FUNCTIONAL DAIRY FOODS FOR A HEALTHIER FUTURE

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ABSTRACT

There has been a growing interest on functional foods, markedly recognized as being able to provide additional benefits on health promotion, wellbeing maintenance, and disease prevention. Based on this scenario, food industries have been increasingly focused in developing added-value foodstuffs, being dairy foods one of the most currently used food products for functional purposes. Different extraction and encapsulation technologies have been used to obtain target food bioactive ingredients and to ensure an effective functionalization of dairy products, respectively. Probiotics, prebiotics, mushrooms, and plant food bioactive extracts comprise the most commonly used food ingredients to produce functional dairy foods, mostly fermented milk, yogurt, and cheese. In fact, dynamic and promissory biological effects have been documented for these functional dairy foods, among them antioxidant, cardioprotective, antihypertensive, immunomodulatory, antimicrobial, antidiabetic, anti-inflammatory, neuro-modulatory, and even bone protection. However, besides the impact of health benefits on consumers' acceptance and subsequent consumption of functional dairy foods, other factors, such as consumers' familiarity with new products and functional ingredients used on their formulation, consumers' knowledge and awareness about the credibility of shared health effects, and finally the organoleptic and sensory evaluation of the developed functional dairy foods, have also a determinant role. Thus, the concept of functional dairy foods may represent an upcoming multiniche market and sustainable trend to be exploited.

KEYWORDS: functional foods, milk, dairy products, yoghurt, cheese

INTRODUCTION

The global pursuit of healthier lifestyles and preventive health-caretion. Among these, functional dairy foods have emerged as a powerful and accessible nutritional category that contributes not only to nourishment but also to disease prevention, health promotion, and wellness maintenance.

Dairy products have long been staples in diets across the world due to their rich content of high-quality proteins, essential fatty acids, vitamins, and minerals. However, advancements in food science and biotechnology have enabled the enhancement of traditional dairy with health-promoting components such as probiotics, prebiotics, bioactive peptides, herbal extracts, and fortified micronutrients. This has transformed everyday dairy items like milk, yogurt, curd, and cheese into potent functional foods capable of addressing modern health concerns—ranging from digestive health and immunity to cardiovascular, metabolic, and cognitive wellness. India, with its deep-rooted dairy culture and position as the world's largest milk producer, holds tremendous potential in leveraging functional dairy to address nutritional deficiencies, lifestyle diseases, and public health challenges. Moreover, growing consumer awareness, increasing demand for personalized nutrition, and the blending of Ayurvedic principles with dairy innovation are catalyzing the development of new, value-added dairy products.

NUTRITIONAL AND BIOACTIVE COMPONENTS OF DAIRY

Dairy products are naturally rich in essential nutrients that support growth, development, and overall health. With the advancement of food processing technologies and deeper scientific insights, the intrinsic components of milk have been identified not only as sources of nutrition but also as bioactive compounds with functional properties. These components

contribute to the preventive, therapeutic, and health-promoting potential of dairy foods, making them ideal carriers for functional food development.

1. High-Quality Proteins

Milk contains two main protein groups—casein (80%) and whey proteins (20%), both of which are complete proteins with all essential amino acids.

Casein

Slowly digested, forms a gel in the stomach, making it ideal for sustained amino acid release. It is also a source of bioactive peptides with antihypertensive, immunomodulatory, and antimicrobial effects.

Whey Proteins

Rapidly digested and rich in branched-chain amino acids (BCAAs), especially leucine. Whey supports muscle repair, immune function, and has antioxidant properties due to cysteine content (a precursor to glutathione).

2. Essential Fats and Fatty Acids

Though traditionally feared for their saturated fat content, milk fats are now recognized for their complex mix of beneficial fatty acids:

Conjugated Linoleic Acid (CLA)

Found in higher quantities in grass-fed cow milk; known for anticancer, antidiabetic, and anti-obesity properties.

Omega-3 Fatty Acids

When cows are fed flaxseed or algae-enriched diets, milk becomes a source of heart-healthy omega-3s.

Short-Chain Fatty Acids (SCFAs): Such as butyrate, have anti-inflammatory and gut health benefits.

