



Innovations in Fermented Dairy Foods: Science to Market

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The demand for innovative fermented dairy products is expanding rapidly, driven by rising health consciousness, urbanization, and a growing understanding of gut microbiology. Historically rooted in traditional Indian dietary staples such as *dahi* and *chhaas*, as well as global heritage foods such as yoghurt and kefir, fermented dairy has evolved into a key pillar of the functional food and nutraceutical industries. Modern advances in lactic acid starter cultures, probiotics, prebiotics, and synbiotics have enabled the development of targeted health products that promote digestive wellness, enhance immunity, and mitigate chronic conditions. In India, the yoghurt market is undergoing a significant transformation, transitioning from traditional homemade curds to commercial, value-added offerings (e.g., Greek, flavoured, and functional yoghurts). Market projections estimate that the Indian yoghurt market will grow from INR 2.9 billion in 2024 to INR 14.7 billion by 2033 at a CAGR of ~19.7%. To capitalize on higher profit margins and support sustainable rural economic empowerment toward India's 2047 development goals, the dairy sector must expand its processing infrastructure, modernize production, and shift its focus from fluid milk to high-value fermented foods.

Keywords: Fermented Dairy Foods, Probiotics, Prebiotics, Synbiotics, Functional Foods, Nutraceuticals, Yogurt Market, Gut Health

Introduction

In recent years, as people have become more health-conscious and aware of the role of nutrition in their diets, opportunities for developing new fermented dairy foods have increased. Recent innovations and rapidly developing technologies in lactic starter cultures and the development of novel functional fermented foods have added new dimensions to this fascinating area of science, nutrition, and health. Value addition of foods through fermentation and the use of probiotic organisms is a need of the present time. Fermentation is one of the oldest and simplest processes known for food preservation (Gadde *et al.*, 2019). Among fermented foods, milk-based products constitute the largest group consumed by the majority of our population.

Since time immemorial, fermented or, I would like to call them, "Cultured Dairy Products", have been a part of our Indian Diets. Our great "Rushis" used to consume Dahi and "chhaas" (buttermilk) besides Milk and Cereals as the Era of vegetarianism began. Dahi and chhaas are believed to aid digestion in the stomach. According to legend, yoghurt and kefir were born on the slopes of Mount Elbrus in the Caucasus range by a miracle of nature. Microorganisms of various kinds landed in a pitcher of milk at the same time and at the right temperature, and they found that they could live in a symbiotic relationship.

However, it is further claimed that there is much truth in the story that yoghurt acts as a "preservative" against human ageing; that if you happen to meet a Cossack galloping along bareback in some Caucasian valley, he is likely to be 130 to 140 years old. The Eminent Scientist and Nobel Prize Winner, Dr. Élie Metchnikoff, was a Russian bacteriologist. He was the first to identify the bacilli that created yoghurt, thus making it possible to process this food on a mass scale. Metchnikoff wrote that the most important fact is that the bacteria found in yoghurt produce generous amounts of B-vitamins in the digestive tract, where they are absorbed and distributed throughout the body.

Yoghurt contains certain bacteria that break down the milk sugar lactose into lactic acid, in which disease-producing bacteria are unable to survive. Metchnikoff attributed the longevity and stamina of the people in the Balkan countries to this marvellous food. He found that although they were among the poorest people in the world and were deprived of most foods normally containing the necessary vitamins, they were practically immune to stomach problems. The ulcers were almost undetectable. He attributed their good health and long life to yoghurt. He found that during the time he conducted this important study, there were 1600 Bulgarians over the age of a hundred for every million people, compared to only 11 Americans per million. Some of our dairies in the past tried to market dahi in returnable glass bottles and bulk containers. Gujarat Co-operative Milk Marketing Federation Ltd. (GCMMF), which has India's largest cold chain, was the first to manufacture and market packaged nationwide Dahi (Masti Dahi) in plastic containers. Other dairies followed suit, and at present, more than two dozen dairies manufacture and market approximately 100 tons of packaged dahi.

Beneficial Effects of Fermented Milk

Healthy humans have a good microflora, consisting of beneficial microorganisms, in the gut. The importance of fermented microflora in protecting against potential pathogenic bacteria has been extensively recognized (Valencia *et al.*, 2025). Intestinal motility is improved by consuming fermented milk, which reduces constipation. Fermented milk reduces the risk of cancer and elevates natural killer cell activity by attacking abnormal cells (Liong, 2008; Shen, 2024).

Dairy Products as Health Foods

The availability and increasing popularity of functional foods provide consumers with the opportunity to consume dairy products with health benefits beyond those of traditionally formulated products. Nutraceuticals, a term generally used for such foods, refer to functional foods that provide benefits beyond basic nutrition and may prevent diseases and/or promote health. Dairy ingredients combine functionality and nutritional qualities, making them attractive to consumers. Many milk components have excellent applications in nutraceuticals.

