

Fermented Foods

Dr Ekta Khare

Department of Microbiology,
School of Life Sciences and Biotechnology,
Chhatrapati Shahu Ji Maharaj University, Kanpur

Fermented foods

- Fermented foods are defined as foods or beverages produced through controlled microbial growth, and the conversion of food components through enzymatic action.
- Fermented foods contain live microbes, which increase gut diversity and can help lower inflammation.
- Top choices include kefir, kimchi, sauerkraut, kombucha, and miso, as well as certain aged cheeses like cheddar or parmesan.
- For the best results, aim to eat small amounts of several different fermented foods daily rather than large amounts occasionally.
- **Fermented foods** are foods produced by the controlled growth and metabolic activity of microorganisms such as **lactic acid bacteria (LAB), yeasts, and molds**.
- During fermentation, microorganisms convert carbohydrates, proteins, or other substrates into **lactic acid, ethanol, CO₂, organic acids, enzymes and flavour compounds**, resulting in changes in taste, texture, aroma, digestibility and shelf life.
- For example, when you add yeast to sweetened tea, it ferments and becomes kombucha. Similarly, bacteria react with milk to create yogurt.
- While people first used this ancient practice for its preservative effects, eating fermenting foods has recently gained popularity because of its reported health-promoting effects.
- Fermented foods [can benefit your health](#) in a variety of ways, such as improving digestion and lowering your risk for certain diseases, like type 2 diabetes and heart disease.

Fermented foods

- Fermented foods are foods made using desirable microorganisms that change the properties of the food components.
- Throughout human history, fermentation has served as a way to preserve and transform foods, creating more stable and diverse foods with unique tastes and textures.
- All fermented foods require microbes for their creation, but not all fermented foods contain live microorganisms at the time of consumption.
- When they do, the number of microorganisms can vary significantly depending on how products were manufactured and processed, as well as conditions and duration of storage.
- Fermented foods are generally safe to eat because the fermentation process typically keeps harmful microorganisms at bay.
- Few microorganisms in fermented foods meet the criteria for probiotics because they have not been specifically named and tested for health benefits.
- Instead, microorganisms in fermented foods typically fall under the category of live dietary microbes.

Fermented foods

- Many fermented foods — such as kefir, kombucha, and fermented vegetables — [contain probiotics](#), but not all do.
- [Probiotics](#) are foods with living microbes that can travel to your gut and provide some benefit to your health.
- Prebiotics serve as food for the good microbes living in your gut.
- Crucially, they promote a healthier and more diverse [gut microbiome](#), the collection of microorganisms living in your gut.
- Regularly eating fermented probiotic foods — such as yogurt, kefir, sauerkraut, and miso — may positively affect your health.
- But not all fermented foods contain probiotics.
- Fermented foods are just one part of a balanced diet.

Microbes in Fermentation

- **Bacteria:** *Lactococcus*, *Leuconostoc*, *Pediococcus*, *Propionobacterium*, *Bravibacterium*, *Bacillus*, *Micrococcus*, and *Staphylococcus* (lactic acid from carbohydrates)
- **Yeast:** *Saccharomyces*, *Candida*, *Torulopsis*, and *Hansenula* (production of vinegar, wine and beer)
- **Moulds:** . *Aspergillus*, *Pencillium*, *Rhizopus*, *Mucor*, *Monascus*, *Actinomucorare* (enzyme production & flavor enhancement).

Type of fermentation	Food	Region	Main raw material	Simplified production process	Important microorganisms
Lactic acid	Dahi	India	Milk	Milk → heat treatment → starter → incubation → coagulation	LAB; <i>Streptococcus</i> , <i>Lactobacillus</i> , <i>Lactococcus</i>
Lactic acid	Idli	India	Rice + urad dal	Soaking → grinding → mixing → fermentation → steaming	LAB + yeasts
Lactic acid	Kanji	India	Carrot + salt + water	Cutting → salting → fermentation → maturation	LAB
Lactic acid	Kimchi	Korea	Cabbage + vegetables	Salting → seasoning → packing → fermentation	<i>Leuconostoc</i> , <i>Weissella</i> , lactobacilli
Lactic acid	Sauerkraut	Germany	Cabbage + salt	Shredding → salting → anaerobic fermentation	LAB

