

WHITE PAPER 01

Fermented Foods

We all know them, but what do we know about them?

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Fermentation's Origins

Archaeologists and anthropologists all agree: humans have been preparing and consuming fermented food and drink for thousands of years.

Back then, fermenting's main purpose was to preserve the nutrient-dense summer crops to better survive the scarcity of winter. Not only did fermenting help keep our species alive, but it also created some of the most delicious foods we still enjoy today.

Foods like yogurt, cheese, olives, miso, sausages, beer, and wine. Even making bread involves fermentation. One could also argue that these tasty results of fermentation are even better than their original ingredients! In our modern times, fermentation still improves food quality, but now we also understand its many other benefits.



What exactly is fermentation though?



Fermentation, when you boil it down to its essence, is simply a degradation process. In non-controlled conditions, you would call it a rotting process.

However, by using the right micro-organisms - selected bacteria, yeasts, and molds - the result of the fermentation is a product with new and improved properties.

The product has a longer shelf life, better texture and mouthfeel, a nicer taste, and, importantly, it becomes easier to digest.

The reasons for this lie in the activity of those selected microorganisms. They produce enzymes, molecules that act as a catalyst for biochemical reactions.

Enzymes can:

01 Degrade (ferment) larger sugars to smaller acidic compounds such as lactic acid or acetic acid, which help to preserve food much longer.

02 Degrade larger protein molecules into smaller ones, which has an influence on both taste and texture.

03 Produce antibacterial compounds such as acids, peroxides, or so-called bacteriocins, which will kill or prevent bad bacteria from growing.

04 Produce alcohol and carbon dioxide, which gives beer its foam and taste as well as make bread dough rise.

05 Increase the nutrient level of the food, e.g., by the production of vitamins or antioxidants, or the degradation of anti-nutrients or bad tasting molecules.

Besides the production of enzymes, fermented foods are also a rich source of harmless bacteria.

A huge variation

There are hundreds of food-fermenting microorganisms and tens of thousands of combinations that can be made - this is what gives us such a wide variety of fermented foods, animal feeds, and beverages.

The most frequently used microorganisms used in fermentation are bacteria and yeasts. Yeast fermentation is the least complicated of the two. It produces mainly alcohol and carbon dioxide (gas) from sugar. A yeast called *Saccharomyces cerevisiae* is one of the most famous and universally enjoyed yeasts. It produces carbon dioxide that makes bread dough rise and produces alcohol in beer and wine. Sometimes, bacteria and yeasts are combined to create a specific fermentation effect. Kefir is a popular

example of precisely that - lactic acid bacteria and different types of yeasts work together to form so-called Kefir grains. The yeasts in the kefir grains produce alcohol and carbon dioxide as well, making it a slightly alcoholic and somewhat fizzy dairy drink.

The main end products of bacterial fermentation are acids, most often lactic acid or acetic acid, which are produced from sugars. Most people are familiar with bacterial names like *Lactobacillus* and *Bifidobacterium*. They are commonly found in fermented products you find in the supermarket. Maybe you also know *Lactococcus*, *Streptococcus* and *Enterococcus* which also belong to the lactic acid bacteria. In fact there are hundreds of different species in the lactic acid domain.

The ones that can be used safely in food are listed by the European Food Safety Authority (EFSA) and you can find them on:



<https://www.efsa.europa.eu/en/efsajournal/pub/6174>

We all know it: Sauerkraut

When talking about fermented foods, you simply can't ignore sauerkraut. Made by taking fresh, sliced cabbage and salting it to stop unwanted bacterial growth. The salt also extracts water, which in turn produces the brine for the fermentation. The initial bacterial species starting the fermentation is a fast-growing lactic acid bacteria, called *Leuconostoc mesenteroides*. It produces mainly lactic acid and carbon dioxide that quickly make the cabbage acid, which inhibits undesirable



microorganisms. The carbon dioxide gas that replaces the air in the closed fermentation vessel creates an anaerobic condition - meaning an environment without oxygen. This anaerobic state is necessary for the later steps in the fermentation process. These include the activity of other lactic acid bacteria such as *Lactobacillus brevis*, *Lactobacillus plantarum*, and sometimes *Pediococcus cerevisiae*, which also produces lactic acid and carbon dioxide.

On top of that, ethanol and acetic acid are formed, and some compounds that, through their fruity smell, will contribute to the taste of the sauerkraut. The total process can last 1 to 2 months! The length will depend on the bacteria, the quantity of cabbage, the salt concentration and, importantly, the temperature.

So, tell me About the Benefits!



It's clear that fermentation can increase food safety, improve its nutrient content, and make food more digestible. Over the last 100 years research has shown the other benefits of these so-called “friendly bacteria” as well.

Since some foods may have very high numbers of bacteria at the end of the fermentation, a certain percentage of them may survive the passage through the stomach and reach the gut alive. Since they will remain there for a certain period -ranging from one to several days -they influence the intestinal microbiota, the ecosystem that we carry with us in our gut. The new bacteria will interact with the bacteria that are already there, competing for space and nutrients, and producing acids that, as we now know, bad bacteria don't like.

Decades of research have shown the role of bacteria in our digestive and immune systems. Certain bacteria have been selected for one or more of these activities, and when supported by good clinical studies, they are named “probiotics”.



How can I Make Fermented Foods at Home?

Fermentation can occur spontaneously and uncontrollably. Therefore it is important to be aware of a number of important risks. Especially in case you want to produce your own fermented foods!

The first thing that is advised to do is to use “starter cultures”, which in the industry are considered standard practice and will help you make your own beer, sauerkraut, or yogurt at home. Starter cultures contain high concentrations of whichever bacteria needed for a specific fermentation. They ensure that the process is started quickly and that enough acid is produced to discourage bad bacteria and guarantee a safe product.

Starter cultures are not only selected for their efficiency but also because they won't produce off-flavors or bad

metabolites, such as biogenic amines. Of course, if you're going to be making your own fermented foods, you also need to mind the link with oxygen. Some fermentations, like the sauerkraut fermentation, should be in anaerobic conditions, while others will only succeed with oxygen. It would also be wise to consider the gasses that can be formed during the fermentation process, if your brewing container is closed too tightly, it might just explode! Wine makers use a “water slot” to release the gas, without letting oxygen in. Temperature is an essential factor as well, since each microorganism involved has their preferences: not too hot, not too cold. Sometimes optimal temperature at the start is even different from the best temperature at the end of the fermentation.





So fermented foods pose no risks?

Fermented foods have been used extensively all over the world for centuries, so it's fair to say that they are safe to consume. As mentioned above, care should be taken during the production process. But when produced correctly, there should be no problem for man or animal, young or old, to make fermented foods part of a healthy daily diet. If you'd like to learn more about fermenting at home safely, visit:



<https://isappscience.org/suggestions-making-safe-fermented-foods-home/>

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