

# PROBIOTIC: SOURCES, PRODUCTS AND HEALTH BENEFITS – REVIEW

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## Abstract:

Probiotics have gained a lot of attention lately due to their potential therapeutic and preventive functions in human health. Probiotics are defined as live bacteria that, when given in sufficient concentrations, offer health advantages to the host. Probiotics are frequently included in nutritional supplements and fermented dairy and non-dairy products. Probiotics are present in a wide range of foods, including grains, vegetables, legumes, fruits, and dairy products. The majority of probiotics with dairy and non-dairy bases are a rich source of beneficial microorganisms. These beneficial microbes, which are mostly belonging to the genera *Lactobacillus*, *Bifidobacteria*, and yeast, play an essential role in maintaining the gut microbiota's balance. Probiotics may be utilized as an adjuvant in the treatment of cancer, hypertension, hypercholesterolemia, and gastrointestinal conditions such as irritable bowel syndrome and diarrhea. The host's immune response is modulated, the gut's barrier function is improved, and harmful bacteria are competitively excluded as part of the mechanism of action. Hence, this review paper explores the sources, properties, mechanisms of action, and health benefits of probiotics.

**Keywords:** Probiotics, health benefits, microbiota, fermented food, microbes.

## Introduction:

The scientist Werner Kollath coined the term "probiotic" in 1953. It was derived from the Latin word pro, which means before and the Greek word βιο, which means "for life." Kollath described probiotics as living organisms that have vital roles in enhancing a range of health outcomes (Gasbarrini *et al.*, 2016). Researchers studied the link between food and health benefits for years, and recently, probiotics (helpful live bacteria) gained attention for their potential to improve health, making it easier to identify specific probiotics and their benefits (Prabhurajeshwar *et al.*, 2019). the FAO and WHO defined probiotics as "live good bacteria" that, when taken in enough amounts, improved the host's health, and this definition was widely accepted by scientists (Maftei *et al.*, 2024). Numerous bacteria from the genera *Propionibacterium*, *Bacillus*, *Lactococcus*, *Enterococcus*, and *Streptococcus* are thought to be candidates for probiotic status (Hamad *et al.*, 2022). Probiotics were essential for preventing and treating various intestinal disorders, such as inflammatory bowel disease, diarrhea, and colon cancer (Wollowski *et al.*, 2001). The European Commission's legal proposal defines probiotic bacteria as living

food supplements that improve consumer health (Guarner *et al.*, 2005). Probiotics are non-pathogenic organisms, such as bacteria or yeast, that are safe to consume, can endure extreme environment, are tolerated by the immune system, and do not cause antibody development, hence boosting health when taken (Mokoena, 2017). The recent trend of using commensal bacteria as probiotics to naturally restore health in varied human habitats has resulted in the creation of Next-Generation Probiotics (NGPs), also known as Live Biotherapeutic products (Martín & Langella, 2019). Researchers looked at how probiotics altered risk factors for heart disease, such as obesity, diabetes, high blood pressure, and high cholesterol, as well as metabolic concerns including excessive homocysteine levels and oxidative stress (Quinto *et al.*, 2014).

## 2. Source of probiotics:

Since ancient times, probiotics have been a part of human diets through fermented foods and beverages, including cheese, yogurt, and drink (Kaur *et al.*, 2020). There were two ways we can consume probiotics, through diet supplements or by consuming fermented foods. Because the use of fermented foods was encouraged to treat certain ailments and was not advised for daily usage, they are highly regarded in comparison to dietary supplements. Dairy products with a fermentation process are an excellent source of probiotics (Liong *et al.*, 2011). The Probiotics can be broadly classified into two categories, both dairy and non-dairy products.

### 2.1 Dairy based probiotic products:

Lactic acid bacteria (LAB)-fermented dairy products are widely used as probiotics in the market and are becoming more and more well-liked within the dairy industry. Table-1 discusses various kinds of dairy-based probiotic products, their health benefits and the microorganisms used in their manufacturing (Syiemlieh & Morya, 2022).

