

Editorial

Functional Probiotic Foods Development: Trends, Concepts, and Products

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1. Introduction

Functional foods offer positive effects on health beyond basic nutrition. Functional foods are considered to promote optimal health and help reducing the risk of illness. The Food and Drug Administration regulates the functional foods claims that manufacturers can make about nutrient content, effects on disease, health, or body function. Probiotics are live microorganisms, which exert positive health effects when consumed in sufficient amounts. According to a definition given by the International Scientific Association for Probiotics and Prebiotics (ISAPP), probiotics are “Live microorganisms that, when administered in adequate amounts, confer a health benefit on the host” [1].

Microorganisms, such as *Lactobacillus rhamnosus* GG, *L. reuteri*, bifidobacteria, and certain strains of *L. casei* or the *L. acidophilus* group, have been characterized for their probiotic properties, and they are commonly used in probiotic foods, particularly fermented milk products. Several other microorganisms, including *Escherichia coli* strain Nissle 1917, *Enterococcus faecium* SF68, and *Saccharomyces boulardii*, have shown therapeutic applications. Well documented health benefits attributed to probiotic microorganisms include modulation of the intestinal microflora, immune system boosting, and alleviation of complaints due to lactose intolerance.

2. Probiotic-Based Functional Foods

Hippocrates, 2500 years ago, established a very important statement: “Let food be the medicine and medicine be the food”. This concept is used to emphasize the role of bioactive compounds of foods in prevention or to treat some chronic diseases. The research focus on probiotics is shifting toward the determination and characterization of specific secondary metabolites, and these are called postbiotics. These postbiotics have the potential to overcome undesirable conditions, such as processing, preparation, storage, and digestion so as to exhibit many physiological activities, such as having antihypertensive, anti-inflammatory, immunomodulatory, antioxidant, and anti-carcinogenic properties [2]. This opens up many possibilities to use probiotics and postbiotics for the development and design of novel health promoting foods and/or food supplements for pharmaceutical and clinical purposes.

ABT-5 probiotic (*L. acidophilus* LA-5, *Bifidobacterium bifidum* BB-12, and *Streptococcus thermophilus*), as well as *L. acidophilus* LA-5, were utilized for the development of a functional fermented beverage from beetroot. Employing the fermentation process contributed toward the many positive traits of the fermented beverage, such as increased antioxidant capacity and zinc content, as well as the enhancement of organoleptic properties (taste, flavor, and consistency) due to the formation of lactate [3]. Reports also suggest that the encapsulation of *L. plantarum* DSM 20,205 and *P. acidilactici* DSM 20,238 with 0.05 % moringa



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could improve the constancy of probiotic capsules in fruit juices and drinkable yogurt [4]. Functional beverages have become popular consumer products, and they are quite prevalent worldwide. A wide range of fermented beverages and non-fermented beverages are sold as probiotic or synbiotic products. Furthermore, protein-rich beverages, including sports drinks, have progressively started to dominate the dairy-centered beverage sector.

A probiotic product is expected to have viable cell count of probiotic microorganism(s) greater than 10^6 colony forming units (cfu) per mL or g. Several factors may affect the viability of probiotics in food products during processing and storage. These factors could be related to intrinsic properties of the product, such as pH, titratable acidity, oxygen, water activity, presence of salt, sugar, hydrogen peroxide, bacteriocins, artificial flavoring, coloring agents, or processing related treatments, or they could be related to conditions, such as fermentation conditions, incubation temperature, heat treatment, cooling and storage conditions, packaging materials, scale of production, or microbiological characteristics of probiotics, such as strain of the microorganism or the rate and proportion of inoculation [5]. The viability during food processing and/or storage, survival after the passage through GIT transit, and the ability to exert health benefits to the host are the most important criteria for the selection of potential probiotics. Most bacteria are unable to tolerate the harsh conditions during the upper GIT transit. Therefore, the selection of the appropriate probiotic strain is a key factor in formulating products with viable probiotic cells to exhibit health benefits.

3. Trends in Novel Probiotic Food Products

Trends in probiotic food products have progressed away from dairy-based to plant-based products, beverages, and snacks. Traditional probiotic food products are fermented dairy products, such as kefir and yogurt. The subsequent group of probiotic food products includes fermented fruit and vegetable products (such as pickles or olives) and some fermented meat products (such as sausages). The next generation of probiotic food products are interestingly non-dairy and non-fermented, where probiotics are incorporated into breakfast cereals, juices, fruit snacks, chocolates, and confections. In the last few years, non-dairy probiotic foods have attracted significant attention from researchers [6]. Examples of some novel probiotic food products in the market include probiotic fruit beverages, probiotic frozen desserts, and probiotic vegan milk. Vegetables and fruits are the future raw materials in the production of non-dairy probiotic products. Probiotic fruit and vegetable products provide additional functionality and nutritional values (phytochemicals, antioxidants, zero cholesterol, vitamins, minerals, and dietary fibre).

This Special Issue aims to publish quality articles addressing the benefits and importance of probiotics for human health, as well as the development of innovative functional foods containing probiotics, prebiotics, and postbiotics.

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