

## Traditional Indian Fermented Dairy Products: A Probiotic Powerhouse for Health and Innovation

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### Abstract

Traditional Indian fermented dairy products are rich sources of probiotics and bioactive compounds, offering diverse health benefits including antimicrobial, antioxidant, antidiabetic, and cholesterollowering effects. Products like dahi, lassi, shrikhand, and regional variants such as mishti doi and chilika curd are embedded in local traditions and diets. Lactic acid bacteria (LAB) play a key role in enhancing safety, shelf life, and functional properties through bioactive metabolite production. Despite their potential, much remains unexplored at the microbial and molecular levels. Integrating scientific research with industrial application can elevate these traditional products in global functional food markets while preserving cultural heritage.

### Introduction

Milk is a nutrient-rich food that supports growth and health, making dairy products a vital part of the diet of society. Fermented dairy products, in particular, have long been used worldwide to deliver probiotics—beneficial microbes known for their health-promoting effects. These products provide an ideal environment for microbial growth, enabling the production of functional metabolites and the isolation of useful bacteria like *Lactobacillus, Bifidobacterium*, and *Streptococcus*. As a result, fermented milk not only serves as a source of probiotics but also plays a key role in the functional food market, especially as consumer awareness of health and nutrition continues to rise (Kaur et al., 2022). Traditional Indian fermented dairy products contribute significantly to this trend, offering both health benefits and a rich source of diverse probiotic strains. Traditional fermented milk products have garnered significant attention for their multifaceted health benefits, including antimicrobial, antifungal,



antioxidant, antithrombotic, antidiabetic, anticholesterolemic, immunomodulatory, anticancer, and anti-lactose intolerance effects. These therapeutic potentials have expanded the scope and market demand of such products in both Indian and international contexts. Indian curd, in particular, has been recognized as a rich source of beneficial bacteria like *Lactobacillus* and *Bifidobacterium*, which possess significant probiotic attributes. These probiotics not only enhance gut health and immune function but may also provide protection against various diseases, making curd an integral part of vegetarian diets for its nutritional and therapeutic value.

Fermented foods have deep roots in Indian history, dating back to 7000–8000 B.C. in the Indus Valley Civilization, where clay pots were used to prepare various fermented items (Ray et al., 2024). The reverence for cows and their milk is evident in ancient texts like the Rig Veda, highlighting the longstanding cultural and nutritional significance of dairy. Traditional fermented milk products such as Dahi, Lassi, and Shrikhand are now widely produced across India, while region-specific delicacies like Mishti Doi, Rabdi, Chhurpi, Pachadi, and Chilka-curd remain integral to local traditions. Exploring the science behind these products not only preserves cultural heritage but also opens doors for commercial expansion and international recognition.



# Fig. Traditional Indian Fermented Dairy Products and their Health Benefits Traditional Indian fermented dairy products

Dahi, or curd, is the most widely consumed fermented milk product in India, traditionally prepared using back-slopping methods. It is rich in lactic acid bacteria (LAB) such as *Lactococcus* 



*lactis, Streptococcus thermophilus, Lactobacillus bulgaricus,* and *Lactobacillus helveticus*. Dahi serves as a natural source of probiotics and bioactive peptides, contributing to improved digestion, reduced lactose content, and potential antihypertensive and cholesterol-lowering effects. Lassi, another staple derived from dahi, is a churned, diluted form served sweet or savory, known for its cooling and digestive properties, especially in summer.

Mishti doi is a sweetened, fermented milk delicacy popular in East India, made by fermenting thickened milk with sugar or jaggery. It harbors LAB strains similar to dahi and has been studied for its ACE-inhibitory peptides and therapeutic effects. Chilika curd, made from buffalo milk in the Chilika region of Odisha, is traditionally fermented in bamboo baskets and contains a robust community of LAB with antifungal properties, extending its shelf life. Chhu (Sheden), a product from the northeastern Himalayan belt, is derived from buttermilk and fermented over several days, harboring diverse LAB and beneficial yeasts such as *Candida castellii*.

Chhurpi, a hard, fermented cheese from yak or cow milk, is a GI-tagged product from the Eastern Himalayas with significant cultural and economic value. It exists in three main varieties—soft, hard, and dudh chhurpi—with the hard variant having an exceptional shelf life of up to two decades. Other lesser-known fermented products include mohi (fermented yak buttermilk), philu (fermented milk set with bamboo or creepers), shyow (gel-like curd), and somar (a bitter fermented paste). These products are deeply integrated into local food systems and are reservoirs of diverse and beneficial LAB species like *Lactobacillus paracasei, Lactobacillus bifermentans*, and *Lactococcus cremoris*.

