

Plant Molecular Farming for Food Proteins

Plant molecular farming (PMF) uses plants as “factories” to produce proteins or other valuable molecules, such as milk proteins, enzymes or vaccines.

Unlike conventional farming, these plants are genetically engineered to produce specific proteins directly within their tissues, which can then be harvested and used in food or healthcare applications.

In the context of food, this approach can help produce high-quality, functional proteins that contribute to nutritional diversity – for example, creating plant-derived proteins with amino acid profiles similar to animal proteins or enriched with essential nutrients.

Plant molecular farming (PMF) technology offers a method that can reduce the environmental footprint associated with animal proteins by cultivating these proteins in plants. PMF products can be grown year-round and are not bound by climate or geography in the same way as conventional crops. The process can produce more complete animal proteins compared with nutritionally less available plant counterparts. However, compared to precision fermentation (PF) or biomass fermentation (BF), PMF requires more land and resources, as crops still need inputs to grow.

While the technology has existed for many years, PMF food ingredients are not currently permitted under any regulatory framework.

Currently, companies are testing and producing ingredients ranging from fats to several types of proteins (e.g. dairy proteins, myoglobin and collagen). Crops such as potato, corn and oilseed are being used as host plants. In contrast to precision fermentation or biomass fermentation, plant molecular farming uses the plant itself as the production host and harvests the engineered product once the plant is fully grown.

Consumer knowledge of plant molecular farming is very limited, and consumers generally remain wary of high-tech interventions in their food.

- Compared to other alternative proteins, consumers find PMF to be the least tangible protein source.
- Consumers have difficulty understanding how PMF products are produced.
- Consumers find PMF descriptions unfamiliar, highly technical and abstract.
- Consumers have negative associations with the genetic modification required in PMF production.
- With increased exposure to the benefits of PMF, consumers are generally more positive and more willing to accept the technology.



Demographics

- Studies suggest that consumers in the US are less hesitant towards genetically modified foodstuffs than European consumers.
- Concerns over the allergenicity of PMF products are central to their viability for sensitive individuals.
- Some uncertainty remains around cross-reactions and other potential complications in PMF food composition, which can deter consumers with allergies.
- Some consumers are more open to accepting medicines created using genetically modified organisms than novel food items or ingredients.
- Increases in public support for biotechnology in agriculture have been linked to government support for such technologies in food systems.

The potential of plant molecular farming lies in its nutritional promise, offering complete proteins without the need for animals.

- Consumers seeking animal-free products can find alternatives to animal-based proteins in PMF products.
- Consumers looking to support food sovereignty and food security may view PMF as a way to access local food production, as PMF is not constrained by geographical or environmental limits.
- Consumer perceptions of PMF products are limited due to the current lack of such products on the market; therefore, these recommendations draw on insights from other high-tech food categories.

Uncertainty and unfamiliarity with plant molecular farming drive scepticism

- The long-term safety of PMF products is a concern for consumers.
- They question the rigour of regulatory processes and whether they can trust the safety of these ingredients.
- Consumers worry that PMF products may not be nutritionally reliable.

Strategies for increasing understanding

Consumer perceptions of PMF products are limited due to the current lack of such products on the market; therefore, these recommendations draw on insights from other high-tech food categories.

- Refer to familiar food items related to PMF, such as whey protein or collagen.
- Refer to well-known products produced using PMF, such as insulin for pharmaceutical use.
- Emphasise the potential benefits of PMF products: Get all the essential nutrients you need, without feeling guilty about animal harm or your climate footprint.
- Avoid associations with 'high-tech' processes or laboratory environments.
- Emphasise the benefits of PMF products, such as delivering essential nutrients without animal harm or a large climate footprint.
- Avoid overly technical jargon.
- Use descriptors such as 'animal-free'.

References/Extra resources:

Alternative proteins:
Consumer Perceptions of Current and Future
Innovations EIT Food Consumer
Observatory 2025

