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Probiotics: A Modern Way of Value Addition of Dairy Products

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Abstract

Functional foods are foods that improve health in addition to their nutritional benefits to customers. Functional dairy products have a bright future, but customer pleasure is the key. Because they are becoming more aware of the health benefits of functional foods, such as strengthening the immune system, preserving the proper microbiota in the intestines, preventing gastrointestinal disorders, and lowering blood pressure and cholesterol, consumers are now looking forward to using these products.

Introduction

India is the world's largest producer of milk. However, there was a time when India was a milk-deficit country. This journey from a deficit country to the world's largest producer has mostly been made possible by a network of institutions and supportive policies that have assisted millions of rural households.

The organised dairy industry collects and processes around one-fifth of the milk produced. Over twelve million small-scale dairy farmers are now connected to metropolitan markets through cooperatives, which also give them a reliable source of income. India's dairy business is undergoing significant transformation because of the government's economic restructuring and liberalisation initiatives. As a result, the private sector is now more involved.

The business sector has been more involved as a result. This aligns with worldwide patterns as well, which may promote a deeper integration of Indian dairying with the global milk and milk products industry. India currently has the largest and fastest-growing milk and milk product market in the world, with an approximate registered 58 % increase during the last nine years i.e., during the year 2014-15 and 2022-23 and increased to 230.58 Mn Tonnes in the year 2022-23. The milk production has increased at CAGR 5.85 % over the past 9 years.

Market for Value added dairy products

The consumer's interest in value added milk products is gaining momentum due to the development of new food processing techniques, changing social attitudes due to scientific evidence of health benefits of certain ingredients. The processing of milk into value added milk products is very less in our country as compared to other developed countries, which benefits middlemen and shopkeepers. To make milk production and animal husbandry a profitable business, it is necessary to adopt techniques like food fortification, enrichment, preservation, etc., to promote the idea of value addition of agricultural food products in the food processing industries.

Table 1- Different milk products and value-added products made by utilizing them.

Commodities	Value added products
• Full Cream Milk Powder • Skim Milk Powder • Butter • Butter oil/Ghee • Cheddar cheese • Caseinates • MPC 70 • Lactose	• Whey protein Isolates • Whey protein concentrates • Functional MPC • Specially designed dairy ingredients • Functional MPC and WPC ingredient for Yoghurt, Analogue cheese, Protein bars. • Colostrum MPC/Immunoglobulin • Protein fractions • Whey protein hydrolysates • Probiotics • Complex carbohydrates • Complex lipids

Functional foods

Food scientists, nutritionists, health professionals, and regular consumers have all shown a great deal of interest in functional foods and

bioactive ingredients in food in recent years. Beyond its fundamental nutritional purposes, a functional food can lower the risk of chronic diseases. It can look like a traditional food and be consumed as part of a regular diet. However, it also offers numerous physiological benefits. The market for functional foods has shown steady growth in sales volume.

Probiotic, prebiotic, and symbiotic foods are only a few of the many functional foods that have been created recently and are being manufactured globally. Prebiotics are short-chain carbohydrates that specifically increase the activity of specific types of good bacteria while remaining indigestible to human digestive enzymes. Beneficial bacteria in the gut digest prebiotics to create short-chain fatty acids. In the large intestine, prebiotics provide numerous additional health advantages, including a lower risk of cancer and improved absorption of calcium and magnesium. Prebiotics are regarded functional food ingredients with major technological benefits. They can be found in a variety of fruits and vegetables.

Their inclusion boosts a wide range of food applications, including fermented dairy products, by improving sensory qualities like flavour and texture as well as the stability of foams, emulsions, and mouth feel. Dairy and non-dairy probiotic foods were the two categories into which probiotic functional foods were separated. Probiotic dairy products such as ice cream, frozen fermented dairy desserts, cheese, bio yoghurt, drinking yoghurt, kefir, freeze-dried yoghurt, and spray-dried milk powder have been investigated as potential probiotic bacterial carriers.

Probiotic ice-cream

Ice cream is a great source of essential amino acids of milk proteins, vitamins and minerals, and its components are easily digested and absorbed in the body (Abghari *et al*., 2008). Probiotic microorganisms are added to both fermented and unfermented mixtures to create probiotic ice cream. The two most popular lactic acid bacteria species utilized as probiotics for fermented dairy products are *Lactobacillus* and *Bifidobacterium*. Non-fermented ice cream has a pH of about seven, which helps probiotic bacteria thrive. The probiotic bacteria in ice cream are shielded by its high total solids content, which includes milk solids and fat.

