

PLANT-BASED FERMENTED MILK: Concept, health benefits, current trends and applications

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ABSTRACT

The global fermented dairy products market has experienced significant growth in the past decade, with Russia alone producing over 2 million tons of items like yogurt and kefir. These products are prized for their health benefits, including easing lactose intolerance and supporting gut health. Recent studies challenge previous worries about saturated fat in dairy, suggesting a more intricate relationship with cardiovascular diseases. At the same time, the demand for plant-based milk is increasing due to factors such as lactose intolerance, environmental sustainability, and health considerations. The market for plant-based milk alternatives is forecasted to reach around \$26 billion USD in the next five years, driven by a variety of options and fortified products. Plant-based milk provides alternatives to dairy with differing protein, fat, and micronutrient profiles. Moreover, plant-based fermented milk products, made from sources like soy and coconut, contain bioactive compounds and probiotics that enhance gut health. These products offer sustainable substitutes for dairy, especially catering to lactose intolerance and environmental concerns. However, further research is necessary to optimize production methods and improve the quality of these products.

KEYWORDS

Plant-based milk, fermented, health benefits, cardiovascular diseases (CVDs), lactose intolerance, life style disorders

BACKGROUND

FERMENTED DAIRY PRODUCTS

The global market for fermented dairy products has witnessed a steady increase in size over the last decade, accompanied by a notable surge in individual per capita consumption (Alekseeva et al., 2022). In Russia, specifically, the production of fermented milk products surpassed 2 million tons in the previous year, encompassing a variety of items such as yogurt, fermented baked milk, varenets, and kefir (Fernandes, Chandan, and Shahani, 1992). The popularity of fermented dairy products extends beyond Russia to encompass regions like the CIS, Europe, America, and Australia (Grandi and Daise Aparecida Rossi, 2010). These products are valued for their diverse health advantages, including alleviating lactose intolerance symptoms, modulation of gut microbiota, and preventing infections, inflammation, and cardiometabolic diseases. The anticipated value of the global fermented dairy products market is estimated to reach US\$ 4,920.5 Million by the end of 2022. A projected Compound Annual Growth Rate (CAGR) of 8.5% is forecasted for the market from 2022 to 2032, with an expected final value of US\$ 11,125.2 Million. In the historical period from 2016 to 2021, the industry demonstrated growth at a CAGR of 8.1% in terms of value. (Insights, 2022)