3. Vitamins

Milk naturally contains several water- and fat-soluble vitamins:

Vitamin A

Supports vision, immune health, and skin integrity.

Vitamin D

Essential for calcium absorption and bone health; often added via fortification.

B-complex Vitamins (B2, B12)

Aid in energy metabolism and red blood cell production.

Folate

Important for foetal development and reducing neural tube defects.

4. Minerals

Dairy is a leading dietary source of:

Calcium

Crucial for bones, teeth, nerve transmission, and muscle function.

Phosphorus

Works with calcium for bone mineralization and energy production.

Magnesium, Potassium, and Zinc

Support heart rhythm, muscle function, and immunity.

5. Probiotics

These are live microorganisms, often added to fermented dairy (like yogurt and curd), which confer health benefits when consumed in adequate amounts. Common probiotic strains include: Lactobacillus acidophilus, Bifidobacterium bifidum, Streptococcus thermophilus

They aid in: Improving gut flora balance, enhancing nutrient absorption, reducing inflammation and boosting immunity

6. Prebiotics

Prebiotics are non-digestible food components (like inulin or galacto-oligosaccharides) that selectively stimulate the growth of beneficial gut bacteria. Some dairy products are now fortified with prebiotics to enhance gut health and create symbiotic effects when combined with probiotics.

7. Bioactive Peptides

Released during digestion or fermentation, these short chains of amino acids can: Lower blood pressure (ACE-inhibitory peptides), Improve immune response, Exhibit antioxidant or antimicrobial activity, Regulate satiety and metabolic processes

8. Other Bioactive Compounds

Sphingolipids: Play a role in brain development and cellular health.

Lactoferrin

A multifunctional protein with antimicrobial, anti-inflammatory, and iron-regulating properties.

Immunoglobulins

Provide passive immunity, especially important in colostrum and early childhood nutrition.

TYPES OF FUNCTIONAL DAIRY PRODUCTS

1. Probiotic Dairy Products

These contain live beneficial microorganisms that, when consumed in adequate amounts, help balance the gut microbiota and improve digestive and immune health.

Common types

Probiotic yogurt, Curd and fermented milk, Kefir (Kefir is a self-carbonated, slightly foamy viscous beverage, with a uniform elastic consistency and sour, acidic, and slightly alcoholic flavour), Buttermilk with added probiotics

Health benefits

Improved digestion and gut flora, Enhanced immune response, Relief from lactose intolerance and irritable bowel syndrome, Prevention of gastrointestinal infections

2. Prebiotic-Enriched Dairy Products

These products are fortified with non-digestible food components (like inulin, fructo-oligosaccharides, or galacto-oligosaccharides) that stimulate the growth of beneficial bacteria in the gut. Examples: Milk or yogurt enriched with prebiotic fibers, Synbiotic drinks (contain both prebiotics and probiotics)

Health benefits

Improved gut health, Better calcium absorption, Lower risk of colon diseases

3.Synbiotic Dairy Products

These combine both probiotics and prebiotics, delivering a dual benefit by introducing healthy microbes and nourishing them simultaneously.

Examples: Synbiotic yogurts (Bioyogurt or synbiotic yogurt is fermented with probiotic bacteria such as Bifidobacterium and Lactobacillus strains), Dairy-based health drinks or smoothies

Health benefits

Superior gut health, Enhanced nutrient uptake, Strengthened immune system

4. Fortified and Enriched Dairy Products

These are conventional dairy products fortified with vitamins, minerals, or other functional ingredients to address specific nutritional needs.

Common fortifications:

Vitamin D and A in milk (for bone health and immunity)

Iron, folic acid, and zinc in milk (for anaemia prevention)

Omega-3 fatty acids in milk or cheese (for cardiovascular health)

Calcium-enriched milk or yogurt

Health benefits

Micronutrient deficiency prevention, Bone and joint health, Cardiovascular and brain development support

5. Herbal and Ayurvedic Functional Dairy

Infused with herbal extracts and traditional medicinal ingredients, these are gaining popularity in India and globally for their holistic benefits.

