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Emerging trends in probiotic dairy products

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Abstract
In recent years, there has been an increasing interest in probiotic foods, which has stimulated innovation and fueled the development of new products around the world. Probiotic bacteria have increasingly been incorporated into foods in order to improve gut health by maintaining the microbial gastrointestinal balance. The most popular probiotic foods are produced in the dairy industry because fermented dairy products have been shown to be the most efficient delivery vehicle for live probiotics to date. Dairy products containing probiotic bacteria are produced by the various fermenting methods, especially lactic acid fermentation, by using starter cultures and those are having various textures and aromas. Today, fermented dairy beverages in general are produced locally by using traditional methods. Recently, due to the increased demand for natural nutrients and probiotic products, fermented dairy beverages have reached different heights and are considered to have an important impact on human health and nutrition. Due to the health promoting effects of Probiotic products many studies have been published yet and the role of probiotics and their viability in dairy food such as yogurt, cheese and ice cream. The focus of this article is to review the current scenario of Probiotic dairy products and their and their prospective potential applications for functional foods for better health and nutrition of the society.

Keywords: probiotics, fermentation, dairy products, functional foods

Introduction

According to the FDA functional foods and beverages have high nutritional value and also medicinal properties and many features for consumer health (IFIC, 2007). Nowadays, the demand for functional foods has increased significantly. According to a study by IFIC in 2007, more than 80% of the participants consumed these foods or they had tendency to use them. Growing need for functional foods due to increased consumer awareness is one of its benefits (IFIC, 2007).

The recently extended range of functional foods include probiotic, prebiotics and symbiotic foods. In addition, foods enriched with antioxidants, Isoflavones, Phytosterols, Anthocyanins and fat and sugar reducing foods are considered as functional foods. It is estimated that probiotic functional foods comprise 60% to 80% of total functional foods. The probiotic dairy products have a special role among functional foods and they form the major part of the functional foods' market especially in the last decades (Homayouni, 2014). Probiotic dairy products contain lactic acid bacteria (LAB) or Bifidobacterium spp. Other dairy products are enriched with prebiotics, fiber, calcium, omega-3, acethanol and bioactive peptides from LAB (Homayouni, 2014).

India is the world's largest milk producer which contributes to about 18.5 percent of the total world milk production achieving an annual output of 146.3 million tons during 2014-15. Out of this about 50- 55% of the total milk production is converted into traditional milk products, which is mainly confined to the cottage scale in the non-organized sector. With the rapid growth of dairy industry in our country, the technology and design of process equipment has also undergone needed changes and equipment for making indigenous products are no exception. The small-scale technology for the preparation of indigenous products cannot be exploited for industrial production. India has made substantial growth of urban and semi-urban areas. As a result, increasing number of persons in the cities is desirous of purchasing quality milk products and milk-based sweets (Patel & Bhadania, 2015) [15] Functional dairy products have a prominent place within the functional foods segment, accounting for over 40% of this market. Vast majority of functional dairy products are fermented products. Yogurt and yogurt-type functional products including low-lactose or lactose free products and those supplemented with functional ingredients such as minerals, vitamins, conjugated linoleic acid (CLA), sterols/stanols and probiotics/prebiotics have been enjoying the market success for a long time. The global functional dairy beverages market is a very dynamic segment of the dairy industry and global dairy-based beverages market is forecasted to reach a market value of 13.9 billion USD by 2021, excluding traditional dairy beverages such as kefir, buttermilk, kumiss. (Nazli *et al*. 2019) [12]

Yoghurt is a fermentative dairy product which is made of milk and is produced by lactic acid bacteria. In production of yoghurt two starters are used including Streptococcus thermophilus and Lactobacillus bulgaricus; But none of the above can survive the digestive tract, thus aren't able to provide probiotic properties since they're destroyed under acidic conditions. Acid-resistant species must be used. Yoghurt is produced by adding probiotic Lactobacillus and Bifidobacterium in the presence or the absence of starter. Health benefits of probiotic are intensified in the presence of starter and these properties are doubled while adding the

probiotic bacteria. Many types of yoghurt with different probiotics have been produced around the world. Many studies have been done on the viability of probiotics during fermentation and storage. In a study, it was determined the best conditions which is affecting the parameter of temperature on survival of probiotics containing Lactobacillus acidophilus and Bifidobacterium lactis in the environment (Streptococcus thermophiles and Lactobacillus bulgaricus). Same authors examined the storage temperature for cooling as the third parameter, the best time for the viability of both bacteria is to evaluate the initial probiotic bacteria and the average time for yoghurt preservation. Probiotic yogurt in addition to their nutritional value, have an important role in fighting against the pathogens (Mahmaoudi *et al*. 2015) [13]. They investigated the survival of probiotics and other properties of probiotic yoghurt in the presence of different concentrations of mint extract with the count of 108 -109 cfu/ml. 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*, 2014). Studies on different factors affecting the durability of probiotics resulted in the fact that this product can be presented as a functional probiotic product.