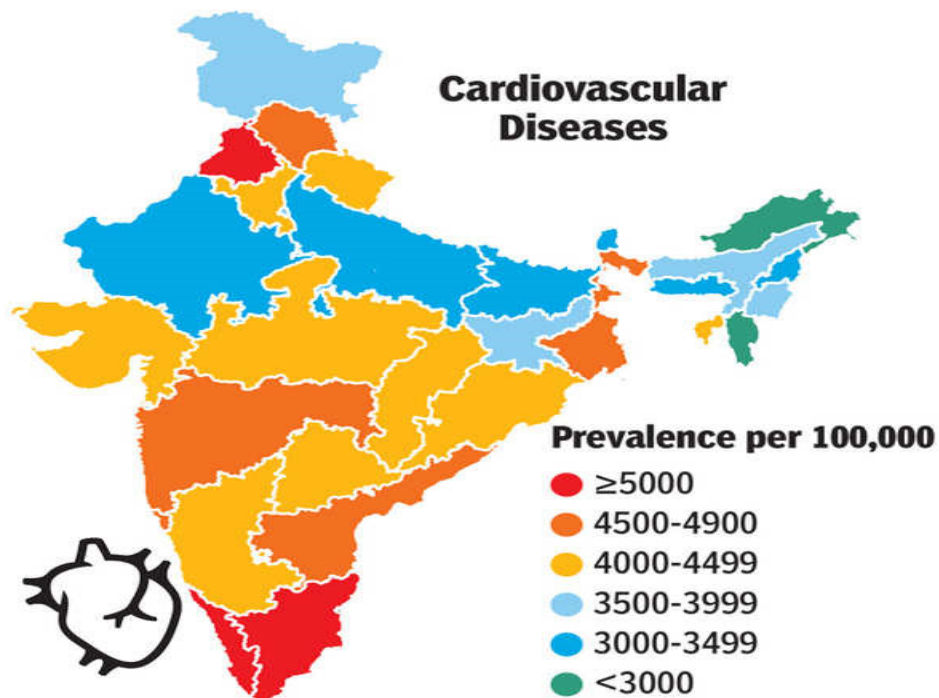
DEMERITS OF DAIRY PRODUCTS

Figure 1: Heart disease the biggest killer in India, and COPD second biggest (The Lancet, 2018)

Cardiovascular diseases (CVDs) contribute significantly to global mortality and morbidity, prompting dietary guidelines to limit saturated fatty acid (SFA) intake due to their perceived link with elevated blood cholesterol and increased CVD risk. Dairy products are a major source of dietary SFAs, leading to a potential reduction in their consumption due to these guidelines. However, numerous meta-analyses indicate a neutral or negative correlation between dairy intake and CVDs. While early studies had methodological limitations, recent prospective studies and controlled trials challenge a straightforward positive association between SFA intake and atherosclerotic CVD risk. Despite evidence supporting the link between SFAs and increased low-density lipoprotein cholesterol (LDL-C), a known factor in atherosclerotic CVD, this alone does not consistently predict or cause CVD risk. These findings suggest that restrictions on dairy intake may not be justified, emphasizing the need for a deeper understanding of how different types of dairy products relate to chronic diseases, especially in the context of type 2 diabetes. (Givens, 2022)

Dairy products are valuable sources of essential nutrients like energy, calcium, and protein, but they often contain high levels of saturated fats. While conventional dietary advice suggests reducing saturated fat intake to lower the risk of coronary artery disease (CAD), recent research challenges this notion. Some studies indicate that replacing saturated fats with omega-6 polyunsaturated fats found in vegetable oils may increase the risk of CAD and cardiovascular disease (CVD) unless balanced with omega-3 polyunsaturated fats. Substituting saturated fats with high-glycemic-index carbohydrates is also linked to a higher CAD risk. Surprisingly, observational studies suggest an inverse relationship between dairy product consumption and CVD incidence.

Dairy products, including cheese, may not have the expected negative impact on blood lipids solely based on saturated fat content. Calcium and other bioactive components in dairy might modify effects on LDL cholesterol and triglycerides. Additionally, dairy consumption, particularly yogurt, has been associated with probiotic benefits. Observational studies suggest that consuming yogurt and other dairy products is linked to a reduced risk of weight gain, obesity, and CVD, supported in part by randomized trials (Astrup, 2014).

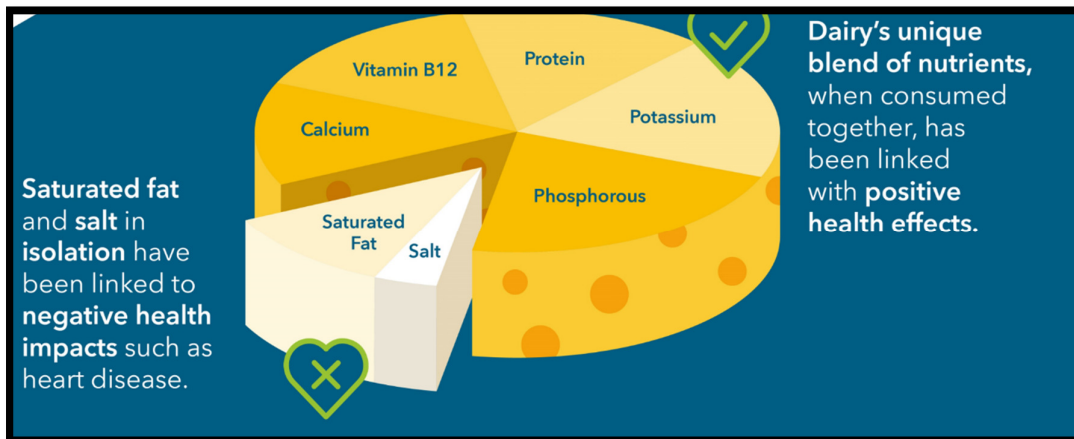


Figure 2: NEGATIVE EFFECTS OF SATURATED FAT PRESENT IN DAIRY PRODUCTS

(<https://khni.kerry.com/news/the-dairy-matrix-beyond-individual-nutrients/>)

