



## FERMENTATION: A BIOBASED REVOLUTION?

The growing demand for **biobased and natural solutions** is reshaping industries, from food and cosmetics to pharmaceuticals and specialty chemicals. At the heart of this transformation is **fermentation**, an age-old process that is now being optimized for modern sustainability goals. But is fermentation just another trend, or is it a fundamental shift in production methods? In this article, we explore the future of fermentation, compare different fermentation processes and the evolution of fermentation, and examine how **AFYREN's innovative fermentation technology** is driving sustainability forward.

If you want to get a first view on the history of fermentation, industrial fermentation as a method to obtain biobased products and the challenges of industrializing a fermentation process, please read our article about the subject.

### What is fermentation?

To put it simple, fermentation is a metabolic process in which microorganisms, such as bacteria or yeast, convert organic substances into different products. Some of the most widespread fermentation types are:

- **Lactic Acid Fermentation:** Bacteria break down sugars into **lactic acid**, used in yogurt, cheese, and pickled foods.
- **Alcoholic Fermentation:** Microorganisms convert sugars into **ethanol**, producing beer, wine, and biofuels.
- **Acetic Acid Fermentation:** Bacteria turn ethanol into **acetic acid**, creating vinegar and kombucha.
- **Butyric Acid Fermentation:** Bacteria transform sugars into **butyric acid**, contributing to cheese flavor and biofuel production.

### Fermentation: A Trend or a Long-Term Shift?

Fermentation is far more than a passing trend. It represents a **structural shift** in global industries, driven by sustainability imperatives, technological innovation, and changing consumer preferences.

Recent studies confirm this transformation. The global fermented food market is projected to reach **\$989 billion by 2032, and the compound annual growth rate (CAGR) is expected to be 5.6%**. Precision fermentation, an innovative method for producing alternative proteins and biobased chemicals, is also expected to have a very high CAGR. Additionally, consumer demand for natural and sustainable products continues to rise, with over **60%** of consumers willing to pay more for such alternatives.

Regulatory support is also accelerating this shift. Initiatives like the **EU Green Deal** and the **US Biomanufacturing Initiative** are actively promoting biobased alternatives, further embedding fermentation into the industrial landscape. With lower environmental impact, efficiency gains, and strong consumer and regulatory backing, fermentation is not just a temporary movement—it is the future.

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# Evolution of Fermentation: From traditional artisanal to optimized industrial fermentation

Fermentation has been used for years and years, starting with the indigenous fermentation. It has developed in the course of time until what we see today, the optimized, scalable industrial fermentation. **Fermentation is a biotechnology** which allows, among others, the **production of biobased alternatives** to fossil-derived chemicals, usually reducing carbon emissions and environmental impact.

## Traditional artisanal Fermentation

Indigenous fermentation has existed for thousands of years. Examples date back to ancient civilizations like Mesopotamia, Egypt, and China, where **fermentation was used for preservation, flavor enhancement, and medicinal purposes**. Today, these methods are still commonly used in artisanal food production and are increasingly popular due to their perceived health benefits. Some of the most known examples are Sourdough bread, kimchi and natural vinegar. However, traditional artisanal fermentation isn't optimized for a larger scale production

### DIY fermentation – more and more popular

DIY fermentation is flourishing as consumers seek natural, sustainable, and health-boosting foods. From kombucha and sourdough to kimchi and yogurt, home fermentation kits make it easy to create probiotic-rich products. However, challenges include quality control and education, uncontrolled microbial activity leads to variable results, and DIY fermentation should always be proceeded with caution.»

## Traditional Industrial Fermentation

The ramp up to industrial fermentation emerged in the early 20th century. Drivers were to increase efficiency and the **need for large-scale mass production**, where the benefits were immediately seen. One notable revolution is the discovery of penicillin and the need to move to large-scale production to be able to produce and distribute enough during World War II, which saved numerous lives.

Traditional fermentation uses naturally occurring or selectively bred microorganisms under controlled conditions to produce, for example, **organic acids, alcohols, enzymes, antibiotics, and biofuels**.





## Optimizing the Fermentation to increase yield

Optimized fermentation began to take off in the mid-20th century as a response to the **increasing need for efficient and cost-effective large-scale production processes**. Optimizing natural fermentation is taking the traditional industrial fermentation one step further. Compared to traditional industrial fermentation, the aim is really to optimize the output and minimize the waste by finding **optimal variables during the fermentation process**, such as nutritional control, finding the right mix of natural microorganisms, pH, temperature etc. Today different companies work in different ways to optimize their yield.

A process which can be categorized as optimized fermentation is **precision fermentation**. It produces a specific product through selected microorganisms, natural or genetically modified. It gained significant momentum with advances in

genetic engineering, GMO, which allowed for more precise and effective fermentation which can allow increasing yields. One of the most remarkable milestones of precision fermentation happened in 1982 when the first recombinant DNA drug product was approved – insulin to treat diabetes.

