

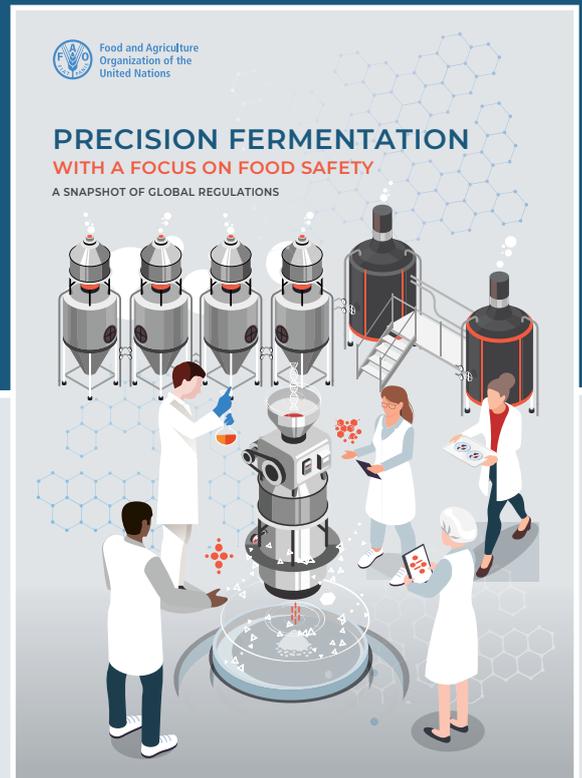


Food and Agriculture
Organization of the
United Nations

PRECISION FERMENTATION BEYOND THE BUZZWORD FOOD SAFETY Q&A

In March 2025, the Food and Agriculture Organization of the United Nations (FAO) published a technical document entitled “Precision fermentation – With a focus on food safety”. As several new technologies may have a potential to transform how food is produced, the term “precision fermentation” has gained visibility across scientific, industry, and policy circles. But is precision fermentation just a buzzword? Or does it reflect a meaningful shift in food innovation? This factsheet unpacks what precision fermentation really means, how it works, and what it takes to ensure its safety.

Through the questions and answers, let us explore possible food safety issues, highlight global regulatory trends, and clarify why understanding the precision fermentation process is key to making informed decisions about the future of food.



**Precision fermentation
with a focus on food safety**

<https://doi.org/10.4060/cd4448en>

1. What is precision fermentation?

“Precision fermentation” typically refers to the use of microbial hosts to produce, through fermentation, organic substrates into food items. While the term may be relatively new, many pointed out that technology itself has been around for decades. Despite this, as of May 2025, no country has established an official or legal definition of precision fermentation. An interesting regulatory example of developing the categorical definition of a precision fermentation derived food product is presented on [Page 5 of the full report](#).

Case study – definition issues

For example, if regulators integrate the concept of genetic modification of the host microorganism, as a component of its definition, it may result in having two different regulatory approaches to nearly identical products:

- Enhanced production of xylanase, an enzyme with various applications in the food industry, by introducing additional gene copies in the native host microorganism *Trichoderma reesei*.
- Production of xylanase from *Trichoderma reesei* in the non-native host microorganism *Bacillus subtilis*.

Policymakers may wish to take this aspect into consideration when developing definitions. More information about nomenclature issues is available in [Chapter 3 of the full report](#), which illustrates the diversity in terminologies and definitions found and used in various sectors.



2. How does the production process work?

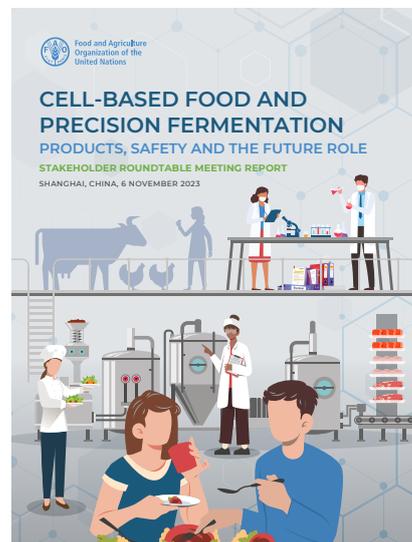
Food items that can be produced through precision fermentation vary widely. They include, for example, “milk” proteins such as whey and casein, egg white protein, collagen and gelatin, myoglobin which can be used for meat flavouring/colouring agent, cheese-making enzymes, fats/oils, vitamins and specialty carbohydrates and fibres like human-identical milk oligosaccharides (HiMOs).

On [Page 20 of the full report](#), FAO has identified three production phases in a generic production process (see the figure below under the question 3). They are 1) technology development, 2) upstream fermentation, and 3) downstream processing. These phases fit to describe many precision fermentation production processes.

