

## Foods We Ferment — And Why

Long before refrigeration prolonged the shelf life of perishable foods, people preserved seasonally available foods so they could have nutritious meals during times of scarcity. Fermentation is one of many methods of food preservation. The term *fermentation* describes a way to transform foods using the metabolic activity of microbes.

Miraculous little microbes are everywhere — in the air, on surfaces, in the soil, on our skin, and even inside us in our digestive tracts! For millennia, humans have harnessed the power of microbes, using them to make foods more nutritious, tastier, and longer lasting — think sourdough bread, cheese, pickles, beer. Let's take a closer look at these microscopic wonders.



### Microbes: Tiny and Mighty

The word *microbe* was coined as a collective term for various microscopic organisms (this term itself is often shortened to microorganisms). A vast group, it includes thousands upon thousands of species of bacteria, fungi, protozoa, and algae. (What about viruses? Some say they're microbes; others exclude them from the group because viruses are considered non-living until they enter a host cell.)

Are microbes "germs?" Out of the countless species that exist on this planet, **by far most microbes are either benign or beneficial to humans**. Only a tiny fraction is considered harmful (also known as pathogenic or disease-causing), such as the *Streptococcus* bacterium that causes strep throat. Other bacterial diseases include cholera, tuberculosis, Lyme disease, and plague — the latter infamous for killing millions of Europeans during the Middle Ages. Although a few microbes like these can cause immense suffering, most play far more positive roles in our lives. Consuming fermented foods, for example, can benefit our digestive tract and contribute to our general well-being.

### How Does Fermentation Work?

Let's start with two very different examples of familiar fermented foods. You'll soon see that the foods being fermented, the types of microbes, the techniques, and time all factor into the final products.



*Homemade sauerkraut*

**Sauerkraut.** During the making of sauerkraut, cabbage is submerged in brine (salty water). *Lactobacillus* bacteria (found naturally on the cabbage or added separately) transform some of the sugars in the cabbage into lactic acid, a natural preservative that inhibits the growth of harmful microbes and acts as a health-

promoting bioactive compound. The fermentation process also radically changes the flavor and texture of the cabbage.

**Sourdough bread.** Crafting sourdough bread involves two types of microbes. The bread gets its flavor from lactic-acid producing bacteria. And it gets its rise from yeast, a type of single-cell fungus that metabolizes sugars in the grain and gives off carbon dioxide gas, creating the bubbles that lighten the loaf.



*Sourdough starter (left) is a blend of flour and water that has been exposed to yeasts that are naturally present in the air. As the yeasts (single-cell fungi) feed on the carbohydrates, they release carbon dioxide, forming the bubbles you see (and causing bread to rise). Sourdough starter can be kept alive for years; you simply use what you need for bread and then keep the rest alive by occasionally “feeding” the yeast with a bit of flour. At right, fresh sourdough bread and a glass of kombucha, another fermented food.*

In the U.S., our modern food system offers most people access to foods year-round, negating the need for time-consuming preservation methods such as fermentation. Yet there's been a resurgence of interest in the diverse family of fermented foods, notably kombucha, kimchi, and kefir. Why? Possible explanations are that fermented foods:

- Introduce unique flavors into our diet
- Offer insights into cultures very different from our own
- Contain health-promoting bioactive compounds

This last attribute may be the driving force behind the remarkable growth in commercial production of fermented foods. Although various fermented foods have been falsely touted as cures for all sorts of ailments, there is truth in their health-promoting properties. Research has shown that a healthy "gut biome" — the spectrum of microbes found throughout the digestive system — is a vital factor in overall health.

The live microbes in some fermented foods introduce beneficial organisms (called "probiotics") into the gut. A proliferation of these "good" gut microbes can help check the growth of harmful organisms. In addition, gut bacteria help us digest and extract nutrients from foods, such as complex starches, that would otherwise pass through undigested.

It appears we humans have come full circle regarding fermented foods. Once a necessity borne of scarcity, home fermentation fell out of favor, replaced by processed foods and faster preservation methods. In recent years, fermentation has made a comeback, evidenced in the popularity of once-exotic dishes of world cuisines. Now, research is showing that the probiotics in fermented foods are a vital component of a healthy gut biome — and a healthy human. Distinctive flavors and improved health are a compelling combination.

