# The Health Benefits of Fermented Dairy



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**Fermented foods have become increasingly popular in recent years, and interest in gut health, both in research settings and amongst individuals, is at an all-time high. Since 2020, 10,000 journal articles have been published on the topic of pre- and probiotics and over 2,000 on fermented foods (Figure 1).[1] Fermented foods are defined as *'foods or beverages produced through controlled microbial growth, and the conversion of food components through enzymatic action'*.[2] A broad range of fermented foods made from varying substrates are popular today, including sauerkraut and kimchi (cabbage/vegetables), miso, tempeh and natto (soybean) and kombucha (sweetened tea). However, fermented milk products – namely live yoghurt and kefir – are the most widely consumed and are supported by the greatest volume of research regarding health outcomes.[1, 3]**

## Fermented dairy, a brief history

Both kefir and yoghurt have long histories and significant cultural origins. Kefir is believed to have originated on the slopes of the Caucasus, a mountain range spanning parts of Russia, Azerbaijan, Georgia and Armenia.[4] The earliest references to kefir date back to 2000 BC.[5] Yoghurt has no single origin, having been consumed in varying forms by many different cultures across the globe for millennia.

Consumption of milk products is believed to have started as far back as 10,000 BC with the domestication of milk-producing animals, with the first written references of yoghurt appearing in ancient Greek texts around 100 BC.[6] The fermentation of milk served as an important preservation method, however it has long been associated with health, with references throughout history of its use to treat illnesses, including the management of digestive disorders such as diarrhoea, recorded as early as the 11th century.[6] The origins of commercial yoghurt production date back to 1919, when Isaac Carasso founded Danone, originally selling yoghurt to pharmacies in porcelain pots. His son would later open the first yoghurt laboratory and production factory in France in 1932.

## Yoghurt & Kefir production

Kefir is traditionally produced through the fermentation of milk by kefir grains, a mass of distinctive bacteria and yeasts embedded in a matrix of protein and carbohydrate.[7] The grains, resembling small florets of cauliflower, are typically recovered at the end of the fermentation process and reused. Kefir differs from other fermented products because the kefir grains contain a specific and complex mixture of lactic acid- and acetic acid-producing bacteria, and lactose-fermenting and non-fermenting yeasts, which live symbiotically.[8] Authentic kefir is still produced in the traditional style using kefir grains today, although some commercial manufacturers now use cultures isolated from kefir grains or starter cultures containing freeze-dried lactic acid bacteria (LAB) and yeasts instead. However, kefir produced in this way may contain a lower number and variety of live cultures than those produced from kefir grains.[8]

**Figure 1: Peer-reviewed publications over the past 30 years**

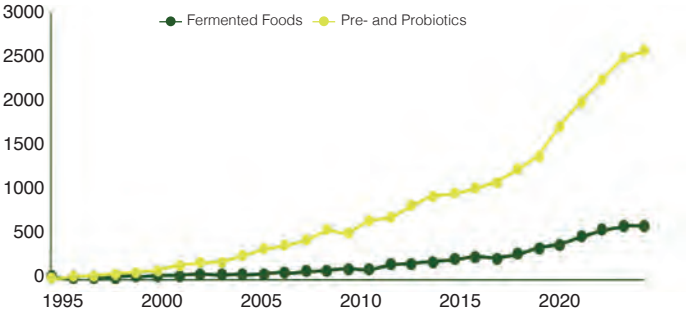


Figure 1. Research interest in pre- and probiotics and fermented foods has continued to increase over the past 30 years, in particular since 2020.

Yoghurt, by definition, is produced by the fermentation of milk with specific bacteria strains, namely *Streptococcus thermophilus* and *Lactobacillus Bulgaricus*.[9] Additional strains may be included to adjust the functional (i.e. health), taste or texture properties of the yoghurt. Plant-based yoghurt alternatives are also popular today, produced using a range of different non-dairy milk alternatives. While many of these are produced through fermentation with traditional yoghurt and lactic acid bacteria strains, research on their health effects, particularly in regard to the impact on the gut microbiota and gut health, is still emerging.