Lactose intolerance is a clinical condition characterized by distinctive signs and symptoms that emerge upon the ingestion of food containing lactose, a disaccharide. Normally, lactase, an enzyme in the small intestinal brush border, hydrolyzes lactose into glucose and galactose. (Vesa, Marteau and Korpela, 2000) The deficiency of lactase, whether due to primary or secondary causes, gives rise to clinical symptoms of varying severity.

Lactose is naturally present in dairy, milk products, and mammalian milk, and this condition is also referred to as lactose malabsorption (Mattar, Mazo, and Carrilho, 2012). The most prevalent form of disaccharidase deficiency is lactase deficiency. Enzyme levels peak shortly after birth but decline thereafter, despite ongoing lactose intake. Unlike humans, nonhuman mammals generally lose their ability to digest lactose into adulthood. Certain human populations, such as those with South American, Asian, and African ancestry, often develop lactase deficiency (Newcomer et al., 1978). In contrast, individuals of Northern European or Northwestern Indian descent typically retain the ability to digest lactose into adulthood. Symptoms of lactose intolerance include abdominal bloating, pain, loose stools, nausea, flatulence, and borborygmi (Micic, Rao, and Rubin, 2019). Upon diagnosis, many individuals begin avoiding milk, turning to specially prepared products with digestive aids, contributing to the overall healthcare burden.

STATISTICAL DATA OF ADVERSE HEALTH CONDITIONS DUE TO THE CONSUMPTION OF DAIRY PRODUCTS

Approximately 60 to 65 percent of the population in India experiences lactose intolerance, signifying that these individuals have difficulty digesting lactose (Bayless, Brown and Paige, 2017). According to experts, approximately 68 percent of the global population is estimated to have lactose malabsorption (Storhaug, Fosse, and Fadnes, 2017). As of May 20, 2023, a recent report from the World Heart Federation (WHF) reveals that worldwide fatalities due to cardiovascular disease (CVD) increased from 12.1 million in 1990 to 20.5 million in 2021 (World Heart Federation, 2023.). The anticipated yearly fatalities attributed to cardiovascular disease (CVD) in India are expected to increase from 2.26 million in 1990 to 4.77 million in 2020, according to projections (Murray and Lopez, 1997). As per the World Health Organization, India is responsible for a significant portion, one-fifth to be precise, of global deaths, particularly among the younger population. Findings from the Global Burden of Disease study indicate that the age-standardized death rate due to cardiovascular disease (CVD) in India is 272 per 100,000 population, surpassing the global average of 235 (Sreenivas Kumar and Sinha, 2020). India is frequently identified as the 'Diabetes Capital of the World,' representing 19% of the global diabetic population. Presently, there are approximately 80 million individuals with diabetes in India, and projections suggest this figure will rise to 135 million by the year 2045 (Mohan and Pradeepa, 2021).

RISE OF PLANT-BASED MILK AND FERMENTED PRODUCTS

The surge in the popularity of plant-based milk can be credited to various factors, including lactose intolerance, concerns about environmental sustainability, and health considerations. Consumers are increasingly opting for alternatives that are both sustainable and differ from traditional dairy beverages (Nawaz et al., 2023). Plant-based milk substitutes are derived from a range of sources, including cereals, leguminous plants, nuts, seeds, and pseudocereals (Silva, Silva, and Ribeiro, 2022). In the USA, there is a noticeable shift and growth in retail sales of plant-based milk, reflecting the increasing preference among consumers for these alternatives (Ramsing et al., 2023). Responding to the rising demand, the plant-based milk industry has expanded its offerings to encompass a variety of plant milk types and associated products (Besir et al., 2022). This global trend extends to the Indian market, where there is a noticeable uptick in the popularity of plant-based milk. Overall, the increased adoption of plant-based milk can be ascribed to factors like consumer choices, nutritional considerations, environmental consciousness, and the availability of diverse plant-based options.