Examples: Turmeric (Haldi) milk – anti-inflammatory and immune-boosting

Ashwagandha-infused milk – stress-relieving

Tulsi or ginger yogurt – antimicrobial and respiratory health benefits

Shatavari milk – reproductive and hormonal support

Health benefits

Combines dairy nutrition with traditional medicine, Supports immunity, stress management, and hormonal balance

6. Low-Fat and Functional Fat Dairy Products

These products are tailored for weight-conscious and heart health-focused consumers, offering lower saturated fats or enriched with healthier fats.

Examples:

Low-fat cheese, yogurt, and paneer

Ghee enriched with omega-3 or CLA

Cholesterol-lowering dairy spreads

Health benefits

Cardiovascular risk reduction, Support for weight loss and metabolic health

7. Bioactive Peptide-Enriched Dairy Products

These are enhanced with bioactive peptides derived during milk fermentation or enzymatic hydrolysis. They are known to influence physiological functions.

Examples:

Blood pressure-lowering fermented milk (ACE-inhibitory peptides)

Antioxidant-rich whey drinks

Health benefits

Blood pressure regulation, Antioxidant support, Immune and metabolic balance

8. Functional Dairy-Based Desserts and Beverages

These include value-added products developed for wider consumer appeal, particularly among children and youth.

Examples: Probiotic ice creams, Functional dairy smoothies, Dairy-based health drinks with added protein or botanicals

Health benefits

Nutrient-rich alternatives to conventional snacks, Improves compliance in children and older adults

Functional Dairy in Indian Context

India, as the world's largest milk producer, is well-placed to develop functional dairy on a large scale. Functional foods are gaining traction due to:

- Traditional familiarity with herbal milk (e.g., haldi doodh, badam milk)
- Post-COVID awareness of immunity-enhancing foods
- Government push for milk fortification through FSSAI's initiative

Examples:

Amul: Turmeric milk, iron-fortified beverages

Mother Dairy: Probiotic curds under "b-Activ" label

Karnataka Milk Federation: Vitamin D fortified milk

These efforts are helping bring scientific validation to traditional practices.

FUNCTIONAL DAIRY AND PUBLIC HEALTH PROGRAMS

Functional dairy holds the potential to revolutionize nutrition-based interventions:

a. Mid-Day Meal Scheme (MDM)

Incorporating fortified milk helps combat anaemia, vitamin deficiencies, and stunting in school children.

b. Integrated Child Development Services (ICDS)

Pregnant and lactating women benefit from calcium, folic acid, and iron-fortified dairy to improve foetal health and birth outcomes.

c. Geriatric Nutrition Program

Probiotic dairy and calcium-rich milk prevent bone loss and improve gut health in the elderly.

These programs align well with government missions such as POSHAN Abhiyaan and Anemia Mukt Bharat.

GLOBAL MARKET AND TRENDS

Globally, the functional dairy market is projected to reach USD 60–65 billion by 2027, driven by: Demand for preventive health foods, Rising lifestyle disorders, Consumer preference for natural, bio-based solutions

Top trends include

Personalized functional dairy (based on genetics, age, lifestyle), Plant-dairy hybrids (dairy + plant protein blends), Clean label products (no preservatives, natural colours)

India is catching up with innovations in sports dairy drinks, high-protein yogurts, and diabetic-friendly milk.

CHALLENGES IN SCALING FUNCTIONAL DAIRY IN INDIA: -

While the future is promising, several challenges must be addressed:

Affordability

Functional dairy often costs more than regular products, making them inaccessible to lower-income consumers.

Consumer Awareness

Lack of awareness about the health benefits and proper usage of functional dairy.

Cold Chain Infrastructure

Probiotic and fortified products require refrigeration throughout the supply chain.

Regulatory Gaps

Standardized definitions, health claim approvals, and labelling rules need improvement under FSSAI.

Rural Penetration

Limited access and acceptability in rural India despite the high need for micronutrient-rich food.

Sustainability and One Health Perspective

Functional dairy contributes to the One Health concept by linking human health, animal welfare, and environmental sustainability:

Eco-friendly practices

Biofermentation reduces energy use and emissions.

Waste valorization

Dairy by-products like whey are turned into protein supplements.

Animal nutrition

Healthier animals produce higher-quality milk for functional dairy use.

