Progress of Research on Probiotics as Dietary Supplements to Support Gut Health in Humans

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Abstract. Probiotics are a class of microorganisms that are beneficial to the host's health when ingested in certain amounts. As people strive to enhance their overall health, probiotics have become increasingly common in several fields whose health functions include balancing flora, synthesizing nutrients, enhancing immunity, etc. Moreover, they can be obtained from a wide range of sources, easily cultivated and applied to dairy products, capsules, fruit and vegetable juices as well as other functional beverage, with broad potential markets and applications. This paper analyzes and discusses the concept of probiotics, their health functions, acquisition and cultivation, as well as product safety, the development of species, and the application in the food industry and different populations. It has been found that probiotics have good effects on the human intestine, immunity and other aspects. It has great impact and has huge application prospects in the field of food and beverages. The conclusions and summary of this article provide new ideas for future research and development of probiotics. Findings of this paper provide ideas for the future research and development of various types of probiotic foods.

Keywords: Probiotics; gut health; dietary supplements.

1. Introduction

In an effort to enhance their life quality, consumers are starting to pay attention to diet, nutrition, and food safety due to the growing health requirements in modern society. Probiotics are specialized bacteria that have been used for millennia in food and become increasingly significant in the field of nutrition. Among the newly emerging functional foods in the market, probiotic-based foods and beverages are considered to be more prominent and acceptable to consumers in the future.

The probiotic organisms that are currently utilized in applied foods are primarily Lactobacillus, Bifidobacterium, and Saccharomyces cerevisiae. Probiotics are widely utilized in the dairy industry since the in vitro fermentation process of dairy products generates probiotics that improves the food taste and adjust to the stomach's acidic pH levels (pH 2-3) [1]. With the development of industrial technology, probiotics started to be employed as food excipients in the pharmaceutical industry as well as in several non-dairy functional beverages. Some studies have shown that probiotics typically added to food as food excipients boost its nutritional value [2].

Probiotics play an essential role as a low-cost food excipient additive in enhancing the nutritional content and sensory properties of foods, proving the importance of probiotic-containing fermented beverages to the global human diet. This review aims to provide an overview of products related to the use of probiotics as food excipients to promote nutrient absorption in the gut and thus improve human health, to evaluate further applications of probiotic products in future food products.

2. The Significance of Probiotics for Human Health

In human daily life, the medium of communication with the external environment is mainly through the skin, respiratory tract and digestive tract and other organs. Therefore, a wide variety of microorganisms exists in these parts, among which the intestinal microbiota is the most abundant and diverse microbial community in the human body and has the closest relationship with the human body. Bacteria with high population densities or numbers in the intestinal flora are known as dominant flora, including Bacteroidetes, Eubacterium, Bifidobacterium, and so on. Additionally, the flora can be

categorized into beneficial, harmful, and intermediate flora based on their effects on the host. Lactobacillus and Bifidobacterium probiotics are the dominant and beneficial flora found in the human body. According to certain research, the dominant flora can suppress or lessen the amount of harmful flora, and they are the flora that perform physiological functions on the host [3].

2.1. Maintaining Intestinal Function

Probiotics are a component of the intestinal microbiota, and a diversity of microorganisms in common coordination to maintain appropriate intestinal tract function. Antibiotic-associated diarrhea and ecological dysregulation of the intestine commensal microbial community are quickly brought on by the extensive use of antibiotics. However, It is difficult to exploit this disruption of ecological balance to re-establish a new microbial homeostasis simply by humans obtaining microbes from outside sources. Evidence indicates that antibiotic-associated diarrhea in children can be treated to restore the gut microbiota by oral probiotic supplementation with Bifidobacterium shortum and Lactobacillus rhamnosus in order [4]. Therefore, probiotics are essential for maintaining gut health and are "ecological rebuilders" of the gut microbiota.

2.2. Nutrients

Nutrients in the human body not only come from the substances we ingest from the outside world, but probiotics can also synthesize important micro-nutrients for the human body so that they can be absorbed and utilized by the human body, probiotics in the intestinal tract will continue to produce a variety of vitamins and promote the absorption of vitamins. In addition, probiotics can ferment indigestible carbohydrates, produce short-chain fatty acids, and regulate energy metabolism, nutrient absorption and lipid metabolism. Currently in the use of probiotics, many products are not only limited to the use of live strains, in vitro fermentation, material metabolism after the production of multivitamin B or active prebiotics, etc. The application of probiotics is also a hotspot in the development and research of probiotic products [5]. Therefore, probiotics can be used as one of the "processors" of human nutritional sources.

2.3. Immune Function

Since probiotics have the same structure with most harmful bacteria, the mucosal epithelium of the intestinal tract activates various immune cells of the human body through the consumption of probiotics, which enhances the resistance to harmful bacteria. Probiotics can prevent the adhesion and proliferation of harmful pathogens in the mucosal layer, thus protecting the intestinal intestinal epithelium and lamina propria. Some studies have shown that immunocompromised elderly people can positively influence the composition of intestinal flora by supplementing Bifidobacterium and Lactobacillus and interact with different immune cells to improve their own immune function, which can reduce the risk of disease in the elderly [6]. Therefore, probiotics are the "guardians" of human health and immune regulation.