Here are some examples:

- “Milk” proteins: Yeast, fungi or microalgae can be used as a host and cultivated in a bioreactor, a large fermentation tank, with nutrients. During fermentation, the host microbes express desired “milk” proteins.
- HiMOs (identical to the sugar in breast milk): Using bacteria such as *Escherichia coli* (most strains are harmless) or *Bacillus subtilis*, cultivation can be done in a bioreactor with a sugar-rich medium. The bacteria express a set of enzymes that can construct HiMOs. Products usually go through an isolation / purification process to be used as a food product.
- LegH, the hemoglobin of leguminous plants, is used to enhance flavor of plant-based meat alternatives. After fermentation, the yeast cells are broken open to recover LegH, which is an intracellular product.

There are more specific examples with flowcharts in [Chapter 4 of the full report](#). Additional precision fermentation production processes are also illustrated on Pages 3-6 of the “[Cell-based food and precision fermentation – Products, safety and the future role](#)” stakeholder roundtable meeting report.

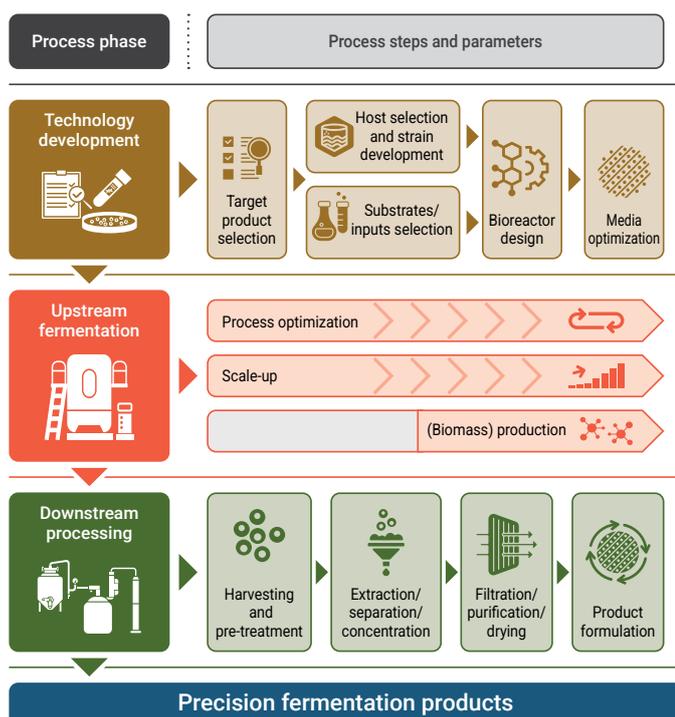


Cell-based food and precision fermentation: Products, safety and the future role

<https://doi.org/10.4060/cd0311en>

3. How can food safety be assured?

Generic production process in precision fermentation



Source: Sturme, M., van der Berg J.P., and Kleter, G., 2025. *Precision fermentation – With a focus on food safety*. Rome, FAO.

The [FAO report](#) found that the majority of the food safety hazards identified in precision fermentation production process are similar to those in conventional food production. Therefore, to assess product safety, a focus can be put on the inputs materials and equipment that can be new in the production steps. [Chapter 5 of the full report](#), 34 countries and a jurisdiction shared the status (as of July 2024) of the regulatory requirements for foods derived from precision fermentation, and many reported that existing regulatory frameworks are sufficient to address food safety issues related to precision fermentation.

Some jurisdictions require a pre-market approval with a food safety assessment for commercializing precision fermentation-derived food products. Among them, many regulatory experts and precision fermentation producers have identified that pre-submission consultations between applicants and regulators have been valuable for both parties and thus recognized as good practice. To ensure operational food safety, many experts pointed out that some of the key food safety tools, such as good practices and Hazard Analysis and Critical Control Points (HACCP), are suitable and effectively applied for various precision fermentation production processes.

4. How are foods derived from precision fermentation regulated across countries?

Among the 34 countries and a jurisdiction that provided a written summary of their regulatory frameworks, 16 have precision fermentation-derived food products on the market. When asked about regulatory categorization of the products, all reported that the final food category depends on the intended use - ingredients and/or additives. 18 reported that precision fermentation product developers would require pre-market approvals which involve food safety assessments. For countries that require food safety dossiers to be submitted for approval, making specific food safety assessment guidelines has been found to be useful and time-saving. There is an overview table for the regulatory snapshot available on [Pages 27-28 of the full report](#).



5. I work at a food safety authority. What actions can I consider taking to start working on this topic?



1. Review your country's existing regulatory framework to assess whether it adequately covers foods derived from precision fermentation.

2. Facilitate open dialogues with developers and producers using precision fermentation to identify current and upcoming products in your market.

3. Engage subject-matter experts (e.g. from universities, research institutions, or scientific bodies) to better understand scientific elements of precision fermentation.

4. Read the full FAO publication "[Precision fermentation – With a focus on food safety](#)" to gain a comprehensive understanding of the topic and learn from other countries' experiences.