Carbon-conscious farming

Low-input dairy farming helps reduce climate impact.

POLICY AND REGULATORY FRAMEWORK

A robust policy ecosystem can support functional dairy through:

FSSAI regulations

Guidelines on fortification and health claims must be enforced.

Public-Private Partnerships

Collaboration between government, cooperatives, and private dairies can scale production and distribution.

Incentives for functional dairy startups

Tax rebates, subsidies, and incubation support can boost innovation.

Inclusion in government food programs

Mandating use of fortified or probiotic dairy in ICDS and MDM.

FUTURE OF FUNCTIONAL DAIRY IN INDIA

Functional dairy is poised for exponential growth in India due to:

Young, health-conscious population, Expanding middle class, Deep cultural ties to milk consumption, Widespread dairy infrastructure via cooperatives

Key opportunities include:

- Launching personalized dairy plans for diabetics, athletes, elderly
- Promoting school-based dairy nutrition education
- Using digital marketing to raise awareness
- Strengthening farmer training to enhance milk quality for functional processing

CONCLUSION

Functional dairy is at the intersection of science, tradition, and public health. It offers a powerful, scalable solution to modern health problems—ranging from undernutrition to lifestyle diseases. With proper investment, policy alignment, and consumer education, India can become a global leader in functional dairy innovation. In celebrating dairy's power to nourish both people and the planet, functional foods emerge as the future of holistic nutrition. They reflect how one simple food—milk—can be transformed into a vehicle of well-being, resilience, and sustainability.

REFERENCES

Ahmed, Z., Wang, Y., Ahmad, A., Tariq Khan, S., Nisa, M., Ahmad, H., Afreen, A., 2013. Kefir and health: a contemporary perspective. Crit. Rev. Food Sci. Nutr. 53, 422-434.

Allen Foegeding, F., Cakir, E., Koc, E., 2010. Using dairy ingredients to alter texture of foods: implications based on oral processing considerations. Int. Dairy J. 29, 562-570.

Algorta-Pineda, J., Chinchetruranedo, M.J., Aguirre, J., Francisko Terreros, S., 2005. Hypoholesterolemic effectiveness of a yogurt containing plant stanol esters.

Alenisan, M., Allgatan, H., Tolbach L.S., Shori, A., 2017. Antioxidant properties of dairy products fortified with natural additives: a review. J. Assoc. Arab Univ. Basic Appl. Sci. 24, 101-106.

Altin, G., Gültekin-Özgüven, M., Ozcelik, B., 2018. Liposomal dispersion and powder systems for delivery of cocoa hull waste phenolics via Ayran (Drinking Yoghurt): Comparative studies on in-vitro bioaccessibility and antioxidant capacity. Food Hydrocoll. 81, 364-370.

Alzate, A., Perez-Conde, M.C., Gutierrez, A.M., Camara, C. 2010. Selenium-enriched fermented milk: a suitable diary product to improve selenium intake in humans. Int. Dairy J. 20, 761-769.

Annunzita, A., Vecchio, R., 2013. Consumer perception of functional foods: A conjoint analysis with probiotics. Food Qual.

Bakr, S.A., 2015. The potential applications of probiotics and prebiotics on dairy and non-dairy foods focusing on viability during storage. Biocat. Agricult. Biotechnolog.

Baschali, A., Tsakilidou, E., Kyriacou, A., Karvasiloglou, N., Matalas, A., 2017. Traditional low-alchocolic and non-alchocolic fermented beverages consumed in European countries: a neglected food group. Nutr. Res

Bhat, Z.F., Bhat, H., 2011. Milk and dairy products as functional foods: a review. Int. J. Dairy Sci.

Bimbo, F., Bonnano, A., Noclla, G., Viscecchia, R., Nardone, G., Devitiis, B., Carlucci, D., 2017. Consumer's acceptance and preferences for nutrition-modified and functional dairy products: a systematic review.

Bogue, J., Collins, O., Troj, A.J., 2017. Market analysis and concept development of new functional foods, in: Bagchi, D., Nair, S., (Eds.), Developing new functional food and nutraceutical products. Academic press, San Diego,

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