**Table 1.** Dairy based probiotic product and its health benefits

Product	Sources	Microorganisms	Health Properties	References
Yogurt	Cow's milk	<i>L. acidophilus</i> ; <i>S. thermophiles</i> ; <i>L. bulgaricus</i> ; <i>L. plantarum</i> ; <i>L. rhamnosus</i>	Improvement of gastrointestinal; Antimicrobial effect; Lowering the cholesterol	Panesar, 2011; Jang <i>et.al.</i> , 2024
Curd	Buffalo's or Cow's milk	<i>L. lactis subsp. lactis</i> ; <i>L. delbrueckii subsp. bulgaricus</i> ; <i>L. plantarum</i> ; <i>Streptococcus lactis</i> ; <i>S. thermophiles</i> ; <i>S. cremoris</i>	Cholesterol level; improvement of immune function, resistance to infectious diseases	Bengoa <i>et al.</i> , 2018

Product	Sources	Microorganisms	Health Properties	References
Kefir	Kefir Grains and Buffalo's or Cow's milk	<i>L. casei</i> , <i>L. acidophilus</i> , <i>L. fermentum</i> , <i>K. marxianus</i> , <i>S. unispours</i> , <i>S. cerevisiae</i>	Antimutagenic effect; anticaecinogenic effect; reducing lactose tolerance	Jang <i>et.al</i> 2024; Bengoa <i>et al.</i> , 2018
Butter milk	Buffalo's or Cow's milk	<i>Lactocaseibacillus paracasei</i> ; <i>Lactocaseibacillus casei</i>	Maintains proper metabolism antitumor or cholesterol-lowering impact	Yeragi <i>et al.</i> , 2016; Barukcic <i>et al.</i> , 2019
Cheese	Buffalo's or Cow's milk	<i>L. acidophilus</i> ; <i>L.casei</i>	Microbial antigenotoxic – antimutagenic properties	Kalyankar <i>et al.</i> , 2022
Paneer	Buffalo's or Cow's milk	<i>Staphylococcus aureus</i> <i>E. coli</i>	Improving digestion, antioxidant properties, reduces cramps in muscles.	Pal <i>et al.</i> , 2023
Shrikand	Buffalo's or Cow's milk	<i>Lactobacillus bulgaricus</i> , <i>Streptococcus lactic</i> , <i>Streptococcus diactylactis</i> , <i>Lactobacillus citrovorum</i> , <i>Streptococcus thermopiles</i>	Maintaining & promoting a good health	Chopade <i>et al.</i> , 2022

## 2.2. Non-Dairy based probiotic products:

Probiotics can be found in milk and other dairy products, but their availability was limited by lactose intolerance, cholesterol levels, and allergies to milk proteins (Rasika *et al.*, 2021). The several kinds of non-dairy probiotic drinks can be made from mixtures, fruit and vegetable juices, milk made from cereals, legumes, and pulses (S & MS, 2019). Table-2 highlights the sources of non-dairy products with their health benefits.

**Table 2.** Non-Dairy based probiotic products and its health benefits

Products	Sources	Microorganisms	Health properties	References
Kimchi	Vegetables and various seasonings	<i>Leuconostoc</i> , <i>Weissella</i> , <i>Lactobacillus</i> , <i>Pediococcus</i>	Antimicrobial, antifungal and antiviral activities	Cha <i>et al.</i> , 2023
Tofu	Soybean	<i>Streptococcus</i> lutetientis, <i>Clostridium spp</i> , <i>Weissella confusa</i>	Anticarcinogenic, isoflavones, blood cholesterol & sugar lowering	Rossi <i>et al.</i> , 2016
Kombucha	Beverages, tea and sugar	<i>L. casei</i> , <i>L. plantarum</i> , <i>L. nagelii</i> , <i>L. mali</i>	Mediating blood sugar level (antidiabetics), cholesterol levels	Wang <i>et al.</i> , 2022
Sauerkraut	Cabbage	<i>L. mesenteroides</i> , <i>L. plantarum</i> , <i>L. brevis</i>	Antioxidant, anti-inflammatory & chemo preventive action against certain type of cancer	Peñas <i>et al.</i> , 2017; Zabat <i>et al.</i> , 2018
Meat	Chicken	<i>L. casei</i> , <i>L. acidophilus</i> , <i>L. plantarum</i> , <i>L. sakei</i> .	Balanced diet, prevention of cancer, atherosclerosis and coronary disease	Kołożyn-Krajewska & Dolatowski, 2012
Miso	Soyabean, grains	<i>T. halophilus</i> E. <i>faecium</i>	Anticancer, antimicrobial & antiobesity	Saeed <i>et al.</i> , 2022
Dosa	White rice, black gram	<i>Leuconostoc mesenteroides</i> , <i>L. fermentum</i> & <i>Bacillus amyloliquefaciens</i>	To maintain a healthy body weight	Snehal <i>et al.</i> , 2020; Krishnamoorthy <i>et al.</i> , 2018