## **An Aside: The Gut Biome and the Soil Biome**

In essence, gut bacteria perform roles similar to those of microbes in the soil! Various soil dwellers, including microbes, are called "decomposers" because they break down complex molecules into forms that plants can take up as nutrients. Plus, a healthy soil biome helps control the growth of "bad" (pathogenic) microbes that can harm plants. Very similar to what probiotics do in our digestive tract!

## **A World of Goodness**

Over centuries — even millennia — cultures across the globe have created signature foods that have not only become staple foods in everyday life, but have also come to represent shared cultural pride. The living microbial colonies responsible for the distinct qualities of some fermented foods, such as kefir grains and sourdough starter, are family treasures literally passed (as in a crock of sourdough starter) from generation to generation.

Here's a small selection of the many fermented foods consumed daily worldwide.

**Kombucha.** Made with black tea, sugar, and a bacteria-and-yeast culture called a SCOBY ("symbiotic culture of bacteria and yeast"), kombucha is a tangy drink easily made at home. You can reuse the gelatinous SCOBY to make continuous batches. (Probable origin: Russia and Ukraine)





*A SCOBY floats on a batch of fermenting kombucha. Short for "symbiotic culture of bacteria and yeast," the SCOBY is a layered, gelatinous mass containing microbes that drive the fermentation process. (Technically, the layered mass is called the pellicle and the microbes are the SCOBY; however, the term SCOBY is now commonly used to refer to the entire mass.)*

**Kefir.** During fermentation, "kefir grains" (clumps of yeast and bacteria) are added to milk. As it ferments, the bacteria transform the lactose sugar into lactic acid, rendering the milk easier to digest. (Probable origin: Eastern Europe).

**Kombucha.** Made with black tea, sugar, and a bacteria-and-yeast culture called a SCOBY ("symbiotic culture of bacteria and yeast"), kombucha is a tangy drink easily made at home. You can reuse the gelatinous SCOBY to make continuous batches. (Probable origin: Russia and Ukraine)

**Miso.** Soybeans, brown rice and/or barley and salt are mixed with a fungus called koji and allowed to ferment anywhere from a few weeks to a few years. The result is a paste that ranges widely in flavor, color, and taste, depending on the process and time. (Origins: Japan, Korea)

**Kimchi.** Prepared by Korean families for over 1500 years, kimchi consists of cabbage and other vegetables that are fermented in their own juices, as well as brine and spices. Historically used as a way to preserve vegetables for out-of-season consumption, kimchi is a staple in Korean culture. (Origins: Korea)

**Poi.** This staple is made from starchy vegetables, usually taro stems, breadfruit, or plantain, that have been cooked and mashed into a paste or dough. Although it can be eaten fresh, fermenting poi makes it easier to digest and increases the available nutrients. (Origins: Hawaii, Polynesia)

**Injera.** This spongy, fermented flatbread starts off with teff, an ancient, gluten-free grain. The teff is mixed with water, and then ersho is added to trigger fermentation. Ersho is a liquid containing certain bacteria and yeasts, that is saved from batch to batch of injera. (Origins: Ethiopia, Eritrea)

**Chocolate.** Once the cacao beans are freed from their pods using machetes — a laborious and dangerous job — the beans and surrounding white pulp are covered and left to ferment. During the fermentation process, chemical changes occur that develop the chocolate flavor. (Origins: ancient Mesoamerica, present-day Mexico)

Other popular fermented foods include beer, yogurt, wine, fish sauce, soy sauce, cheeses, pickles, and sausages.

## Fun Facts about Microbes

- Scientists believe that we've identified only about 1% of the microbes on earth. The remaining 99% are still a mystery.
- It's estimated that each of us has trillions of microbes on and in our bodies.

## Related Lessons and Activities

[Exploring Food Preservation Lesson Plan](#)

[Easy Homemade Refrigerator Pickles](#)