Dahi: Dahi is a product obtained by lactic fermentation of milk. It is one of the most popular fermented foods consumed by a large section of the Indian subcontinent. Dahi is accepted as a dietary adjunct with high nutritional and therapeutic value. This product is prominently mentioned in ancient Hindu scriptures. The use of dahi has been strongly advocated for the treatment of ailments such as dyspepsia, dysentery, and other gastrointestinal disorders. Dahi, buttermilk, or lassi used at the end of meals increases digestibility. This product is also believed to improve appetite, vitality, and digestibility. Some of the beneficial effects of dahi are attributed to the antibacterial components formed during fermentation and the low pH, which prevents the growth of putrefactive and other undesirable organisms, including potential pathogens.

Yoghurt: Yoghurt, which made its foray into the Indian market just a few years ago, has taken over the decades-old dahi in metros and semi-metros due to health consciousness, rising disposable incomes, quality dependence, and more awareness about the product, and has given a tremendous boost to the food processing sector in India. In India, yoghurt has been positioned as a healthy dessert option; therefore, increasing health and wellness awareness will help yoghurt gain popularity with the same momentum. Consumers are becoming increasingly

concerned about hygiene, fat, and nutritional content; therefore, the demand for packaged yoghurt is expected to rise robustly in the coming years.



Figure-1: Transforming Traditional Wisdom and Modern Science into Nutritious, Functional and Market-Ready Dairy Foods

Yoghurt market in India

According to a 2025 report by the IMARC Group, the Indian yoghurt market was valued at INR 2.9 billion in 2024. IMARC projects strong future growth, estimating that the market will reach INR 14.7 billion by 2033, with a CAGR of ~19.7% over 2025-2033.

Key Trends & Drivers

- **Health & Wellness Demand:** Growing health consciousness among Indian consumers is fueling the demand for yoghurt owing to its nutritional benefits (protein, calcium, and probiotics).
- **Convenience & Changing Lifestyles:** Yoghurt has become a convenient breakfast/snack/dessert option compared to traditional dairy products like milk or homemade curd as urbanization and busy lifestyles increase.
- **Product Innovation & Variety:** The market is expanding beyond plain yoghurt to include flavoured yoghurts, Greek yoghurt, yoghurt drinks, frozen yoghurt, and plant-based yoghurt alternatives. Packaging innovations (e.g., single-serve cups/pouches) have also improved their appeal.
- **Distribution & Retail Expansion:** Growth of supermarkets/hypermarkets and convenience stores, notably online retail, is making yoghurt more accessible across urban (and increasingly semi-urban) India.
- **Changing Food Habits:** With growing exposure to global food culture and increasing integration of Western-style eating habits, yoghurt is becoming more accepted over traditional dairy staples in many households, especially among younger and urban demographics.

Industry & Market Structure

- The yoghurt market in India includes both large, established dairy players and new entrants. Big names include Amul, Britannia, Mother Dairy, Karnataka Milk Federation (and regional cooperatives), along with private players and startups.
- The segment is increasingly competitive, with firms expanding their product portfolios (premium yoghurts, flavoured variants, and plant-based options) to differentiate themselves from competitors.
- Distribution channels are diversifying: from traditional kirana shops (especially in rural/semi-urban areas) to organized retail, such as supermarkets and convenience stores, and a growing online/e-commerce presence.

Outlook

- The yoghurt market in India appears set to grow rapidly over the next 5-10 years, potentially reaching ~INR 14.7 billion by 2033, according to IMARC's forecasts.
- Demand will likely be fuelled by urbanization, growing health consciousness, changing food habits, and rising disposable incomes, all leading to broader adoption of yoghurt as a regular part of the diet (breakfast, snacks, and desserts).
- Product innovation, especially in flavoured, functional, plant-based, and convenience-oriented yoghurts, will probably continue to be a key differentiator for brands seeking growth.
- As distribution expands (especially through e-commerce and modern retail), yoghurt, which historically had limited penetration beyond urban pockets, may reach broader demographics and geographies, including smaller towns and semi-urban areas.

According to the Health Focus International Global Trends 2024 report, more than half of consumers (55 %) choose foods and beverages to improve digestion and gut health, and launches with fiber or prebiotic claims are on the rise. There are several reasons why gut health is still a big dairy business, and scientifically proven prebiotic fibers can be powerful drivers of purchase. As consumer awareness of the importance of digestive health for overall health has significantly increased, digestive wellness has diversified. In fact, according to Beneo's (2023) global survey on prebiotics, which included 9, 000 participants from nine countries, approximately three out of four consumers worldwide believe that digestive health influences not only their physical well-being but also their immune system, weight, and energy levels.

