Questions and Answers from BNF webinar: Fermented Food – Separating hype from facts

The most popular questions submitted by delegates during the live webinar event, *Fermented Food – Separating hype from facts* are answered below by Prof Bob Hutkins, Dr Eirini Dimidi, and Anne de la Hunty.

Prof Robert Hutkins, *Khem Shahani Professor of Food Science,* University of Nebraska-Lincoln answers:

Q: Are all fermented foods with live cultures considered probiotic?

A: The short answer is no. The microbes used to make fermented foods are selected on their quality performance, not their health properties. Probiotics have a precise definition: "*live microorganisms that, when administered in adequate amounts, confer a health benefit on the host*". Importantly, to demonstrate that the microbes in fermented foods confer a health benefit necessarily means that the microbes are identified, that they are consistently present, and that health benefits have been shown in a clinical study. Consider products like kimchi or miso that are fermented by the naturally occurring microbes in the raw material, the identity of the microbes will vary from region to region, and batch to batch, and rarely would a manufacturer go through the trouble of identifying all the microbes in those products. But to show that those microbes are probiotic would require they actually be identified each time, followed by clinical studies. It's just not practical.

That being said, many fermented foods do contain established probiotics, but they are usually added to the food separately. For example, many yogurts contain probiotic bifidobacteria that are not involved in the fermentation at all. Not to make this more complicated, but the microbes used to make yogurt may themselves (*Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp. *Bulgaricus)* have probiotic activity. In particular, they can help improve lactose digestion in lactose intolerant individuals.

Q: If it is the bacteria in yogurt that confers health benefit, would we expect similar health benefits to be reported with intakes of non-dairy yogurt that contains bacteria?

A: Probiotic bacteria added to traditional yogurt would likely have the same health-promoting activity in non-dairy yogurt. As noted above, yogurt bacteria can help with lactose digestion in lactose intolerance, but that benefit would not count for much in non-dairy yogurt.

Dr Eirini Dimidi, *Lecturer in Nutritional Sciences,* King's College London answers:

Q: Is there evidence that kefir is any more beneficial than plain yogurt with regards reducing the effects of lactose malabsorption?

A: One randomised controlled trial compared the effect of kefir vs yogurt vs milk (among other interventions) (Hertzler et al, 2003). Both yogurt and kefir consumption led to lower breath hydrogen production (*indicating less lactose malabsorption)* compared to milk, and there was no difference between yogurt and kefir. Similarly, both yogurt and kefir consumption led to lower flatulence severity compared to milk, and no difference was found between yogurt and kefir. Therefore, the study suggests that kefir is as well tolerated as plain yogurt in adults with lactose malabsorption.

Q: Do we understand the biochemical or cellular pathways that would explain the potential beneficial effect of kefir on H. pylori infection?

A: We don't entirely understand the mechanisms through which kefir may improve the effectiveness of triple antibiotic therapy in eradicating H. pylori. It is hypothesised this may be attributed to a potential "probiotic" effect of the microorganisms found in kefir. *In vitro* studies have shown that certain (other) probiotic microorganisms may inhibit the growth of H. pylori through competition for adhesion sites and nutrients or through the production of metabolites with antimicrobial activity. However, no such studies exist for kefir-specific microorganisms. Kefir was also shown to decrease gut symptoms, such as diarrhoea, compared to placebo, during triple therapy. Although not confirmed, this finding could be attributed to the effect of kefir on gut physiology (gut microbiota, metabolite production etc), as discussed in my webinar presentation, thus leading to fewer antibiotic-related side effects.

Q: Would you anticipate differences in effects between milk kefir and water kefir?

A: A dairy-free version of kefir, called water kefir, is a fermented beverage made of water, sugar and water kefir grains, which contains bacteria and yeasts. However, the microbial composition of the water kefir starter cultures is different from the traditional dairy kefir starter cultures. Therefore, it is likely that they have different physiological effects in the gut, not only due to the different microbial composition, but also due to differences in the ingredients (milk), metabolite content, nutrients etc. To date, there are no randomised controlled trials on the effect of water kefir in the gut, therefore its effectiveness is unknown.

Q: Can outcomes from different studies on fermented foods be compared considering the heterogeneity of the microbial communities of different batches of the same or similar kinds of fermented foods?

A: Since the physiological and clinical effects of microorganisms appear to be strain-specific, we cannot currently generalise findings to all similar fermented products (e.g. kimchi A may be different from kimchi B). Similarly, we cannot compare outcomes between different fermented food types (e.g. kefir vs kombucha), as they differ in their microbial composition, nutrient composition, ingredients, fermentation method etc.

Q: Would the same effects on gut health be expected from artisanal and commercial fermented foods?

A: One key difference between artisanal and commercial fermented food products is that artisanal products lack standardisation in terms of their microbial composition and preparation methods. For example, a kefir product made by Person A may be different than that made by Person B. Similarly, it is possible that different batches of kefir made by the same person differ in their microbial and nutrient composition. Therefore, it is more difficult to determine the effectiveness of all artisanal products, as they can considerably differ from one another. It doesn't necessarily mean they do not offer any health benefits; this however is difficult to confirm in a research setting, hence the lack of evidence.