The International Dairy Federation (IDF) advises that at the time of consumption, each gram of product should have a minimum of 10^7 viable probiotic bacterial cells since live bacteria have a greater therapeutic potential than unviable cells. One novel approach to boosting probiotic survival is the physical shielding provided by microencapsulation. When compared to other probiotic strains, *Lactobacillus casei* (Lc01) and *Bifidobacterium lactis* (Bb12) exhibit the greatest tolerance to simulated acidic, alkaline, and ice cream environments, rendering them ideal for use in probiotic ice cream.

Probiotic cheese

Probiotic cheese can be generated in two ways: first, by modifying and adapting the manufacturing methods of cheese products to the needs of probiotics; second, by applying the right probiotic strains or by creating new cheese products. The probiotic cheese's flavour and taste are significantly influenced by the proteolytic and lipolytic characteristics of the probiotic bacterial cells. The generation of compounds that largely block or deactivate unrelated bacteria or other similar starting organisms is a common cause of antagonism between bacteria. Because cheese acts as a buffer against the very acidic environment of the gastrointestinal tract, it offers a valuable means of delivering probiotics. This, in turn, generates an environment that is more favourable for probiotic survival during the stomach transit, even at higher pH levels. In addition to increasing the generation of lactate and short-chain fatty acids in petit Suisse cheese, the prebiotics inulin and oligofructose can also accelerate the growth rates of *bifidobacteria* and *lactobacilli*.

Probiotic yoghurt

The starters used for manufacturing of yoghurt i.e., *Lactobacillus bulgaricus* and *Streptococcus thermophilus*, cannot survive transit through the intestinal track, they are not regarded as probiotics. However, adding *Lactobacillus acidophilus* and *Bifidobacterium bifidum* to yoghurt can enhance its physiological and nutritional qualities. Also, *Lactobacillus casei* as the probiotic agent and they

showed that the amount of probiotic bacteria in combination with mint extract in probiotic yoghurt is higher than the minimal amount which is needed for observing the functional effects (Mahmoudi *et al.*, 2015). The standard starting culture is inoculated into heat-treated homogenized milk with an elevated protein content (3.6–3.8 %) at 45 °C or 37 °C, and the mixture is then incubated for 3.5 or 9 hours, respectively. The probiotic culture is introduced either after the product has cooled to 4 °C from fermentation or before it is packaged, concurrently with the normal yoghurt cultures. Probiotic bacteria in fermented dairy products are dependent on a variety of factors, including the chemical makeup of the fermentation medium (such as the source of carbohydrates), the final acidity, the amount of milk solids, the availability of nutrients, growth promoters and inhibitors, the strains used, the interaction between the species present, the culture conditions, the concentration of sugars (osmotic pressure), the level of inoculation, the incubation temperature, the fermentation time, and the storage temperature.

Probiotic milk

When making acidophilus milk, the milk is heated to 95 °C for one hour or to 125 °C for fifteen minutes. *Lactobacillus acidophilus* grows when exposed to such high heat because it releases peptides and denatured proteins. To give any spores present time to germinate, milk that has been subjected to high heat is cooled to 37 °C and maintained there for three to four hours. After that, milk is sterilised once again, eliminating nearly all vegetative cells. The heat-treated milk is homogenized and cooled to inoculation temperature (37 °C), unless skim milk is used. As an active bulk culture, *Lactobacillus acidophilus* is added. Typically, 2-5 % of the milk is infected, and it is allowed to ferment until the pH reaches 5.5-6.0 or less than 1 % lactic acid is produced, leaving no alcohol behind. When the fermentation is not active, it takes roughly 18 to 24 hours. Compared to milk, acidophilus milk contains more free amino acids. *Lactobacillus acidophilus* hydrolyses lactose present in milk with the help of β-galactosidase. Acidophilus milk is better suited for people with lactose intolerance. Acidophilus milk has been fortified with vitamins, iron, and calcium.

Conclusions

Due to the growing significance of functional foods, probiotic-containing functional foods are top priority for manufacturers. Dairy products are crucial among all the probiotic functional goods since they are probiotic bacteria carriers. Numerous studies are carried out on the creation of functional foods, their beneficial effects on public health, and potential ways to improve the viability and stability of probiotics during production and preservation, such as encapsulating the bacterial mass. It is also essential to assess the viability of probiotics under the harsh freezing and low pH conditions of ice cream and cheese. It is advised that more research should be done on the viability of probiotic microbes in different beverages.

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