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Mycoprotein: A Fungal Protein for Modern Diets[1]

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This publication introduces mycoprotein, explains how it is produced, and summarizes its nutritional, health, and sustainability attributes. It is intended for UF/IFAS Extension agents, nutrition and food systems professionals, and consumers seeking science-based information on emerging protein foods and their role in balanced diets.

Abstract

Mycoprotein is a protein-rich food ingredient produced from fungi through controlled biomass fermentation. It is gaining attention as part of diversified, modern diets. Unlike proteins derived from plants and animals, mycoprotein comes from fungi. The name mycoprotein refers to fungal mycelium, the naturally fibrous growth structure of fungi. Mycoprotein is consumed as whole fungal biomass rather than as an extracted protein isolate. It has a unique nutritional profile that combines protein, essential amino acids, and dietary fiber, while being low in saturated fat and free of cholesterol. As interest in sustainable food choices that support both human health and environmental stewardship has grown, mycoprotein has emerged as a potential contributor to resilient food systems.

Mycoprotein Is One of Many Alternative Proteins

Alternative proteins come from a variety of biological sources. These include plant-based proteins (e.g., soy, peas, beans, seeds, and nuts), fungal proteins such as mycoprotein (produced from filamentous fungi), insect protein, and algal protein. Some alternative proteins, including mycoprotein, are produced through controlled biomass fermentation, in which microorganisms such as filamentous fungi, yeasts, or bacteria are cultivated and their biomass is harvested for use as a food ingredient (Lima et al. 2022).

Mycoprotein is an alternative protein source made through the controlled biomass cultivation of fungi. Fungi is a kingdom of eukaryotic organisms that includes mushrooms, yeasts, and molds. Current estimates suggest that there are probably 2.2–3.8 million species of fungi, making them significantly more diverse than plants and comparable in diversity to animals (Hawksworth and Lücking 2017). All fungi are heterotrophic (meaning that they obtain nutrients from other organisms), but they are fundamentally different from animals because they are also osmotrophs (i.e., they secrete digestive enzymes into their environment and then absorb nutrients directly through their cell walls) (Hibbett et al. 2025).

Mycoprotein is most often produced from a filamentous fungus called *Fusarium venenatum* (Figure 1) (Finnigan et al. 2019). This species was originally found in soil in the United Kingdom in the 1960s during efforts to develop new protein sources, a period sometimes referred to as the “Green Protein Revolution” (Wiebe 2002).

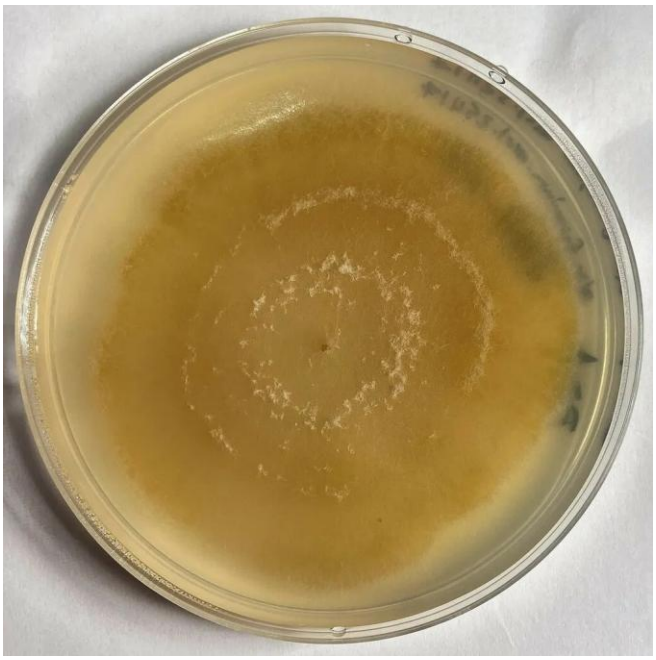


Figure 1. *Fusarium venenatum* mycelium.
Credit: Josh McGinnis (Los Angeles, CA), licensed under CC BY-NC, via iNaturalist.