3. Acquisition and Cultivation of Probiotics

3.1. Acquisition Route

Studies have shown that probiotic strains isolated from healthy human feces are better adapted to the human environment and show maximum activity in foods and medicines used by humans [7]. Probiotics can also be isolated from traditionally fermented dairy products, sauerkraut and plants, and the main role of these probiotics is to increase the shelf life, nutritional elements and taste of food, as well as to regulate intestinal function. Probiotics can also be genetically engineered when they are needed for specific functions. Probiotic products are simple to obtain from a wide variety of sources, powerful, and have great application prospects.

3.2. Cultivation Conditions of Fermentation Materials

The mild fermentation temperature of probiotics in dairy products and plant ferments is around 37℃, and most of the metabolic substrates are from lactose or glucose contained in directly obtained dairy products or plant ferments. The duration of fermentation is around 72 hours for dairy products and 28 days for plant ferments. During the fermentation process, with the consumption of sugars and the increase of organic acids, the pH will gradually decrease and stabilize at 4-5, and this pH can inhibit the activity of the harmful flora of the fermentation products and provide a better buffer for the probiotics before they enter the stomach to contact gastric acid, which is conducive to their colonization in the intestine [1]. The fermentation conditions of probiotic products are mild, the fermentation substrate is relatively simple, the fermentation cycle is shorter, and it has better economic value.

4. Development and application of probiotics in dietary products

4.1. Safety

Through the study of multi-source probiotics, cultures of 10 species of bacilli and bifidobacteria such as Lactobacillus shortus HL6 from kimchi and milk, Streptococcus thermophilus FUA329 from breast milk sources, Saccharomyces cerevisiae and Lactobacillus plantarum isolated from wine and plants, and Lactobacillus fermentum SJRP30, Lactobacillus cheesus SJRP37, and SJRP66 isolated from cheese were not found to produce any harmful toxins [8-10], indicating that probiotics from multi-channel sources have good safety for use as excipients in current foods and beverages.

4.2. Product Variety

There are more than 500 probiotic-functional foods available globally, of which dairy products account for about 80%, including yogurt, ice cream, cheese, whey beverages, buttermilk, sour cream, and other fermented dairy foods, suggesting that the dairy product range has a relatively good acceptance globally, but that they may have negative effects on the consumer, such as malabsorption of lactose, allergy to milk proteins, and elevation of blood fat and cholesterol levels,. Therefore, non-dairy fermented alternatives must be introduced into the food industry. Probiotic products fermented with fruit juices and vegetable drinks as substrates have become increasingly abundant in recent years, e.g., blueberry, pear-fruit cactus, curly kale juice, etc [11-13]. Currently, in order to maintain the viability and stability of probiotics and to make it easier for consumers to carry them around, developers have developed microencapsulated products [14]. As we continue to recognize the ingredients and the development of the food industry, more types of probiotic products will be developed one after another.

4.3. Baby Food Accessories

A large number of microbial colonization of the human gut begins at birth, and good development of the gut microbiota early in life may make a significant contribution to the long-term health of the host. In infancy, the composition of the gut flora depends mainly on the external environment and diet, with the earliest acquisition of probiotics from breastfeeding. Literature reports that probiotics as food supplements in infant formulas may reduce the risk of disease in infancy and childhood by improving the intestinal flora and acquiring immunity from the gut as early as possible [15]. The use of probiotics as excipients can help to improve the intestinal flora of the human body and improve the human immune function.

4.4. Important Applications of Probiotic Additives in Medicine

Intestinal diseases seriously affect the quality of life of patients, and the incidence of Inflammatory Bowel Disease (IBD) in the global population is increasing year by year, and the damage to the intestinal epithelial mucosa caused by the immune system dysregulation is the main pathological

feature of IBD, and the intestinal microorganisms are related to the immune system response. The introduction of a large number of probiotics to the intestines to regulate intestinal mucosal immunity and protect microorganisms and intestinal epithelial cells through the consumption of dairy ferments and fermented dairy products may improve the condition of patients [16]. In addition, it has been reported in the literature that consumption of probiotic fermented food products can enhance memory and cognition in Alzheimer's disease through the gut-brain axis and provide positive neuroprotection [17]. Blackberry functional drink also has some effect on prostate disease [18]. The number of studies exploring the effects of probiotic products on improving diseases of various human organs is increasing year by year.

5. Conclusion

With the development of industrial level, human research on the use of probiotics as additives to develop nutritious food has made significant breakthroughs, its safety is beyond doubt, the number and types of strains found from animal dairy sources to non-dairy fermentation alternatives, which greatly subverted the past human cognition, so that people can obtain probiotics more convenient, and its related products play an important role in the fields of preventive health care, the treatment of intestinal diseases, as well as improving immune function and quality of life of the special populations. Its related products play an important role in preventive health care, treatment of intestinal diseases, and improving the immune function of special populations to improve their quality of life. Through various experimental observations and clinical applications, it has been further confirmed that probiotics can improve certain diseases in human beings, highlighting the great research and application value of probiotics in the medical field. However, research on the effects of a single strain of probiotics and the ingestion of fermentation products on human health is still insufficient, especially for chronic diseases, cancer, seasonal epidemics, outbreaks of infectious diseases, and many other diseases affecting human health, which still need further research and confirmation. In addition, the existing probiotic access and cultivation conditions limit the expansion of probiotic flora in terms of quality and quantity, and the number of genera and types of probiotics is still a drop in the ocean compared with the abundant natural resources. In conclusion, at present, probiotics have great economic value in the field of food and health, and with the exploration and application of probiotic products, it is hoped that more probiotic products that can promote human health and improve diseases can be developed.

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