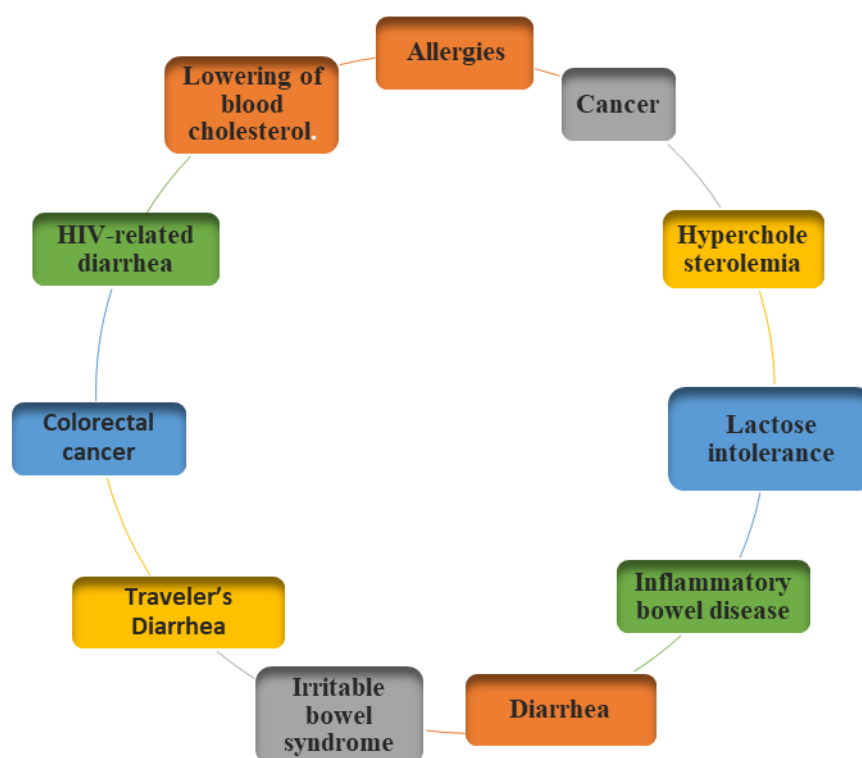
### 3. Properties of probiotics:

Researchers tested probiotic strains for four key features surviving stomach acid, adhering to gut surfaces, fighting harmful bacteria, and interacting with bile salts, to confirm their health benefits (Kechagia *et al.*, 2012). Despite the varieties of target, some basic standards were established, they weren't toxic or pathogenic to the host, had a proven positive impact with a clear mechanism, remained stable during shelf life, contained enough live cells for health benefits, and were compatible with the product's sensory

qualities (Sanders *et al.*, 2007). Probiotic bacteria like *Lactobacillus* were found to boost the immune system by increasing antibodies and activating immune cells, improving overall and gut immunity (Galdeano *et al.*, 2006). Studies found that probiotic bacteria had a positive impact on the immune system, but the exact way it worked was unclear, although it was shown to benefit people who consumed them (Kumar *et al.*, 2018). Probiotics were shown to effectively treat various chronic conditions, act as antioxidants and anti-inflammatory agents, and were ideal for producing beneficial chemicals due to their simple metabolism (Abdelazez *et al.*, 2018). Recent research demonstrated that probiotics could neutralize COVID-19 infections (Das *et al.*, 2022).

#### 4. Health benefits of probiotics:

Probiotics are thought to help prevent and treat a variety of disorders. Probiotics have been shown in studies to help treat allergies, cancer, hypercholesterolemia, lactose intolerance, inflammatory bowel disease, diarrhea, and irritable bowel syndrome (Fig-3) (Latif *et al.*, 2023).



**Figure 1.** Health benefits of probiotics

##### 4.1. Allergies:

Allergies, characterized by type 1 hypersensitivity, occur when the immune system overreact to harmless environmental antigens, leading to various allergic reactions, such as asthma, eczema, and hay fever, which affected approximately half of the population in Europe and North America (Latif *et al.*, 2023). Probiotics alleviate some food allergy symptoms, such as those triggered by milk protein, by breaking down the proteins into smaller components, and when added to infants' hydrolyzed whey formulas, they reduced symptoms of atopic dermatitis (Parvez *et al.*, 2006). A study found that probiotic

supplements containing *Lactocaseibacillus rhamnosus* reduced atopic eczema symptoms in infants, with only 23% developing the condition compared to 46% in the placebo group, suggesting probiotics may help prevent some allergies (Salam *et al.*, 2023).

#### **4.2. Cancer:**

Probiotic microorganisms have shown antitumor effect in animal experiments (Vafaeie, 2016). Probiotics have previously been claimed to reduce cancer risk by breaking down harmful substances in food, altering the gut environment to reduce cancer-causing bacteria, producing butyrate to trigger cell death, developing compounds that could slow cancer cell growth, and boosting the immune system to fight cancer cells more effectively (Sharma *et al.*, 2012).