Alcoholic	Toddy	India	Palm sap	Sap collection → natural fermentation	Yeasts + LAB
Alcoholic	Handia	India	Rice	Cooking → starter addition → fermentation	Yeasts + LAB + molds
Alcoholic	Bread	Worldwide	Wheat flour	Dough preparation → yeast fermentation → proofing → baking	<i>Saccharomyces cerevisiae</i>
Alcoholic	Beer	Worldwide	Barley malt	Malting → mashing → wort → yeast fermentation → maturation	<i>Saccharomyces</i> spp.
Alcoholic	Wine	Worldwide	Grapes	Crushing → must preparation → yeast fermentation → maturation	<i>Saccharomyces cerevisiae</i>
Acetic acid	Vinegar	Worldwide	Alcoholic liquid	Alcoholic substrate → aerobic oxidation → maturation	<i>Acetobacter</i> , <i>Komagataeibacter</i>

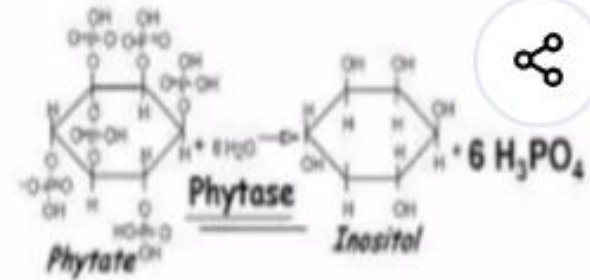
Alkaline	Kinema	India/Nepal	Soybean	Boiling → cooling → packing → fermentation	<i>Bacillus</i> spp.
Alkaline	Natto	Japan	Soybean	Soaking → steaming → inoculation → fermentation	<i>Bacillus subtilis</i>
Fungal	Tempeh	Indonesia	Soybean	Soaking → cooking → fungal inoculation → solid-state fermentation	<i>Rhizopus</i> spp.
Koji/mixed	Soy sauce	China/Japan	Soybean + wheat	Cooking → koji → brine fermentation → maturation	<i>Aspergillus oryzae</i> + yeasts/LAB
Mixed dairy	Kefir	Caucasus	Milk + kefir grains	Milk → kefir grains → fermentation → grain removal	LAB + yeasts + AAB
Mixed	Cheese	Worldwide	Milk	Starter → acidification → coagulation → curd processing → ripening	LAB + yeasts/molds

Health benefits

- **Kimchi:** Similar to sauerkraut but spicier and known as Korean kraut. It may contain peppers and other vegetables. Rich in antioxidants. Vitamin A, thiamine (B1), riboflavin (B2), calcium, and iron anti cancer .World's Healthiest Foods .
 - **Sauerkraut:** Made from fermented cabbage rich in vitamin C, K & B, Iron, Potassium, copper, manganese, Good for stomach, anti cancer.
 - **Coffee:** Anti cancer, help in treatment of Diabetes type II.
 - **Chocolate:** Improve circulatory system, rich source of flavonoids, decrease cholesterol level
 - **Cheese:** Prevent tooth decay, tryptophan improve sleep & relieve tension
- **Yogurt:** protein, calcium, vitamin D, riboflavin, vitamin B6, B12, Prevent osteoporosis, reduce the risk of High blood pressure, decrease gastrointestinal infections
 - **Kefir:** Detoxification, improve immune system, digestion, against allergies, build bone density.
 - **Pickles:** Cancer reduction, antibiotic production, improve mental health.
 - **Vinegar:** Detoxification, help in weight loss, skin problems, lower blood pressure and cholesterol, ease arthritis.

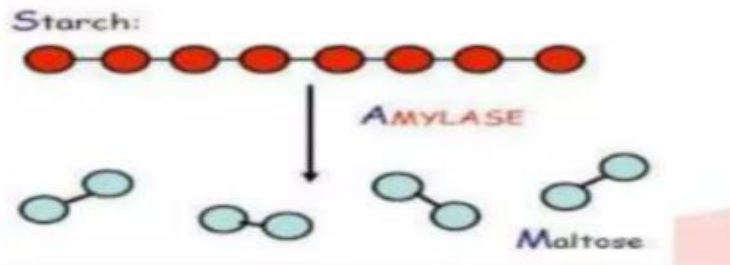
Removal Of Antinutrients:

- **Antinutrients:** These are chelating compounds (phytic acid) of metal ions present in bran and seed of every crop, they make strong bond with protein, Ca and other inorganic ions and make indigestible compounds. This deficiency cause cavity, bone lose and osteoporosis.
- *Aspergillus oryzae* produce phytase enzyme which convert it into inositol a sugar and digestible.
- Soya beans have phytic acid but soya sauce is antinutrient free.