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## Nutritional composition & health benefits

Kefir and yoghurt are nutritionally dense foods, with the majority of products providing a good source of protein, calcium, B vitamins, magnesium and iodine. The nutritional content of both kefir and yoghurt is of course highly dependent on the individual product and how it's produced, with yoghurt containing a fat content ranging from almost zero to over 10%, and protein from around 3% to over 10%. Kefir typically has a protein content closer to that of milk at around 3-4%, but fat levels can vary depending on whether skimmed, semi-skimmed or whole milk is used as a substrate. The fermentation process has been demonstrated to increase the concentration of certain micronutrients in fermented milk products, in particular certain B vitamins. This occurs as vitamins are synthesised by LAB during fermentation, including folate, riboflavin and B12.[10] Additionally, enhanced bioavailability of certain trace elements including calcium may occur as a result of the increased acidity of fermented milk compared to raw milk.[11] The lower pH of fermented milk means calcium and magnesium are present in fermented milk mostly in their ionic forms which positively affects absorption.[12] A further benefit of the fermentation process for anyone who suffers with lactose intolerance is the reduction in lactose that occurs during fermentation. Both kefir and yoghurt contain β-galactosidase expressing bacteria, that being bacteria which express lactase enzymes, digesting some of the lactose within the milk. The resultant decrease in lactose (about 30%) means many lactose intolerant individuals are able to consume live yoghurt and kefir without experiencing symptoms.[3] In the EU and UK, improved lactose digestion for individuals who have difficulty digesting lactose is an approved health claim for yoghurt and fermented milk products containing at least $10^8$ colony forming units of *Streptococcus thermophilus* and *Lactobacillus Bulgaricus* per gram.[13]

## Are fermented dairy products probiotic?

The specific microorganisms or live cultures used in the fermentation process are responsible for various attributes of the end product, including taste, texture, and importantly, potential health effects. The term 'probiotic' was defined in 2001 by an Expert Consultation of the Food and Agricultural Organization of the United Nations and the World Health Organization (FAO/WHO) as *'Live microorganisms that, when administered in adequate amounts, confer a health benefit on the host'*.[14] The action of probiotic microorganisms is highly strain specific, meaning any evidenced benefits relate only to that individual strain of bacteria or yeast (**Figure 2**). Therefore, only fermented foods containing specific strains demonstrated to confer a health benefit may be considered probiotic, with specific benefits linked to the individual strain. A 2014 study in patients prescribed antibiotics compared two commercially available probiotic supplemented yoghurt drinks, both containing *Lactobacillus casei*, but of different strains. Patients given the drink with *Lactobacillus casei* CNCM I-1518 saw a significant reduction in antibiotic associated diarrhoea, whilst the group receiving *Lactobacillus casei* Shirota did not.[15]

Additionally, the FAO/WHO definition highlights the importance of 'adequate amounts' of beneficial strains. There is no set number of beneficial bacterial or yeast strains required to be considered a probiotic, the level should relate to what has been demonstrated as effective in human studies.[14] Where they satisfy the criteria of probiotic (**Figure 3**),[16] fermented foods have several distinct advantages over probiotic supplements. Most fermented foods will typically provide a source of macro and micronutrients, as well as potentially phytonutrients or other beneficial food compounds, depending on the substrate. They may also be a more cost-effective option than many supplements, and could be seen as less medicalised, and so more acceptable for some. For probiotic fermented foods, it is important that the whole food has been demonstrated to provide beneficial effects, rather than just the strains. Unlike probiotic supplements, with fermented foods the whole food matrix can play a role in the beneficial effects seen.[17] The same strains or blend of strains within a different food matrix may have different effects.