Shrikhand is a sweet fermented milk dessert from Gujarat and Maharashtra, made by blending chakka (dewatered curd) with sugar and flavoring agents. It is nutrient-dense and contains a rich matrix of probiotic LAB. Fortified or herbal variants of shrikhand, such as those containing ashwagandha or ginseng, have demonstrated antioxidant and immunomodulatory properties, elevating their value as functional foods. Buttermilk (chhash or chaas), commonly consumed across India, is an affordable and digestible beverage with probiotic benefits, often spiced to enhance palatability and gut health.

In South India, curd-based dishes such as pachadi, kichdi, and mor kuzhambu are traditionally served as side dishes and feature sour curd combined with vegetables or spices. These preparations are not only flavorful but also contribute significantly to digestive health and nutrient intake. Overall, India's traditional fermented milk products are diverse, rich in functional microbial communities, and hold immense potential for health promotion, therapeutic application, and commercial development.

### Health Benefits of fermented dairy products

Recent studies support the use of LAB from traditional fermented foods to enhance the safety and functional properties of probiotic dairy products (Kariyawasam et al., 2021). Lactic acid



production by probiotic bacteria plays a pivotal role in dairy fermentation by enhancing food preservation and preventing the growth of spoilage organisms and pathogens. Lactic acid bacteria (LAB) produce various antimicrobial compounds, including bacteriocins, that function as biopreservatives, notably against Listeria monocytogenes, a psychrotrophic pathogen responsible for listeriosis and commonly associated with post-processing contamination of ready-to-eat dairy products like soft cheeses. Some LAB strains are associated with health benefits such as anti-obesity and antidiabetic effects, cholesterol reduction, immunomodulation, antioxidant activity, and ACE-inhibition, along with exopolysaccharide and bacteriocin production (Ağagündüz et al., 2021). In milk-based fermentations, dominant LAB genera include Lactococcus, Lactobacillus, Leuconostoc, Streptococcus, and Enterococcus, along with psychrotrophs, yeasts, and molds that also influence product characteristics. These microbial consortia impact the sensory and techno-functional properties of fermented milk products through the production of lactate and other metabolites. The metabolic byproducts of lactic acid bacteria (LAB), including bacteriocins, enzymes, organic acids, gases, hydrogen peroxide, vitamins, exopolysaccharides, diacetyl, acetoin, acetaldehyde, and several low molecular weight compounds such as reuterin and phenyllactic acid, significantly influence the technological and functional attributes of fermented dairy products. These compounds contribute to product stability, preservation, and bioactivity. Fermentation-induced enzymatic action modifies milk proteins, resulting in the formation of bioactive peptides with diverse health-promoting properties. The nature and functionality of these peptides may vary depending on the milk source, species, and breed. Consequently, fermentation using bio-protective LAB has become increasingly relevant for developing functional dairy products like Dahi, Lassi, Shrikhand, and buttermilk.

#### **Future Scopes and Challenges**

As health consciousness increases, the dairy industry is seeking to optimize fermented dairy products for enhanced health benefits without compromising traditional sensory attributes. This has opened new avenues for incorporating novel probiotic strains into conventional fermented milk products, creating opportunities for innovation. Coupling scientific insight with marketing can elevate the status of these products, offering them a place in mainstream health food markets. India's growing e-commerce and service sector offers an ideal platform for promoting authentic regional products directly to consumers across the country and globally.

Fermented dairy products are beneficial not only nutritionally but also therapeutically. They are recommended for lactose-intolerant individuals, support in preventing gastrointestinal infections like diarrhea, and contribute to the reduction of serum cholesterol. However, the microbial consortia and their specific functions within traditional dairy matrices remain largely underexplored. Traditional



Indian milk products, often fermented using artisanal cultures, possess rich, diverse microbial populations. There is a critical need to investigate these consortia using modern scientific tools, especially integrated 'omics' technologies like metagenomics and metabolomics, to unveil their full potential (Mallappa et al., 2021).

### Conclusion

Traditional fermented dairy products are a valuable reservoir of beneficial probiotics, contributing significantly to the enhancement of texture, sensory appeal, and therapeutic potential in modern dairy innovations. Although numerous scientific studies have highlighted the health-promoting properties of probiotics derived from these products, much of the research remains confined to laboratory investigations. To fully harness their potential, it is essential to translate these findings into scalable, industrial applications that ensure product quality, safety, and efficacy. The rising consumer interest in functional foods, driven by the longstanding link between dairy and health, underscores the urgency and relevance of advancing traditional fermented dairy products through practical, evidence-based innovation.

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