In contrast, other fungi, such as *Aspergillus oryzae* (commonly known as koji mold), have been used for centuries in East Asia in traditional food fermentations to produce products such as miso and soy sauce (Molfetta et al. 2022). In traditional food fermentation, microorganisms or their enzymes transform an existing food substrate, influencing its flavor, texture, preservation, or digestibility. Mycoprotein production differs in that the main goal is to grow fungal biomass under controlled conditions and then harvest that biomass as a protein-rich food ingredient. Modern food biotechnology is now adapting both traditional and newly characterized fungal species for the production of protein-rich ingredients, including mycoprotein. Today, fungal-derived proteins are widely used as meat alternatives (Figure 2) or as additional protein sources in various food products (Figure 3) (Majumder et al. 2024).



Figure 2. Mycoprotein prepared and served as a meat analogue.
Credit: Daniel Neville (Melbourne, Australia), licensed under CC BY 2.0, via Wikimedia Commons.



Figure 3. Cubed mycoprotein (Quorn®) pieces.
Credit: Anne Jea, licensed under CC BY-SA 4.0, via Wikimedia Commons.

Mycoprotein Production Requires Controlled Fermentation and Processing

Mycoprotein is produced by growing selected fungi under controlled conditions in large tanks called bioreactors or fermenters (Figure 4). Traditional fermentation is a food processing technique used to make everyday foods like yogurt, bread, and beer (Ahmad et al. 2022). Mycoprotein is produced through aerobic fermentation, in which the fungus is supplied with water, oxygen, a nitrogen source, and minerals that support fungal growth, as well as a carbon source such as glucose, another sugar, or starch-derived feedstocks (Majumder et al. 2024; Ahmad et al. 2022).

As the fungus grows, it produces amino acids, which are the building blocks of protein. Over time, these amino acids accumulate within the fungal cells, forming a protein-rich biomass (Ahmad et al. 2022; Majumder et al. 2024). Once sufficient biomass is achieved, the mycoprotein is harvested and heat-treated to reduce ribonucleic acid (RNA) content, making it safe for human consumption (Khan et al. 2024). Controlled heat treatment inactivates fungal proteases, enzymes that break down proteins into smaller parts, helping preserve protein in the biomass. Under these conditions, RNA-degrading enzymes break down cellular RNA, which helps prevent excessive uric acid formation in humans (Linder 2024). The excess water is then removed from the fungal biomass. Depending on the process design, some of this water and dissolved nutrients may be recovered and reused (Durkin et al. 2022) while the biomass undergoes additional processing steps (Figure 4). This series of processing steps helps create a firm, fibrous structure that allows mycoprotein to resemble the texture of meat and serve as a versatile ingredient (Gnaim et al. 2025; Majumder et al. 2024; Maseko et al. 2025). Depending on the production process, a single batch of mycoprotein may take several weeks to complete.