Probiotics, Prebiotics & Synbiotics

Probiotic foods contain live mono-or mixed cultures of microorganisms that, when consumed by humans, beneficially affect the host by improving the properties of intestinal microflora by selectively stimulating the growth and/or activity of one or a limited number of naturally present or introduced bacterial species in the colon, leading to improved host health.

The use of probiotics, prebiotics, and synbiotics is a promising approach for developing functional foods. Dairy foods appear to be the preferred medium for introducing probiotic bacteria such as human-derived species of lactic acid bacteria (e.g., *L. acidophilus*, *L. casei*, *L. gasseri*, *L. rhamnosus*, *L. reuteri*, *Bifidobacterium bifidum*, *B. breve*, *B. infantis*, and *B. longum*). *Lactobacillus* spp. (naturally found in the human small intestine) and various *Bifidobacterium* spp. (major organisms in the human large intestine) are the most commonly used probiotic cultures in the food industry (Huang *et al.*, 2024; Gibson *et al.*, 2017).

Synbiotics are products in which both probiotics and prebiotics are combined to have an additive or synergistic beneficial effect on the host by improving the survival and/or implantation of probiotics in the intestinal tract. In laboratory rats treated with a carcinogen, the combination of bifidobacteria (i.e., a probiotic) and oligofructose (i.e., a prebiotic) has been demonstrated to reduce the risk of colon cancer. Most functional foods containing synbiotics are yoghurt products found primarily in Europe and the United States (Liong, 2008).

By 2027, the market for products such as cheese, flavoured milk, lassi, buttermilk, whey, and organic milk is expected to grow by more than 20% per annum. Some Dairy Products with good potential for rapid growth in the future are probiotic dairy products (20%). Cheese: 25%, whey: 22%, ice cream: 18%, sweet condensed milk: 20%, milkshake: 22 %, flavoured milk: 25%, UHT Milk: 19%, and flavoured and frozen yoghurt: 22%.

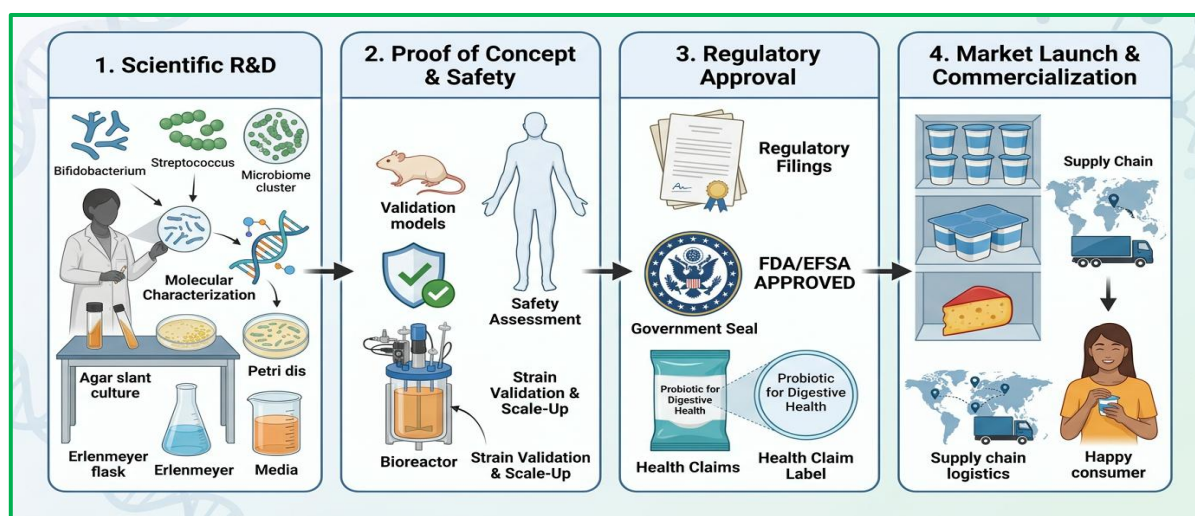


Figure-2: An infographic detailing the four-stage lifecycle of innovation in fermented dairy foods--from initial scientific R&D to market launch

As we foresee achieving global leadership, we need to align ourselves with the vision of India becoming a powerful, developed nation by 2047 and contribute copiously. Dairying has enormous potential to contribute to this vision, as it is one of the best tools for empowering rural populations. India can only advance when its rural areas progress. This progress can only be realized when we have a clear pathway and blueprint to achieve our goals. Currently, only 25% of the milk purchased by dairies is converted into dairy products. Increasing capacity utilization for manufacturing milk products, enhancing milk processing capacity, and modernizing existing infrastructure for high-value-added products are the need of the hour. Since value-added products generate higher margins than liquid milk, both the cooperative and organized private sectors must work innovatively to increase the share of value-added products, such as fermented dairy foods, which in turn would help provide a sustainable remunerative price to dairy farmers.