#### **4.3. Inflammatory bowel disease:**

Inflammatory Bowel Disease (IBD), comprising ulcerative colitis and Crohn's disease, was a chronic condition with an unknown exact cause, but was believed to result from a combination of genetic and environmental factors, and although various treatments were available, there was no cure (Onyenweaku *et al.*, 2016). Engineered probiotics, such as ECN-pE(C/E)2, acted as a chemical medicine to protect the colon and reduce inflammation. Probiotics also helped restore balance to the gut flora, which is frequently disrupted in IBD patients. Overall, probiotics have been shown to be effective in treating IBD by lowering inflammation and supporting intestinal repair (Venkatesh *et al.*, 2024).

#### **4.4. Lactose tolerance:**

According to The Harvard Medical School Family Health Guide (September, 2005), individuals with lactose intolerance were able to consume yoghurt with minimal effects because its bacteria, such as *L. bulgaricus* and *Streptococcus thermophiles*, broke down lactose in the small intestine, allowing for comfortable digestion (Onyenweaku *et al.*, 2016). The lactic acid in yoghurt alleviated lactose intolerance symptoms in individuals lacking lactase, likely due to the lactic acid bacteria stimulating lactase activity in the small intestine, thereby enhancing lactose digestion (Parvez *et al.*, 2006).

#### **4.5. Hypercholesterolemia:**

Hypercholesterolemia increases the risk of lifestyle-related disorders such as atherosclerosis, CVDs, and stroke (Pourrajab *et al.*, 2020). This syndrome frequently resulted in early onset of coronary artery disease (Sivamaruthi *et al.*, 2021). Probiotics, particularly *Lactobacilli* and *Bifidobacteria*, were found to lower cholesterol levels by breaking down bile acids, which led to increased removal of cholesterol from the body through feces.

#### **4.6. HIV-related diarrhea:**

Opportunistic infections in HIV patients cause gastrointestinal damage, microbial translocation, and diarrhea. Recent studies indicate that probiotic medication is safe and well-tolerated in HIV-infected people, while symbiotic supplementation may boost gastrointestinal immunity conducted a randomized, double-blind, placebo-controlled clinical trial with 77 HIV-infected children aged 2-12 years. Probiotics appear safe for HIV-infected persons, but their effectiveness yet to be proved (Passariello *et al.*, 2014).

#### **4.7. Traveler's Diarrhea:**

In several studies, probiotics helped minimize traveler's diarrhea, with one finding a 15% reduction in the risk. Overall, probiotics appeared to help some travelers prevent diarrhea, but outcomes varied. Probiotics were found to be helpful in reducing the risk of diarrhea in a variety of conditions, including 52% when taking antibiotics, 8% when travelling, and 34% overall. Children benefited the greatest, with a 57% reduction in acute diarrhea against a 26% drop in adults. Overall, probiotics reduced the prevalence of diarrhea in children and adults (Islam, 2016).

#### **4.8. Urinary tract infections:**

Urinary tract infections (UTIs) were a major global health concern affecting individuals of all ages, and they were associated with inflammation of the urinary system, including the kidneys, bladder, and urethra. Mitiku's latest study discovered that bacteria isolated from UTI patients were highly resistant to various medications but generally responsive to ciprofloxacin, ceftriaxone, nitrofurantoin, and norfloxacin. *E. coli* was the most prevalent bacterial isolate, particularly among adult, female, and married individuals. As antibiotic resistance increased, it became critical to track resistance patterns and investigate alternative treatments such as probiotics, prebiotics, and immunostimulants (Mokoena, 2017).

#### **5. Conclusion:**

Scientific data backed up the use of probiotics in nutrition for health advantages. While this evidence was strong for avoiding and treating certain problems, such as gastrointestinal disorders, it was either hopeful or disputed for others. The well-documented effects included the treatment of lactose intolerance, antibiotic-associated diarrhea, infectious diarrhea, Traveler's diarrhea, urinary tract infection, HIV related diarrhea, colorectal cancer, lowering of blood cholesterol and allergies. As consumer knowledge increased, these products became more popular and accounted for a large portion of the functional food market, with dairy products such as yoghurt serving as the principal carriers of probiotics. The non-dairy sector has also evolved as a result of developments in food technology and increased demand. This set off a cycle in which the development of new products led to increased public acceptability, prompting the food business to invest more in the market. However, the development of probiotics for human use was still in its early stages, with more research needed to find the most effective probiotics, dosages, and patient groups, as well as to ensure safety and establish worldwide rules. Although probiotic research has evolved tremendously, a key breakthrough in completely understanding their mechanisms had yet to be recorded.

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