were from the Good Food Institute, corroborated with publicly available data where possible. Annual patent counts and their composition were taken from Google Patents. Regulatory information comes from Federal agency websites, and analysis of comments to the ANPR relied on public data related to the Federal Register notice. The analysis of these comments involved assessment of their intents and meanings, assignment to categories, and regression analysis.