**Figure 2: The importance of strain specificity**

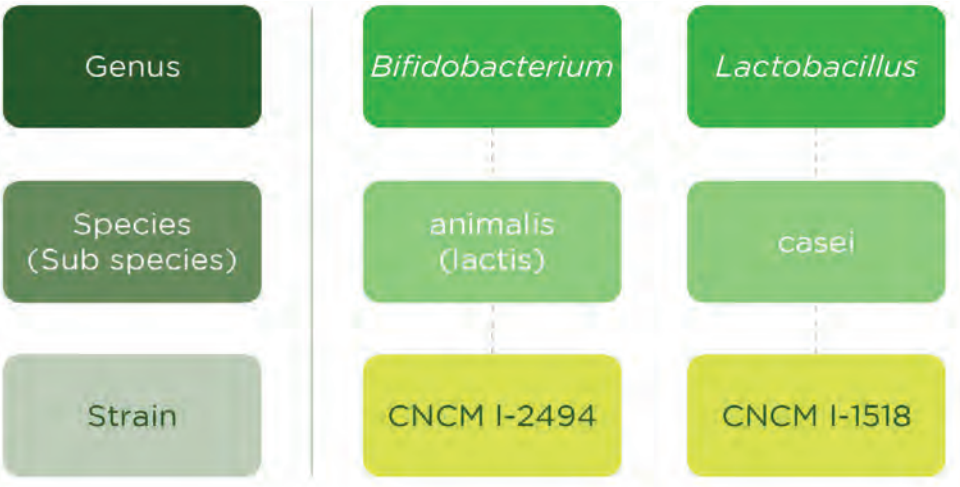


Figure 2. Probiotics work in a strain-specific manner. In order for a fermented food to be considered to be a probiotic it must contain a strain or blend of strains evidentially demonstrated to provide beneficial effects to the host.

**Figure 3: Probiotic strain decision tree**

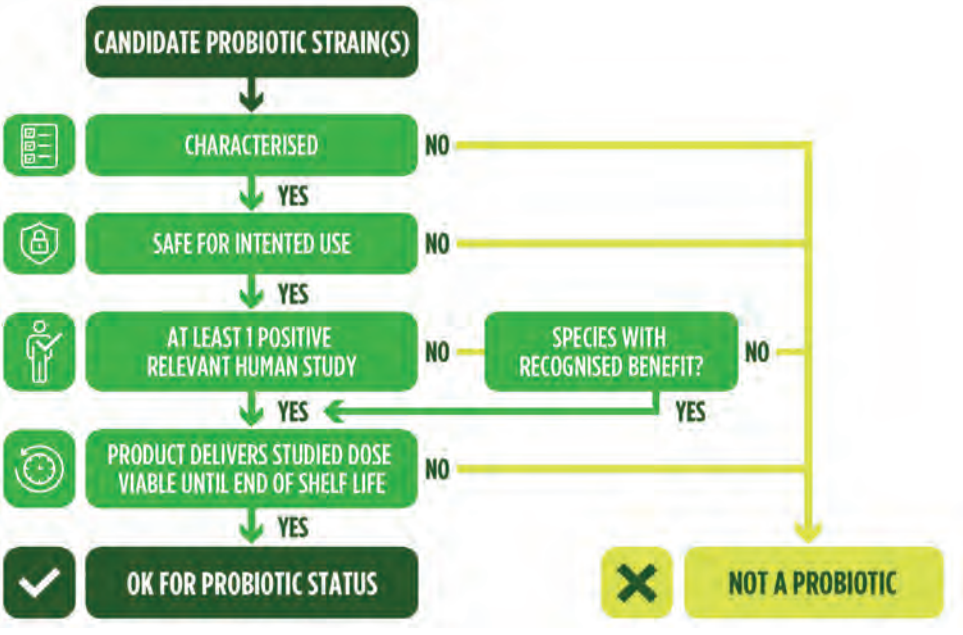


Figure 3. Decision tree to help determine if a strain fulfils the definition criteria of a probiotic. Adapted with permission from Binda *et al*, 2020.