Prof Robert Hutkins, *Khem Shahani Professor of Food Science,* University of Nebraska-Lincoln answers:

Q: Which fermented foods contain bacteria capable of producing vitamins at concentrations high enough for nutritional benefit?

A: Although concentrations can vary considerably, the B vitamins, folate, and other vitamins can be produced *in situ*, meaning in the food during fermentation. Probably the most relevant examples are vitamin B12 and vitamin K. Again, amounts vary, but nutritionally relevant amounts are produced in tempeh and natto, respectively. There is also evidence that vitamins can be produced *in vivo*, meaning in the gut.

Q: Is salt essential for fermentation?

A: The short answer, is often yes, (with yogurt and cultured dairy products, and beer, wine, and other alcoholic products, as the main exceptions). Salt serves important functions, especially for so-called spontaneous fermentations, i.e., those made without a starter culture. This includes fermented vegetables like sauerkraut and kimchi, as well as some of the traditional European sausages. Salt helps to prevent undesirable spoilage or even disease-causing microbes from out-competing the beneficial lactic acid bacteria needed for fermentation. Once the latter microbes start to grow, they produce acids that further inhibit those unwanted microbes, making these foods well preserved and safe. Salt has other functional properties in products like bread and cheese, and of course it enhances flavour.

Q: How do we balance the health benefits of fermented foods with their often high salt content?

A: Too much salt has negative health implications especially for those populations that consume a lot of kimchi, soy sauce, miso, or other high salt products. Indeed, there are efforts in some of these countries to reduce consumption of those products. There are lower salt versions, but they often still contain rather high levels. For example, one brand of reduced

salt soy sauce still contained 700 mg of sodium in a 1 tablespoon serving. The best advice is to practice moderation, read labels, and seek out fermented foods that are lower in salt.

Anne de la Hunty, *Senior Scientist and Editor of Nutrition Bulletin*, British Nutrition Foundation adds:

The composition of fermented foods varies hugely. Fermented foods can be high in salt (e.g. cheese, soy sauce, kimchi, miso), saturated fat (e.g. cheese) or free sugars (e.g. sweetened yogurts) and so frequent consumption of these foods could lead to diets high in saturated fat, salt and free sugars, with the adverse health consequences that may be associated with this.

Q: In terms of individuals who consume high amounts of fermented foods having a more diverse microbiome, how much of any benefit is related to healthy user and income bias?

A: In general, greater microbial richness and diversity in the gut are considered to be "healthy". However, it is not clear if consuming diets rich in fermented foods increases gut diversity. I am not aware of any studies on income bias.

Anne de la Hunty, *Senior Scientist and Editor of Nutrition Bulletin*, British Nutrition Foundation answers:

Q: At what age can babies have fermented foods?

A: Infant feeding advice is to exclusively breastfeed for around the first 6 months and to continue breastfeeding for at least the first year of life once solid foods have been introduced. Interestingly breast milk has been reported to contain more than 700 species of bacteria, and also contains oligosaccharides with prebiotic activity, stimulating the growth of beneficial bacteria such as *Bifidobacteria*.

In the UK, the Start4Life website (launched as a joint initiative by the NHS, Department of Health and Department for Education and run by Public Health England) says that unsweetened whole milk yogurt and cheese (pasteurised) can be introduced from 6 months. It has been suggested that it may be beneficial for young children to become accustomed the 'sour' taste of foods like yogurt. Complimentary feeding guidelines also include avoiding added salt and free sugars and it is important to recognise that some fermented foods, for example kimchi and sauerkraut, use salt as ingredients.

Q: Are there any studies in young children that show benefit of fermented foods for example with antibiotic treatment?

A: There is a scarcity of research looking at this specific area. In a Cochrane systematic review *Probiotics for the prevention of pediatric antibiotic-associated diarrhea* that looked at probiotics in any form (e.g. capsule, sachet, yogurt), where strain and dose were labelled, only one (out of 33) studies looked at yogurt (Conway *et al.* 2007). This systematic review suggested a moderate protective effect of probiotics for preventing antibiotic associated diarrhoea (AAD) in children with a reduction in the incidence of AAD by 11% in children aged between 3 days to 17 years (5 days to 12 weeks of follow-up, daily dosage of probiotic(s) varied from 100 million to 2 trillion CFUs or colony forming units/day), with subgroup analysis suggesting high dose probiotics (≥ 5 billion CFUs per day) are more effective than low dose.

Q: In light of covid-19, what is the evidence for any effect of fermented foods on the immune system?

A: There is some evidence for a role for probiotics in immune function (https://pubmed.ncbi.nlm.nih.gov/21897224/) and in preventing upper respiratory tract infections, although the quality of the evidence is low (Hau *et al.* 2015). A meta-analysis of 6 studies by Gui 2020 found a small but significant effect of probiotic supplementation, including fermented dairy foods, on natural killer (NK) cell activity in elderly subjects but cautioned that the number of studies was small and they varied a lot (there was large heterogeneity in terms of study design and dose and type of probiotic supplementation). Whether probiotics, prebiotics or fermented foods directly influence COVID-19, or whether the modulation of gut microbiota plays a therapeutic role in COVID-19 patients has not been specifically researched to date. Although some research in this area is emerging and is interesting, it is important that misleading claims are not made.