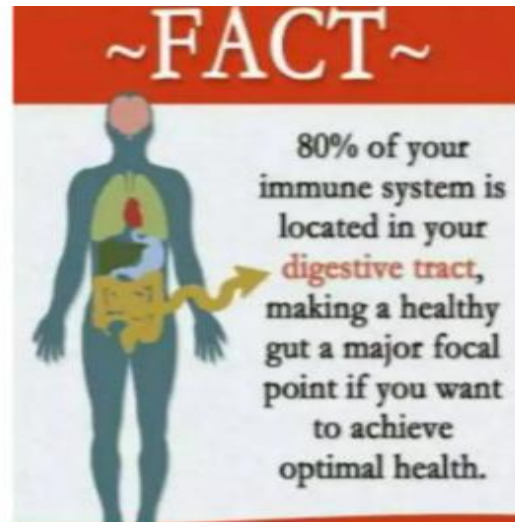
Nutritional Quality

- LAB convert carbohydrates into easily digestible compounds by the production of enzymes.



Probiotic Effect:

- Probiotics are friendly microbes of our gut.
- They play important function in our gastrointestinal tract.



Fermented Foods Fight Obesity

Studies show the gut biome of lean people is very different from that of people with obesity. Having a healthy biome can help to prevent or manage obesity. Besides fermented dairy like yogurt, two popular Korean foods may help to get a healthy biome and ward off weight gain: green vegetable-based kimchi (usually made from Napa cabbage) and chungkookjang, a type of fermented soybean.

Warding Off Heart Disease

It's possible that fermented foods can help to stay clear of heart disease. A study done in Finland found that people who eat low-fat fermented dairy -- less than 3.5% fat -- had a much lower risk than people who ate other types of dairy or high-fat fermented foods. Research from Sweden and the Netherlands also found this benefit

Keeping Blood Sugar in Check

Studies show that yogurt has a link to lower blood sugar. It can also help ward off metabolic syndrome and its serious result, type 2 diabetes. Choose yogurt rich in probiotics over the regular kind for the most benefits. If one already have diabetes, eating yogurt with multiple strains of bacteria and yeast can help keep all numbers in line: blood sugar, blood pressure, and cholesterol.

Breathe Easier

The benefits of fermented foods can be very wide-ranging. In addition to offering some protection from diabetes, kimchi might ward off asthma and eczema, also called atopic dermatitis.

Help for High Blood Pressure

One can lower the chances of high blood pressure by eating fermented foods. Top choices are soy foods, like miso and natto. Fermented dairy with multiple strains of helpful bacteria and yeast is also good. They help block an enzyme that has a connection to raising blood pressure. If blood pressure is already high, eating fermented foods regularly can shave a few points off both the systolic and diastolic readings.

Boost Brain Health

Limited research shows that some of the bacteria in fermented foods can jumpstart serotonin, a brain chemical that boosts feelings of well-being. That's because the gut and the brain have a strong connection -- so much so that improving our gut biome can improve the central nervous system. It might also help ease anxiety or depression and boost cognitive function -- our ability to think, remember, and learn.

Lowering Cancer Risk

- The same studies done in the Netherlands and Sweden that found heart benefits from fermented dairy foods also reported a link to a lower risk for bladder cancer. Again, these benefits weren't seen with regular dairy.
- Fermentation bacteria produce short chain fatty acids and protect gut and breast cancer.
- Production of antimutagenic organic acid and normalize the intestinal permeability.

Treatment of diarrhea:

- *Streptococcus thermophilus*, *Bifidobacterium bifidum* and LAB are used to treat acute diarrhea and infection caused by rotavirus .
- High dosage of antibiotic kill the natural microbiota of GIT, *Clostridium difficile* is part of it but it produce mycotoxins which cause colitis .
- Intake of *Lactobacillus GG* part of natural microbiota show remarkable effect (6).

Gut Reaction

- The benefits of fermented foods start in digestive system -- gut. The gut is called second brain because of its powerful influence on many aspects of health, from mood and behavior to appetite and weight. It even affects immune system. Feeding it with fermented foods helps give a better mix of the bacteria known as the gut biome. That boosts gut health and, in turn, all the body functions that our gut supports.
- Fermented foods can help fight inflammation and be part of our plan to manage conditions like irritable bowel syndrome and inflammatory bowel diseases like Crohn's and ulcerative colitis
- Studies show that improving gut bacteria -- along with other anti-inflammatory diet changes -- may help with pain sensitivity and other symptoms of conditions like chronic fatigue syndrome CFS.



Omega -3

- Omega 3 present in salmon and other fermented foods also help in promoting heart health, boost brain function, improve bone health.
- Omega-3 increase the cell apoptosis.

Immune System

- The bacteria that live in our gut have a significant impact on our immune system.
- Due to their high probiotic content, fermented foods can give our immune system a boost and reduce our risk of infections like the common cold.
- Consuming probiotic-rich foods may also help us to recover faster when we're sick.
- Additionally, many fermented foods are rich in vitamin C, iron, and zinc — all of which are proven to contribute to a stronger immune system