The growing popularity of fermented dairy items, such as curd, can be attributed to various factors. A significant driver in the global dairy market is the increasing demand from consumers for novel products (Zobkova et al., 2022). Fermented milk products, known for their historical consumption, have gained prominence, largely owing to their widely acknowledged health advantages (Singh and Shah, 2017). Yogurt, a well-known fermented milk variant, has a longstanding presence in both European and North American markets, solidifying its position (Robinson, 2002). The nutritional significance of fermented milk has been recognized for centuries, and its role in human nutrition is extensively documented (C Khedkar, Kalyankar, and Deosarkar, 2016). Globally, there has been a notable rise in the consumption of fermented milk products, with a substantial increase in yogurt consumption primarily attributed to its perceived health benefits (Fernandes, Chandan and Shahani, 1992).

SIGNIFICANCE OF PLANT-BASED MILK

Plant-based milk has gained popularity among consumers and is being compared to dairy milk concerning nutrition and health implications. Retail sales of plant-based milk are on the rise, and they are generally considered to have lower environmental impacts compared to cow's milk (Ramsing et al., 2023). The nutrient profiles of plant-based milk vary, showing differences in protein, zinc, and potassium depending on the base ingredient and specific product (Cullimore et al., 2023). To align more closely with the micronutrient profile of dairy milk, many plant-based milks are fortified (Scholz-Ahrens, Ahrens, and Barth, 2019). In contrast, cow's milk tends to be higher in fat, including saturated fat, and sugar compared to most plant milks (Merritt et al., 2020). While cow's milk is rich in calcium and often fortified with vitamin D and vitamin A, many plant milks also contain similar fortifications of these micronutrients (Besir et al., 2022). Recommending cow's milk over plant-based milks lacks an apparent health rationale. However, suppose individuals opt for non-fortified and non-supplemented plant-based drinks instead of milk, especially in infants and toddlers. In that case, there may be a risk of deficiencies in essential nutrients.

PRESENT MARKET AND GROWTH POTENTIAL FOR PLANT-BASED MILK

The current market for plant-based milk is experiencing rapid growth and transformation, driven by an escalating demand for these alternatives (Ramsing et al., 2023). Varieties like almonds, soy, oats, coconut, rice, pea, cashew, and others are gaining popularity among consumers in the USA (Silva, Silva, and Ribeiro, 2022). Retail sales of plant-based milk are not only increasing but also witnessing shifts among different products. Projections indicate that the market for plant-based milk substitutes is anticipated to reach an estimated value of around 26 billion USD within the next five years (Besir et al., 2022). Diverse raw materials, including cereals, leguminous plants, nuts, seeds, and pseudocereals, are employed in the production of plant-based milk (Tangyu et al., 2019). This diversity has led to the emergence of powdered plant milk and its derivatives, including cheese, yogurt, fermented products, probiotics, kefir, and ice cream. The market also includes newer plant-based milks like hemp, characterized by high nutritional value, which is being assessed in comparison to other plant milk types. In summary, the expansion of the plant-based milk market is driven by factors such as vegan consumption, nutritional considerations, carbon emissions, and lactose intolerance.

