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The science of sourdough – how citizens are helping shape the future of fermented foods

Citizen scientists are drawing on personal experience to help researchers create new plant-based fermented foods and maximise their health benefits.

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Many will remember the sourdough bread-baking craze that emerged at the height of the COVID-19 pandemic when people were stuck at home and looking for something creative to do.

With social media feeds full of images of sourdough “starters” with quirky names and crisp, freshly baked loaves, home bakers discovered the joys – and the health benefits – of fermented foods.

“During COVID, a lot of people started producing sourdough breads at home,” said Professor Christophe Courtin, a food biochemist at KU Leuven, the University of Leuven in Belgium.

Now, research funding from the EU is helping Courtin and a team of leading food experts from Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Romania, Sweden and Switzerland mobilise that army of home bakers in the interests of science – and our health.

Starting point

The four-year EU-funded HealthFerm team that Courtin is leading brings together researchers and food companies to identify helpful microorganisms and processes in traditional fermented foods like sourdough bread.

They aim to use this information to help develop new plant-based fermented foods that they say could be good for both people and the planet.

A starting point was to capitalise on the power of citizen science – where citizens participate voluntarily in scientific projects – and analyse sourdough starters donated by volunteer bakers in different countries.

A sourdough starter is made from a mixture of flour and water that is left to ferment with the help of naturally occurring microorganisms in the flour and the environment. These include wild yeast (almost always *Saccharomyces cerevisiae)*, lactic acid and acetic acid bacteria.

“These [bacteria] come from a few different species, but functionally speaking, they are relatively similar,” explained Professor Nicholas Bokulich, a microbiologist at ETH Zürich in Switzerland.

This culture is used as a natural raising agent to give the bread its light texture and distinctive flavour. So far, the HealthFerm team has collected around 800 sourdough starters.

“The samples came from all over Europe,” said Bokulich.

The assembled network of citizen scientists has also been testing the acidity of their starters and providing detailed information on how they feed and maintain them. This includes, for instance, storage temperatures, feeding schedules and the type of flour used.

Work is ongoing, but the starters analysed so far already show variations in microbial diversity influenced “to a small but important extent” by location, said Bokulich.

“We are trying to figure out if this is driven by grain mixture, because different flour mixtures are more prominent in some regions than others, or if there is an environmental influence,” he said.

The researchers’ main goal is to identify microbes with properties thought to be beneficial to our health, which could be used to create new foods.

Ancient know-how

Humans have been using microorganisms to alter and preserve food for a very long time. Pottery from Neolithic China suggests that people were producing a drink from fermented rice, honey and fruit from at least 8 000 B.C.

Fermented foods already have an important place in our daily diets, from bread to beer, wine, cheese, yoghurt, pickles, sauerkraut, miso, and much more. More recently, interest in fermented foods such as kefir and kombucha has increased.

The HealthFerm researchers are seeking to shed further light on the health claims associated with these fermented foods.

“For fermented dairy products like yoghurt and kefir, evidence has been building up, and it is clear that there are health benefits,” said Courtin. Indeed, studies suggest that such foods reduce the risk of diabetes, cancer, obesity and heart disease.

But for plant-based fermented foods, such as sauerkraut, kimchi and sourdough bread, there has been less research.

“We want to investigate whether those health benefits are actually there,” said Courtin.

Courtin acknowledges that, if you look at what fermentation does, it would be logical for health benefits to be there. Firming up the evidence for this would, however, be useful. Particularly if scientists want to harness this information to produce new types of fermented food products.

Bacterial breakdown

Fermentation uses bacteria and yeasts to convert ingredients into a final edible product. These microorganisms break down elements of the food, changing its flavour profile and extending its shelf life by suppressing the growth of microbes that could cause the food to spoil.

These processes are known to improve the availability of vitamins and minerals in food, and break down proteins and fibres, in theory making them easier to digest.

However, data is currently lacking to clearly demonstrate the health benefits of consuming these products and explain the reasons why.

One reason could be that fermentation microorganisms, for instance, produce their own by-products, like short-chain fatty acids.

“We know that if these fatty acids are produced in our colon, they are beneficial to us,” explained Courtin. “What we don’t know is if they are equally beneficial when produced in food.”

Research suggests that short-chain fatty acids produced by bacterial fermentation in our bowels help us maintain a healthy gut microbiome, improve liver function and reduce inflammation associated with diseases such as cancer, inflammatory bowel disease and diabetes.

In addition, many plant-based foods contain compounds that are difficult to digest, like lectins, tannins and oxalates. Fermentation microbes can also help to break these down, increasing digestibility.

“The microorganisms can digest these compounds even if people can’t,” said Bokulich.

Health impact, present and future

HealthFerm, which runs until 2026, is conducting five multi-country human intervention trials to assess the health impacts of fermented foods.

Participants eat either a mix of different fermented foods or one specific fermented food. Blood and stool samples are used to study the diets’ effects, compared with participants not consuming fermented foods.

This includes analysing their gut microbiomes and seeing if products like short-chain fatty acids make it into their bloodstreams. General health markers will also be checked.

Some of the foods used will be novel foods created by the research initiative. Microbes from the sourdough starters considered to have desirable characteristics, such as the ability to break down proteins and fibre, or produce short-chain fatty acids and vitamin B, will be incorporated into such foods at a later stage.

Fermented products like these could contribute to Food 2030, the EU’s policy framework to support the transition towards sustainable, healthy and inclusive food systems.

Courtin said that even if no health benefits are seen in fermented plant-based foods, fermented products could contribute from a sustainability perspective, by assisting with the transition towards plant-based diets that is needed to tackle climate change.

If plant-based alternatives to animal-derived products can be produced via fermentation, this is likely to have health benefits simply by increasing the consumption of plant-based products, said Courtin.

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More info

- HealthFerm
- HealthFerm project website
- Ensuring global food supply and food security
- Food-Based Dietary Guidelines in Europe
- Food 2030