Acidophilus milk is produced from high heat treated milk (95 °C for 1 h or 125 °C for 15 min). High heat treatment leads to denaturation of milk serum proteins and release of peptides that are essential for the growth of Lb. acidophilus. After heat treatment, the milk is cooled to 37 °C and kept at this temperature for about 3–4 h to germinate all spores. Then milk is re-heated to kill vegetative microorganisms (Vedamuthu, 2006). Fermentation is achieved at 37 °C until pH 5.5 or 1% lactic acid (usually takes 18–20 h). Average inoculation rate of Lb. acidophilus is 2–5% but in some cases replacement of 25% of Lb. acidophilus by a mixture of yogurt culture is recommended. Enrichment of acidophilus milk with vitamins and minerals to improve functionality of the product is also possible. Various aroma and flavor compounds may be added to acidophilus milk to improve their overall sensory acceptability (Junaid *et al*., 2013) [9].

Acidophilus milk has a very distinctive tangy flavor and slightly thick texture. The shelf-life of acidophilus milk is rather short due to most strains of Lb. acidophilus can produce organic acids at low temperature. Goodarzi *et al*., (2017) [4] employed the cold-sensitive mutants of Lb. acidophilus in the manufacture of acidophilus milk to limit the metabolic activities of the strains during cold storage. The researchers used Rifampicin and Streptomycin resistant mutants of Lb. acidophilus which were subjected to ultraviolet (UV) mutagenesis. Rifampicin and Streptomycin resistant mutations influenced the thermo-stability of the key molecules of cell metabolism in the RNA polymerase and ribosome, respectively. Antibiotic-resistant mutants of Lb. acidophilus lost their ability to grow at low temperatures and naturally, their metabolic activities were limited under cold storage conditions. The viability of the mutated strains was twice as high as the non-mutated parent strain.

Whey is no longer a waste of cheese-making but a raw material for high value-added products including probiotic beverages. It contains many nutritional compounds such as soluble milk proteins, minerals and milk sugar, and offers a suitable food matrix for the growth and viability of probiotic microorganisms (Buriti *et al*, 2014; Castro *et al*., 2013; Pescuma *et al*, 2010) [2]. During the last decade, researches on whey based beverages have increased enormously, predominated by probiotic whey beverages and supplemented whey-based beverage formulations. Although probiotic yogurt provides better immune response indicators (neutrophils and lymphocytes), cytokines responses (TNF-α and IL-1β), improved exhaustive exercise caused immune depression mainly on monocytes and neutrophils, and various standard health parameters than probiotic whey-based beverages (Lollo *et al.*, 2013), supplementation of whey beverages with probiotics and prebiotics exert some health benefits such as reducing blood pressure (Fluegel *et al*., 2010) [3].

Whey can be used in the production of probiotic beverages in various forms. It may be used directly or may be supplemented with dairy based powders (i.e. buttermilk powder, skimmilk powder, etc.) or added to beverage formulations at varying ratios. Skryplonek and Jasińska (2015) [14] developed a probiotic beverage formulation from fresh acid cheese whey supplemented with buttermilk powder (5%) or sweet whey powder (5%). Throughout storage period of 21 days, the counts of Lb. acidophilus La-5 and B. animalis Bb-12 were above 8 log cfu/mL. Formulation containing buttermilk powder received higher sensory scores than the sample supplemented with sweet whey powder.

Conclusions

There is a remarkable increase in the demand for probiotic foods. It can be stated that the future is very promising for such entrepreneurs and researcher who can understand the emerging market demands and requirements; can convert it to a best advantage. This also brings large deviation in taste and preferences for the products. The increasing awareness regarding the health benefits of the probiotic food is the major reason for increasing demand for probiotics. Whey can be used in the production of probiotic beverages in various forms. There is ample scope for developing probiotic indigenous dairy products.

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