## The evidence base for probiotic fermented dairy products

While all fermented foods, unless they have been exposed to high temperatures during processing (for example, sourdough bread) or have had the bacteria specifically removed (for example in beer manufacturing), will contain some live microorganisms, this is where the similarities end. Significant differences in the amount, type and function of these microorganisms exist between almost all fermented foods, owing to the different strains used, as well as the various substrates and processing methods. As already discussed, simply containing live bacteria or yeasts does automatically infer a health benefit. Firstly, to confer a benefit to the host and be considered a probiotic, the microorganisms must reach the gut alive. For the overwhelming majority of fermented foods available to consumers today there is no evidence demonstrating survival to gut. Survival of any live microorganisms is not guaranteed due to the low pH environment of the stomach, as well as bile and the increased osmolarity in the intestines.[18] For some fermented dairy products however we do have evidence of survival of the strains to the gut. Numerous studies have demonstrated survival of *Bifidobacterium animalis* subsp. lactis CNCM I-2494 in the faecal gut microbiota after consumption of yoghurt containing this strain.[19-21] Although, survival is only one piece of the puzzle. In order to demonstrate a benefit, or 'probiotic' effect, evidence of both the mechanism of action and beneficial outcomes is also necessary (**Figure 3**).[16] Again, there is a lack of such evidence for the majority of fermented foods, with the exception of fermented dairy. Studies have demonstrated the modulation of resident gut species and promotion of short chain fatty acid (SCFA) production following consumption of fermented dairy containing the strain *Bifidobacterium animalis* subsp. lactis CNCM I-2494.[22, 23] These observations suggest that alterations in gut microbiota composition, including an increase in certain species of *Bifidobacteria* and a reduction in potentially pathogenic species, coupled with an increase in SCFA production, in particular butyrate, are likely mechanisms by which these strains may exert a benefit on the host.

While evidence of survival to the gut and demonstrated mechanisms of action are important in understanding the probiotic action of any fermented food, specific evidence of beneficial health outcomes for the host are essential to meet the definition of a probiotic (**Figure 3**).[16] Again, fermented dairy, namely live yoghurt and kefir, have a significantly greater volume of evidence demonstrating positive health outcomes than any other fermented foods.[24] Unsurprisingly, effects on gastro-intestinal (GI) health are some of the most widely investigated health outcomes. Studies have identified a significant impact for consumption of kefir in supporting the management of dyspepsia and H. Pylori eradication (as an adjunctive treatment),[5] improved stool frequency and consistency in functional constipation[25] and improvement in intestinal barrier dysfunction markers.[26] Additionally, randomised controlled trials in live yoghurt containing *Bifidobacterium animalis* subsp. lactis CNCM I-2494 have found potential improvements in outcomes such as GI transit, abdominal distension and other symptoms in adults with constipation-predominant irritable bowel syndrome.[27-28] Finally, two meta-analyses across a total of 958 participants and 4 randomised controlled studies have evaluated the effect of fermented milk with *Bifidobacterium animalis* subsp. lactis CNCM I-2494 on GI discomfort (composite score of digestive symptoms) in healthy adults.[29-30] These meta-analyses have shown daily consumption is associated with a consistent and significant improvement of outcomes related to GI discomfort and symptoms.

### Beyond the gut

While much of the evidence for improved health outcomes from consumption of fermented dairy relates to the gut, the positive potential health effects don't end there. Research also shows potential improvements in weight and body composition, lipid profiles, hypertension and diabetes-related outcomes from consumption of live yoghurt and kefir.[5, 31] In fact, the FDA in the US recently gave a qualified health claim that: *'Eating yogurt regularly, at least 2 cups (3 servings) per week, may reduce the risk of type 2 diabetes according to limited scientific evidence.'*[32]

## Key take aways

**The increased interest in gut health in recent years has led to significant growth in the popularity of fermented foods. While fermented foods as a category are generally believed to be health promoting, only a limited number are supported by evidence, primarily fermented dairy products. Dairy products such as yoghurt and kefir provide a range of nutritional benefits in addition to live cultures, typically being a good source of protein, calcium and other micronutrients, and therefore can form part of a healthy, balanced diet for most. For patients or individuals seeking specific health benefits, it is important to recognise the strain-specific nature of probiotics and as such healthcare professionals should be aware of the evidenced benefits of different strains so that they can advise appropriately.**

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