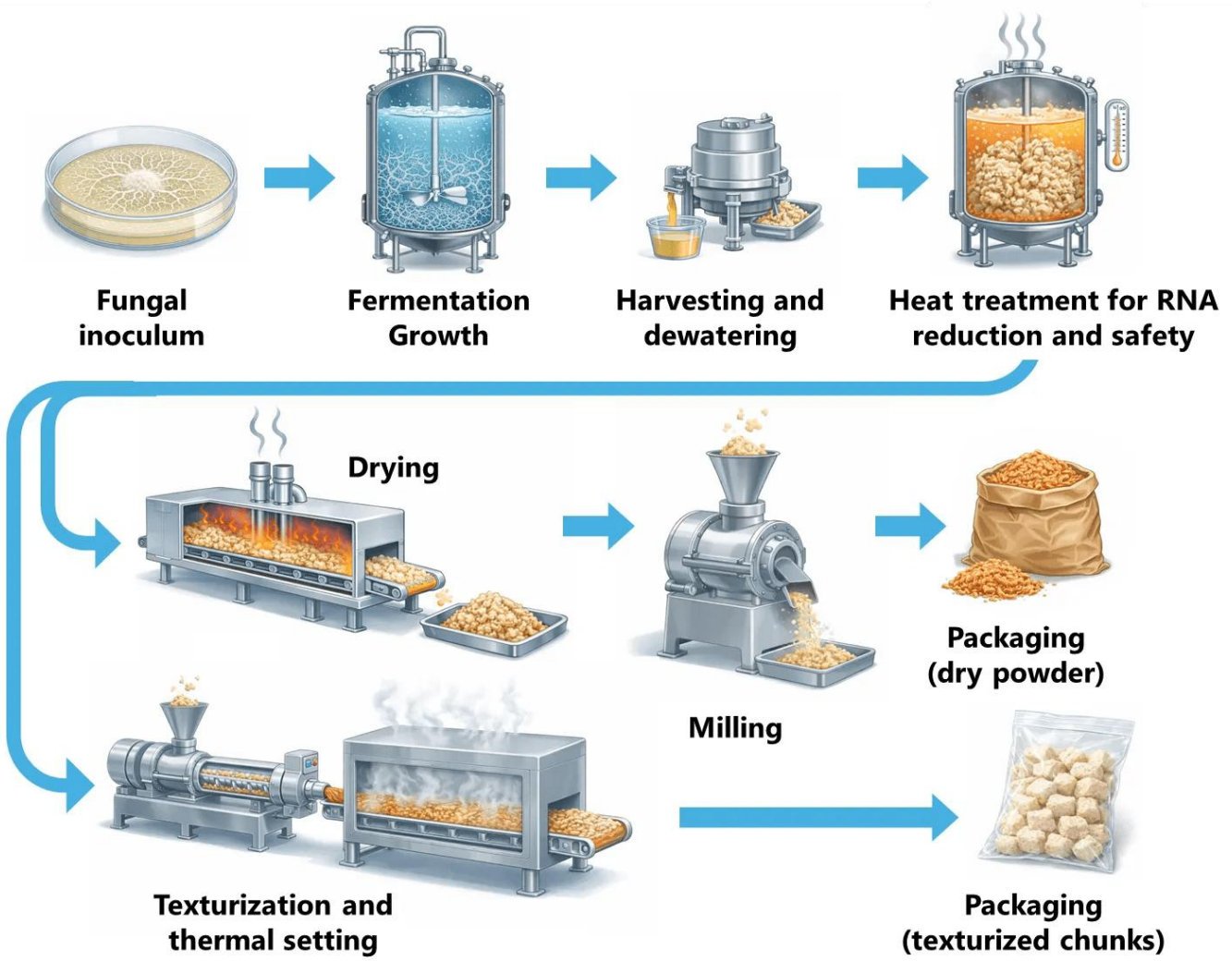


Figure 4. Simplified process for producing mycoprotein ingredients. After submerged aerobic cultivation, fungal biomass is harvested, dewatered, heat-treated to reduce RNA content, and processed into either dry powder or texturized pieces.
Credit: AI-generated image created using Microsoft Designer with DALL-E 3 in Copilot, February 1, 2026, from the prompt "Illustrated process diagram of mycoprotein production showing fungal inoculum, submerged fermentation, harvesting and dewatering, heat treatment for RNA reduction, and two downstream pathways for powder production and texturized mycoprotein chunks, rendered in a clean, semi-realistic scientific illustration style." The image was reviewed and edited by the authors, who take full responsibility for the content.

Although they may sound similar, mycoprotein should not be confused with mushroom protein concentrate or isolated mushroom protein. Mycoprotein is produced by growing fungal mycelium through controlled fermentation. The entire fungal biomass is harvested and consumed as a whole food ingredient. Because it contains intact fungal cells, mycoprotein provides not only protein but also dietary fiber and other cellular components (Ahmad et al. 2022; Majumder et al. 2024).

In contrast, mushroom protein concentrate and mushroom protein isolate are produced from harvested mushrooms (the fruiting bodies of fungi). These products are formed by mechanically and chemically extracting protein from mushrooms, thereby removing much of the fiber and other non-protein components (Li et al. 2023). A protein concentrate typically contains a moderate proportion of protein and some remaining non-protein material, whereas a protein isolate is more highly purified and contains a higher percentage of protein (Hertzler et al. 2020). As a result, mycoprotein is considered a whole-biomass protein food, whereas mushroom protein concentrates and isolates are extracted and purified protein ingredients.