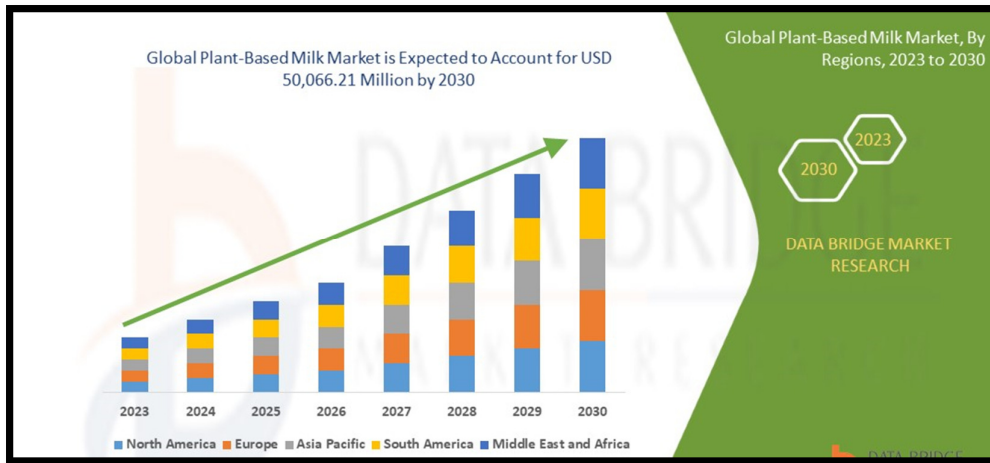


Figure 3: CURRENT MARKET FOR PLANT-BASED MILK

(<https://www.databridgemarketresearch.com/reports/global-plant-based-milk-market>.)

The growth potential of plant-based milk is substantial, with the market for these products experiencing rapid and continuous expansion, particularly within the alternative dairy sector, showing a consistent increase in consumption over the past two decades (Pandey and Poonia, 2020). Plant-based milk substitutes rank among the fastest-growing beverage segments globally, propelled by factors like lactose intolerance and the demand for lower cholesterol and fat content. It's crucial to recognize that the nutritional and physicochemical characteristics of these substitutes vary based on factors such as the plant source, processing methods, and fortification (Jeske, Zannini, and Arendt, 2016). Ongoing research is directed toward enhancing the quality and stability of plant-based milk, with a focus on aspects like sensory evaluation, analytical techniques, lipid oxidation, and fermentation (Tangyu et al., 2019). Despite certain concerns, plant-based milk can be incorporated into a healthy balanced diet and may pose fewer health risks than dairy milk for specific demographic groups (Wright and Smith, 2020).

HEALTH BENEFITS AND NUTRITIONAL SIGNIFICANCE OF PLANT-BASED MILK

Plant-based fermented milk products bring forth numerous health advantages. These items encompass bioactive compounds that enhance physiological processes within the human body (SHORI and AL ZHRANI, 2021). The fermentation process of plant-based milk results in the production of lactic acid and biologically

active compounds, augmenting both nutritional and physiological value (Tangyu et al., 2019). The vitality and proliferation of probiotics in fermented plant-based milk are contingent upon diverse factors, including milk composition, fermentation methodology, probiotic type, storage conditions, acidity, and packaging (PRESTES et al., 2021). Through fermentation, sensory characteristics, nutritional attributes, texture, and microbial safety of plant-based milk alternatives can be enhanced, yielding more valuable and flavorful products (Sukhikh et al., 2019). Both fermented dairy products and their plant-based counterparts play a role in modulating gut microbiota, thereby aiding in the prevention of infections, inflammation, and cardiometabolic diseases (Pelález, Martínez-Cuesta and Requena, 2019). Additionally, these products serve as sources of bioactive compounds such as vitamins, gamma-aminobutyric acid, exopolysaccharides, and bioactive peptides, offering supplementary health benefits.