At the moment of publication of this article, there was no official definition of precision fermentation, but The Precision Fermentation Alliance (PFA) and Food Fermentation Europe (FFE) – two trade associations – have come up with this definition:

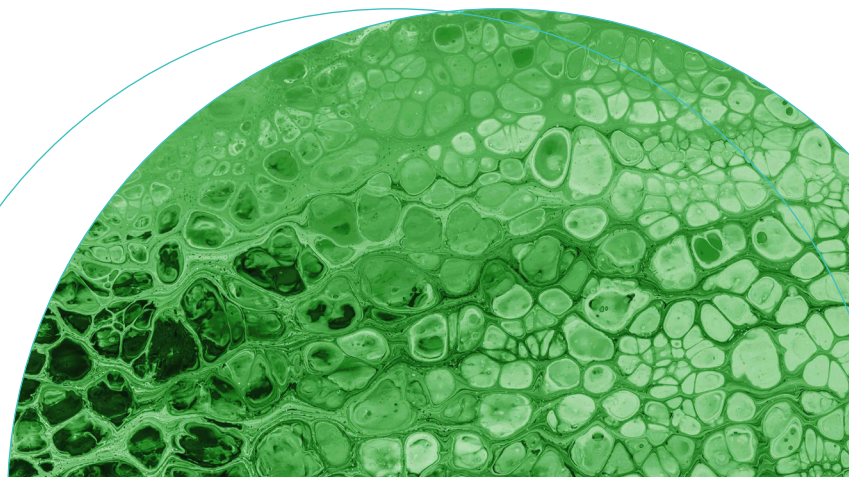
**“** Precision fermentation combines the process of traditional fermentation with the latest advances in biotechnology to efficiently produce a compound of interest, such as a protein, flavor molecule, vitamin, pigment, or fat.”

## Fermentation today

While **indigenous fermentation** is ideal for artisanal and traditional products, **industrial and optimized fermentation** are the cornerstones of modern, sustainable biobased solutions.

Today, **industrial and optimized fermentation** is an essential part of global supply chains, with widespread use in different industries. The food industry is largely using fermentation for many different food ingredients as it uses naturally occurring microorganisms. For example, acetic, citric and lactic acids can be used to improve shelf life. Fermented cultures can be used in dairy products such as yogurt and cheese. Also worth mentioning, industrial fermentation is used today to produce, among other, industrial chemicals, ethanol, bioethanol and pharmaceuticals, for instance probiotics and vitamins.

**Fermentation plays a critical role in the sustainability and development of bioeconomy.**





## How AFYREN's Biobased Fermentation Adds Value

AFYREN is a pioneering company with a circular, innovative fermentation process that transforms agricultural by-products into **high-value organic acids**. Based on a more than a decade of research in chemistry and biology and protected worldwide by 10 patent families, the AFYNERIE® process converts a wide range of **organic waste into biobased molecules using natural, non-genetically modified mix of microorganisms** (microbial consortia). Inspired by living organisms and entirely biomimetic, the process reproduces on an industrial scale the fermentation that has been around for millions of years in natural ecosystems and on which, for example, the methanization process, used today for energy production, is based.

AFYREN's expertise lies in **controlling the transformation of the biobased raw material to promote the production of carboxylic acids**. The acids are extracted then processed through separation and purification stages to obtain products that meet industry specifications and current regulations. Through this innovative technology, AFYREN optimizes the fermentation process and produces 7 carboxylic acids simultaneously, and except for acetic acid and caproic acid, all of these currently only exist as derivatives from petrochemicals.

**“ We have drawn our inspiration from natural ecosystems, where nothing is lost, nothing is created, and everything is transformed, to build a lean, high-performance technology based on extracting value from biomass. Over 12 years of applied research into the control of methanization in the laboratory, we have developed an industrial-scale fermentation process that is unique in its category.”**

*Jérémy PESSIOT – Managing Director, R&D Director and co-founder of AFYREN*



AFYREN's fermentation technology is used across multiple industries:

- **VITAFYREN™**: Biobased acids for food preservation, flavor enhancement, and probiotics.
- **FLAVYREN™**: Biobased acids for fragrances, cosmetics, and sustainable personal care formulations.
- **LUBYREN / AFYBIO™**: Organic acids for lubricants, coatings, and green chemistry applications.

## WHY PARTNER WITH AFYREN?

Fermentation is shaping the future of biobased industries, and choosing the right process is essential. **AFYREN's optimized fermentation technology** offers a sustainable, high-performance alternative that is both scalable and cost-effective. If you are looking for **GMO-free, high-value biobased solutions**, AFYREN is your ideal partner.

- **A carbon footprint more than 80% lower than fossil-based alternatives**
- **Use of renewable and circular feedstocks**
- **A process by biomimicry**