

2023 STATE OF THE INDUSTRY REPORT

Fermentation:

Meat, seafood, eggs,
and dairy



The background is a vibrant yellow with a complex geometric pattern. It features overlapping squares, circles, and triangles in various shades of yellow and gold. Some areas have a fine, repeating pattern of small circles, while others are solid or have diagonal lines. The overall effect is a modern, abstract design.

Executive summary

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The global fermentation industry continued to innovate on animal-free alternatives to conventional proteins in 2023.

In 2023 alone, the number of fermentation companies grew by 16 percent, seven new fermentation-focused facilities opened their doors, and funding milestones were reached in Europe and Africa.

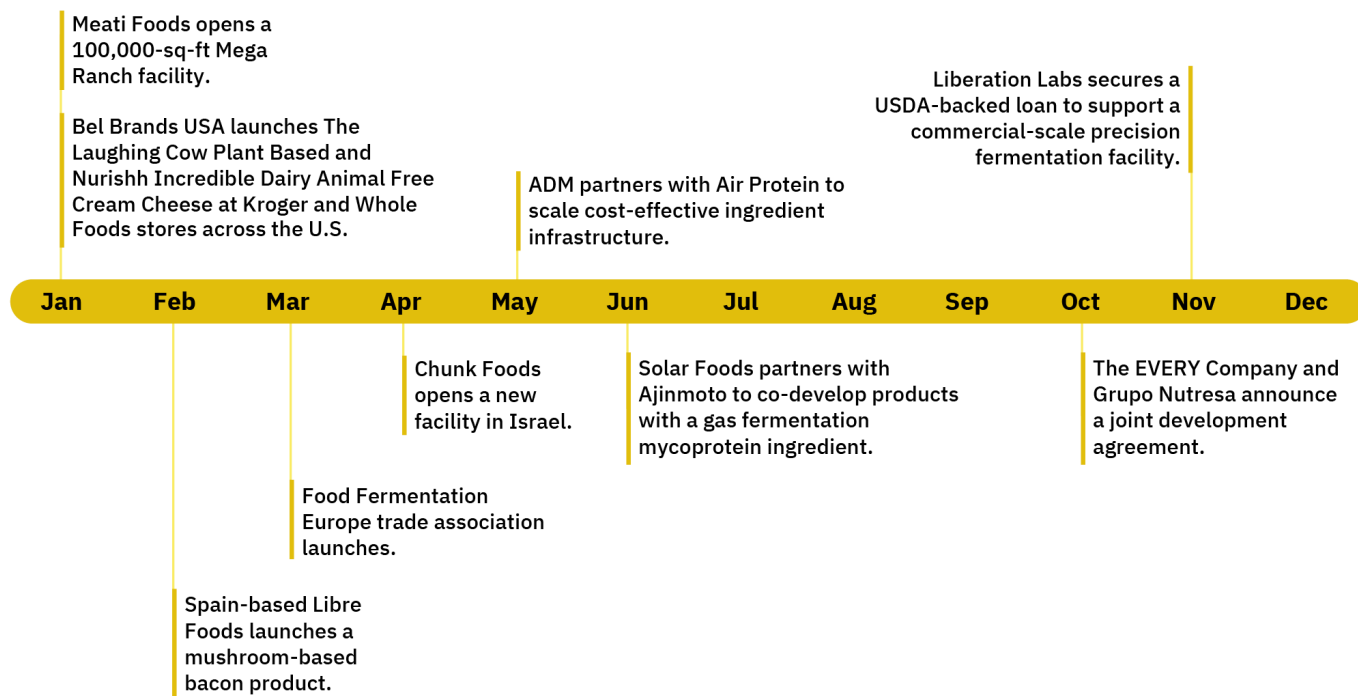
The year also delivered scientific advances, new products, more manufacturing facilities, and notable partnerships. All this progress brought the world more meat, seafood, eggs, and dairy made via microorganisms than any previous year. While challenges in manufacturing capacity and reaching cost parity remain, this nature-inspired technology is primed to transform the future of food.

Table 1: Invested capital in fermentation

Category	2023	2022	All-time (since 2013)	2023 highlights
Total invested capital	\$515MM	\$758MM	\$4.1B	72% of fermentation investment occurred in the last three years alone.
Invested capital deal count	81	118	493	2023's largest investment was \$75 MM (Air Protein).
Unique investors	205	238	693	The number of all-time unique investors increased by 22%.
Growth stage deals (Series B and above)	7	3	31	These included Meati, Enough, Prime Roots, and Solar Foods.
Liquidity events	\$1MM	\$504MM	\$2.1B	Superlatus <u>acquired</u> the Urgent Company, Perfect Day's consumer-facing subsidiary.