IMPORTANCE OF INDIGENOUS PLANT-BASED FERMENTED MILK PRODUCTS

Indigenous plant-based fermented milks hold significance owing to their nutritional and physiological value (SHORI and AL ZHRANI, 2021). Derived from fruits and seeds such as soy, coconut, almond, rice, peanut, lupin, cashew, and hemp, this milk undergoes robust bacterial activity during fermentation, leading to the production of lactic acid and biologically active compounds (Tangyu et al., 2019). Fermented plant-based milk presents a sustainable substitute for dairy products, particularly catering to individuals with lactose intolerance or cow's milk allergy (Mäkinen et al., 2015). In regions where mammal milk is scarce and expensive, these alternatives offer a more economical option (Pandey and Poonia, 2020). Furthermore, fermentation contributes to enhancing the sensory profiles, nutritional attributes, texture, and microbial safety of plant-based milks, elevating their overall value and palatability (Bernat, 2014). Exploring mixed-culture fermentations involving two or more microbial species holds promise for optimizing the fermentation process and elevating the quality of the end products. To fully harness the potential and provide health benefits to consumers, further research is essential to fine-tune processing conditions and develop starters.

TOP MARKET TRENDS

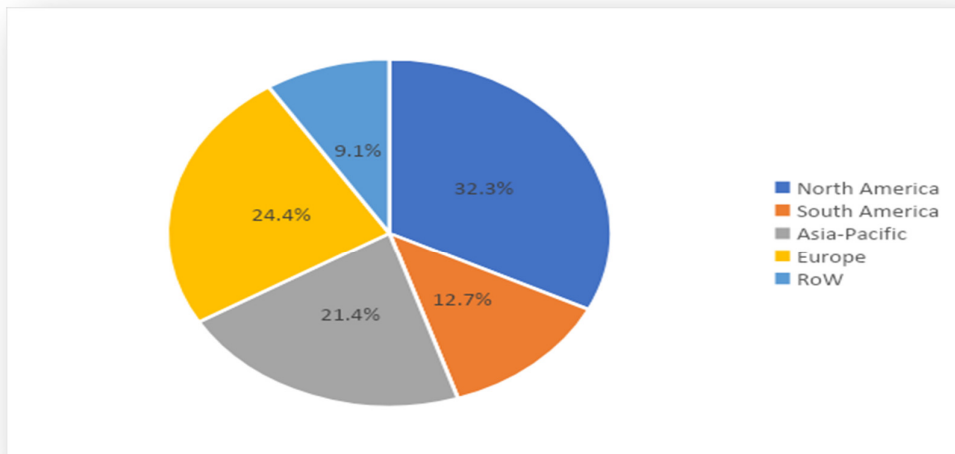


figure 4: Plant-Based Dairy Products Market Share (%) By Region, 2022 (www.industryarc.com)

TOP 10 PLANT-BASED MILK MARKETS GLOBALLY

- Arla Foods
- Daiya Foods Inc.
- Danone S.A
- General Mills
- Saputo
- Chobani
- Earth's Own Food Company Inc.
- Unilever
- Bel Group
- Kraft Heinz

TOP 10 PLANT-BASED MILK MARKETS IN INDIA

- Goodmylk
- Urban platter

- Raw pressery
- Nutriva (Planveda)
- Sofit
- Just plants
- Oat max
- Plantbyte
- Plantyum
- Epigamia

SUMMARY AND CONCLUSION

The global fermented dairy products market has experienced significant growth, with Russia producing over 2 million tons in the past year. These products are valued for their health benefits, such as alleviating lactose intolerance and promoting gut health. However, concerns about saturated fat in dairy have been challenged by recent research, indicating a complex relationship with cardiovascular diseases.

Plant-based milk has gained popularity due to factors like lactose intolerance, environmental sustainability, and health considerations. The market is growing rapidly, driven by diverse options and fortified products. Plant-based milk is compared to dairy in terms of nutrition, with variations in protein, fat, and micronutrient content. The market for plant-based milk substitutes is projected to reach around 26 billion USD in the next five years.

The health benefits of plant-based fermented milk products include bioactive compounds and probiotics that contribute to gut health. Indigenous plant-based fermented milks, derived from sources like soy, coconut, and almond, offer sustainable alternatives to dairy, catering to lactose intolerance and environmental concerns. Further research is needed to optimize processing conditions and enhance the quality of these products.

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