Table 1. Scientific basis, product examples, validation requirements and market opportunities for innovation in fermented dairy foods

Innovation area	Scientific and technological basis	Representative products	Key quality or validation parameters	Market opportunity in India	Reference(s)
Traditional fermentation	Lactic acid bacteria convert lactose into lactic acid, reducing pH and producing desirable flavour, texture and preservation effects.	Dahi, chhaas, lassi, cultured buttermilk	Acidity, pH, viscosity, syneresis, sensory quality, microbial safety and refrigerated shelf life.	Large consumer familiarity, low-cost production and strong potential for standardized packaged products.	Gadde <i>et al.</i> (2019); Marco <i>et al.</i> (2021)
Probiotic fermentation	Selected live microorganisms are incorporated at an adequate level and must provide a demonstrated health benefit. Fermentation alone does not make a product probiotic.	Probiotic dahi, probiotic yoghurt, probiotic lassi, fermented milk drinks	Viable probiotic count throughout shelf life, strain identity, acid and bile tolerance, sensory acceptability, pathogen absence and substantiated health evidence.	Premium gut-health products for health-conscious consumers, children, older adults and urban households.	Hill <i>et al.</i> (2014); Sanders <i>et al.</i> (2019); Gadde <i>et al.</i> (2019)
Prebiotic enrichment	Selectively utilized substrates support beneficial host microorganisms and provide a health benefit; not every dietary fibre qualifies as a prebiotic.	Inulin-fortified yoghurt, oligofructose lassi, fibre-enriched fermented milk	Prebiotic stability, fermentability, fibre content, texture, sweetness, gastrointestinal tolerance and consumer acceptance.	Products positioned for digestive wellness, improved satiety and fibre-gap reduction.	Gibson <i>et al.</i> (2017); Huang <i>et al.</i> (2024)
Synbiotic formulation	A combination of live microorganisms and selectively utilized substrate(s) that confers a health benefit; formulations may be complementary or synergistic.	Synbiotic yoghurt, synbiotic drinking yoghurt, fortified lassi	Viability of the microorganism, selective substrate utilization, functional compatibility, storage stability and substantiated health benefit.	High-value functional foods with scope for premium pricing and differentiated claims.	Swanson <i>et al.</i> (2020); Gibson <i>et al.</i> (2017)
Protein and nutrition enhancement	Concentration or addition of milk proteins improves protein density, while fermentation can improve flavour and product acceptability.	Greek yoghurt, high-protein yoghurt, protein lassi, fermented whey beverages	Protein content, gel strength, viscosity, sedimentation, lactose level, amino-acid profile and sensory quality.	Sports nutrition, weight-management, meal-replacement and convenience-food segments.	Gadde <i>et al.</i> (2019); Unveiling probiotic and prebiotic functional dairy foods (2025)

Innovation area	Scientific and technological basis	Representative products	Key quality or validation parameters	Market opportunity in India	Reference(s)
Flavoured and dessert-style products	Fruit preparations, natural flavours, cocoa, spices and sweeteners improve palatability and broaden consumption occasions.	Fruit yoghurt, flavoured yoghurt, frozen yoghurt, yoghurt desserts	Flavour stability, colour, sugar level, fruit uniformity, viscosity, syneresis and consumer preference.	Attracts younger consumers and supports breakfast, snack and dessert positioning.	Gadde et al. (2019); IMARC Group (2024)
Regional and traditional product innovation	Standardization and hygienic packaging preserve traditional sensory identity while improving consistency and distribution.	Packaged dahi, probiotic chhaas, fortified lassi, spiced fermented milk	Starter-culture performance, acidity development, packaging integrity, cold-chain stability and microbial safety.	Strong opportunity for rural, semi-urban and regional markets because products retain cultural familiarity.	Gadde et al. (2019); Marco et al. (2021)
Sustainable processing and commercialization	Improved processing capacity, cold-chain infrastructure, co-product utilization and modern packaging support scale-up and value addition.	Extended-shelf-life fermented milk, whey-based fermented beverages, recyclable single-serve products	Energy and water use, packaging performance, shelf life, production yield, cost of goods and environmental footprint.	Higher margins than fluid milk, improved farmer-market linkages and rural enterprise development.	IMARC Group (2024); Gadde et al. (2019)

Conclusion

Transitioning India's dairy sector from liquid milk supply to high-value fermented foods, such as *dahi*, functional yoghurts, and synbiotics, presents a vital economic and nutritional opportunity. Driven by strong market growth (~19.7% CAGR) and rising consumer demand for gut health and wellness, expanding modern processing infrastructure will maximise dairy profit margins. Ultimately, this strategic shift will enhance rural livelihoods, support farmer remuneration, and advance India's Viksit Bharat 2047 vision.

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