Source: GFI analysis of data obtained from Net Zero Insights platform

Figure 2: Timeline of key fermentation updates in 2023



Commercial landscape

New industry associations

In early 2023, nine precision fermentation companies cofounded the **Precision Fermentation Alliance**, which will focus on regulatory engagement and consumer messaging. **Food Fermentation Europe**, working to address several issues, including labeling and nomenclature for animal-free proteins, also formed in 2023.

Known companies

The number of companies focused on fermentation for alternative proteins rose to 158, an increase of 16 percent over the number of known companies in 2022, according to GFI's alternative protein company database.

New fermentation facilities

Seven new fermentation facilities opened globally in 2023, and several more were announced or began construction. Notable examples include **Meati Foods'** facility in Colorado and **Liberation Labs'** facility in Indiana.

Partnerships and capacity building

In 2023, 19 new partnerships focused on end products and bioprocess scaling were formed, adding to the 21 partnerships established in 2022. For example, **Alpha Foods** partnered with **The EVERY Company** to develop hybrid plant-based and precision-fermentation-derived products.

Products

In 2023, companies applied fermentation technology to develop end products and ingredients to enhance plant-based products across categories:

Significant expansion in dairy

Several companies utilized fermentation to launch animal-free cheese products including **Bel Brands USA** launching **The Laughing Cow** Plant Based and **Nurishh** Incredible Dairy Animal Free Cream Cheese. **Nature's Fynd** also launched a fungi-based yogurt product made from their Fy protein.

Eggs

An egg white replacer made from upcycled spent brewer's yeast was introduced from Netherlands-based **revyve**. It can be used as a binder in plant-based meats and adds an umami flavor. **The EVERY Company** also launched The EVERY Egg, a liquid egg product made with precision fermentation-derived proteins and plant-based ingredients.

Meat

New fermentation-enabled meat products, including a microalgae-based meat line from **Umani** and a mushroom-based bacon product from **Libre Foods**, launched in 2023.

Investments

According to GFI's analysis of data obtained from the Net Zero Insights platform, fermentation companies raised \$514.7 million in 2023, a year-over-year deceleration mirroring similar trends across markets amid challenging macroeconomic and other global factors. Still, there was some bright investment news in 2023: funding grew in Europe, totaling \$179.4 million, a 22 percent increase from 2022 (and the highest annual total for the region to date). Additionally, the number of unique investors in fermentation globally grew by 22 percent to 693 unique investors.

Science and technology

Research and development

- The **EVERY Co.** unveiled the world's first precision fermentation liquid egg product in December 2023 on the heels of patent protection on recombinant protein purification strategies and precision fermentation-derived recombinant ovomucoid.
- Biotech company **Melt & Marble** was awarded several patents for strain improvements to increase fatty acid and protein production in fungi.
- **Mycorena AB** was granted two patents in Sweden for a dairy replacement and dry food product formulation containing their fungal biomass ingredient. Mycorena has developed a patent-pending method for a printable food product comprising their fungal biomass ingredient.
- **Koralo Foods**, an alternative seafood startup, received a patent for their novel alternative seafood product produced through the co-cultivation of fungal mycelium and microalgae that imparts the taste and texture of seafood while also providing the nutritional benefits of both the fungal protein and microalgae omega-3-fatty acids in a single process.

Environmental and social impact

- The startup **Essential Impact** has begun commercializing a fermentation-derived low-cost, high-quality protein source for low- and middle-income countries.
- **King's College London** modeled the opportunity for feedstocks from agricultural leftovers, forestry residues, and other reliable starch streams and identified almost 4,000 megatonnes of glucose and xylose sugars potentially available as feedstocks for the biomanufacture of food via fermentation.

- Gas fermentation, where microorganisms convert greenhouse gas feedstocks into microbial protein-rich biomass, has received attention as a viable production pathway for food even in the absence of agricultural feedstocks like sugars and starches. **Synonym Bio** was awarded Open Philanthropy funding to explore gas fermentation processes for food production to help understand the current and future techno-economics of gas fermentation approaches.
- The White House released a Building the Bioworkforce of the Future report that named precision fermentation explicitly as a growing sector in the American bioeconomy that will benefit from government investment.
- In the United States, precision fermentation startup **Liberation Labs** received a \$25 million loan guarantee from USDA to accelerate the construction of a facility in Indiana.
- GFI estimates total Defense Advanced Research Projects Agency (DARPA) funding for fermentation at around \$40 million over four years—nearly matching the United States’ all-time investment in alternative proteins before 2023.
- The government of South Africa allocated what may be the first public investment in precision fermentation on the continent, with a grant of ZAR 11 million (\$700,000) to South African startup **De Novo FoodLabs**.

Government and regulation

Investments and funding

- The White House released “Bold Goals for U.S. Biotechnology and Biomanufacturing,” which proposed supportive policies for the domestic biotechnology sector and called for more research on alternative proteins, public-private partnerships, and an ecosystem of agriculture-focused biomanufacturing facilities.