Key Terms Used in Mycoprotein Production

- **heterotrophic.** Describes an organism that cannot make its own food and must obtain nutrients from external sources. Fungi, animals, and humans are heterotrophic.
- **osmotroph (osmotrophic nutrition).** An organism that secretes enzymes into its surroundings to break down food outside its body and then absorbs the dissolved nutrients through its cell walls. Fungi obtain nutrients this way.
- **saprotroph.** An organism that feeds on dead or decaying organic matter. Many fungi used in food production are saprotrophs.
- **mycelium.** The network of microscopic, thread-like filaments that make up the main body of a fungus. Mycoprotein is produced from fungal mycelium rather than from mushroom caps.
- **fermentation (food production context).** Refers to the controlled use of microorganisms or their enzymes to transform food materials into products with desired sensory, nutritional, functional, or preservation properties. In strict biochemical terms, fermentation is an energy-yielding metabolic process that does not require oxygen as the final electron acceptor. However, in industrial food biotechnology, the term is also commonly used for controlled microbial cultivation processes that may occur with or without oxygen.
- **aerobic process.** A biological process that requires oxygen for growth or metabolism. Many industrial fermentations, including mycoprotein production, occur under aerobic (oxygen-present) conditions.
- **biomass fermentation.** An industry term used in the alternative-protein sector to describe controlled microbial cultivation, in which the microorganism itself becomes the food ingredient. For mycoprotein, the desired product is the harvested fungal biomass, not only compounds released by the microorganism.
- **submerged aerobic cultivation.** A production method in which microorganisms grow in a liquid nutrient medium with oxygen supplied to support growth inside controlled vessels called bioreactors or fermenters. Mycoprotein is commonly produced using submerged fermentation.
- **fungal biomass.** The total mass of fungal cells produced during growth. In mycoprotein production, this biomass is harvested and used directly as a food ingredient.
- **whole-biomass protein ingredient.** Protein that is consumed as part of intact cells rather than being purified or chemically extracted. Mycoprotein is a whole-biomass protein.
- **protein concentrates and isolates.** A purified form of protein that has been extracted and separated from other components such as fiber, fats, and carbohydrates. A protein concentrate contains 65%–80% protein, whereas a protein isolate usually contains 90% or more protein, often expressed on a dry weight basis (Meganaharshini et al. 2023). Many plant protein powders used as food ingredients are protein isolates.

Mycoprotein Can Complement a Healthy Diet

Mycoprotein is a nutrient-dense food ingredient that provides high-quality protein, is rich in dietary fiber, and supplies a range of essential vitamins and minerals, while being naturally low in total fat and saturated fatty acids (Table 1). Because it is derived from fungi rather than animals, mycoprotein can complement vegetarian and plant-forward dietary patterns. These characteristics make mycoprotein a practical protein option for diets that emphasize nutrient quality and balance (Ulhas et al. 2023; Lima et al. 2022).

Protein Content and Quality

Mycoprotein is a complete protein source as it contains all essential amino acids required for normal growth, tissue maintenance, and muscle development (Finnigan et al. 2019). The protein digestibility-corrected amino acid score (PDCAAS) is an internationally recognized method for assessing the bioavailability of amino acids and, by extension, overall protein quality (Schaafsma 2005). On this scale, the higher the number, the higher the protein quality. Most animal proteins have high PDCAAS values (typically >0.9), and reported values for mycoprotein are similarly high and comparable to those of milk, egg, and soy protein (Finnigan et al. 2019; Ahmad et al. 2022).

Besides soy, other legumes generally range from approximately 0.7 to 0.9, depending on the species and processing method. On a dry weight basis, mycoprotein products provide relatively high protein content, although total protein levels are usually somewhat lower than those found in most meats.

Dietary Fiber

Mycoprotein is a good source of dietary fiber, which is largely derived from fungal cell walls. Most of this fiber is insoluble and consists primarily of chitin and β-glucans, with a smaller proportion being soluble and fermentable. These fermentable fibers can be utilized by beneficial gut bacteria, supporting cholesterol metabolism and overall digestive health. As a result, mycoprotein can contribute meaningfully to daily fiber intake, which is often low in many diets (Harris et al. 2019; Ahmad et al. 2022).

Fat and Cholesterol

Mycoprotein is naturally low in total fat and saturated fat and contains little to no cholesterol. The fat present is predominantly unsaturated, resulting in a favorable unsaturated-to-saturated fat ratio similar to that found in many plant-based foods (Li et al. 2023). Mycoprotein also provides essential fatty acids, such as omega-3 and omega-6 fatty acids, which support key physiological functions and must be obtained from the diet. These properties allow mycoprotein to fit well within dietary patterns that prioritize cardiovascular health (Ahmad et al. 2022).

Micronutrients

Mycoprotein provides several vitamins and minerals, having a different nutrient profile than many common protein foods. It is a good source of zinc and selenium, providing more of these minerals per serving than milk, eggs, soybeans, and legumes. Mycoprotein contains moderate amounts of iron and very little sodium. Other protein foods provide different nutrients. For example, red meat and soybeans contain more iron, while milk and eggs provide vitamin B12, which is not present in mycoprotein. Sodium levels are generally higher in eggs, milk, and soy products than in mycoprotein. Mycoprotein does not provide vitamins A, C, or E, which emphasizes the importance of including mycoprotein as part of a varied and balanced diet rather than as a sole protein source (Ahmad et al. 2022; Li et al. 2023).

Mycoprotein Is Considered a Sustainable Source of Protein

Unlike livestock production, mycoprotein production involves growing selected fungi as edible biomass in controlled systems rather than raising animals that require feed, grazing or housing space, and longer production cycles. Traditionally, commercial mycoprotein has been produced by cultivating fungi such as *Fusarium venenatum* on glucose or starch-derived carbohydrate feedstocks, followed by heat treatment to reduce RNA content and processing to create textured food ingredients (Finnigan et al. 2019; Majumder et al. 2024; Ng et al. 2025). Because this process converts carbohydrate feedstocks directly into fungal biomass, it can avoid some of the biological inefficiencies associated with animal feed conversion and can operate year-round in contained facilities.

Life-cycle studies generally show that mycoprotein can have substantially lower greenhouse gas emissions and land-use impacts than beef, especially when it replaces beef protein or when production systems recover carbon, nutrients, or energy from process wastewater (Durkin et al. 2022; Pasutto et al. 2025). However, comparisons with pork and chicken are more variable and depend on the fungal species, feedstock, energy source, product formulation, and functional unit used. The sustainability potential of mycoprotein may also improve when agro-industrial residues or lignocellulosic biomass are used as feedstocks, but these systems require appropriate pretreatment and process control (Majumder et al. 2024; Ng et al. 2025). Therefore, mycoprotein is best described as a promising lower-impact protein option, particularly when it displaces beef and when production is optimized for resource efficiency and low-impact formulation.

In addition, because many fungal species used or being explored for mycoprotein production are saprotrophs, scientists have found that they can grow on biological waste materials, including agricultural residues, forestry byproducts, and food-processing side streams. With appropriate pretreatment, these materials can provide fermentable sugars and nutrients for fungal growth, converting low-value residues into protein-rich fungal biomass (Ng et al. 2025; Gebru et al. 2024). Together, these attributes make mycoprotein a promising option for more circular and resource-efficient protein production.

Table 1. Composition of mycoprotein compared with selected conventional protein sources.

Components	Mycoprotein (wet biomass)[a]	Whole milk	Egg	Beef	Soybean nuts	Red beans
Database code (if known)	Not reported	172217	2707154	173355	172441	175194
Consumption method	As is	As is	Boiled	Grilled	As is	Boiled
RACC*	100 g	240 mL	50 g	85 g	30 g	130 g
Total energy (kcal)	98	149	72	154	135	165
Protein (g)	13	7.7	6.2	26.1	13.0	11.3
PDCAAS†	1.0	1.0[b]	1.0[b]	0.9[b]	0.7–0.9[c]	0.7[d]
Total carbohydrate (g)	9	11.7	0.5	0.0	8.7	29.6
Sugar (g)	<0.1	12.3	0.2	0.0	Not reported	0.4
Dietary fiber (g)	8.1	0.0	0.0	0.0	2.43	9.62
Total fats (g)	1.0	8.0	5.0	6.5	6.7	0.7
Saturated fats (g)	0.2	4.5	1.6	2.3	0.9	0.1
Unsaturated fats (g)	0.8	2.4	2.7	2.9	5.1	0.4
Iron (mg)	1.81	0.07	0.84	2.20	1.20	3.80
Zinc (mg)	4.2	0.9	0.6	4.5	1.4	1.4
Sodium (mg)	2.5	105.0	64.5	60.0	0.6	2.6
Potassium (mg)	41	322	66	361	408	524
Calcium (mg)	22	276	24	5	40	36
Selenium (µg)	Not reported	9.0	15.6	33.1	5.8	1.6
Folate, DFE (µg)	0.8	12.2	26.5	6.8	61.5	169.0
Vitamin B12 (µg)	Not reported	1.1	0.4	4.0	0.0	0.0

Source: USDA FoodData Central.

* RACC: Reference amount customarily consumed (according to the FDA).

† PDCAAS: Protein digestibility-corrected amino acid score.

[a] Data from Xian et al. (2025); *Fusarium compactum* MM-135 biomass with 76% moisture.

[b] Data from Hess and Slavin (2016).

[c] Data from van den Berg et al. (2022).

[d] Data from Hertzler et al. (2020).

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