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Probiotics and Probiotic Foods

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Abstract

Probiotics are live and beneficial microorganisms that have been extensively studied and commercially explored in many different products around the world. Their strong benefits to human and animal health have been proven in hundreds of scientific research. Probiotics have shown strong advantages in balancing intestinal flora, reducing the risk of diarrhea and cancer, and lowering serum cholesterol. Therefore, probiotic food is regarded as a functional food. The lactic acid bacteria and Bifidobacterium genera are common probiotic organisms. Besides, the demand of probiotics and related productions are growing rapidly due to the increased awareness of consumers about the impact of healthy living and functional foods. However, development of foods with adequate doses of probiotics at the time of consumption is a challenge, because of several factors during processing and storage affect the activity and viability of probiotics organisms. Apart from that, the presence of probiotics in food products may also adversely affect their quality and sensory properties. In this review, probiotics and probiotic foods are presented along with their health benefits and challenges in food processing.

Keywords

Probiotics, probiotic foods, functional foods, health benefits, challenging

1. Introduction

Nowadays, the functional food is gaining increasing attention. The concept of functional food is documented by EU that a food can be considered as functional if it improves the physical health, such as reducing risks [1]. The ingredients of functional food contain probiotic, vitamins, minerals and prebiotics, which exist and/or added in several foods such as fermented milk, baby foods, and sports beverage [2]. The details of functional food is defined by Functional Food Center (FFC) that a natural or processed food with biologically active compounds. It has e therapeutic advantages which can cure chronic disease by specific biomarkers in the appropriate dosage [3]. Based on the definition, the probiotic food belongs to the category functional foods since promoting healthy, especially for the gut, and the advantages out of range of traditional benefits given by them [4-5].

2. Probiotics and probiotic food

The probiotic is regard as a bioactive food supplement which beneficially affects the host by improving its intestinal microbial balance [6-7]. Additionally, this definition is also admitted by FAO/WHO, and it stated that the health influence for human or other animals needs a sufficient number of probiotics [8]. The lactic acid bacteria and *Bifidobacterium* genera are common probiotic organisms, which often added in fermented dairy products especially for yoghurts [9]. Indeed, probiotic microbe also contain other types of microorganisms like *Bacillus* spp. and yeast (*Saccharomyces* spp., and *Aspergillus* spp.), as shown in Table 1 below.

Some scholars considered that the gastrointestinal tract (GIT) and breast milk are the reliable isolation source of probiotic organisms [10]. A lot of literature confirmed that bifidobacteria was first discovered to be isolated from the intestinal layer of breastfed infants [11]. Besides, the presence of a high count of probiotic bacteria is found in the human faeces. Furthermore, the animal-origin food (fermented foods and raw milk) and plant-origin food also are valid origin of probiotic isolation [10]. Probiotic bacteria partially used in the production of commercial probiotic products isolated

from fermented foods.

Currently, the development of probiotic food is an increasing trend for food manufacturers. Approximately 500 products worldwide related to probiotics, including milk products (*e.g.* cheese, yoghurt) and non-dairy products (*e.g.* fruit or vegetable juices, fermented sausages, cereal-based foods [12]). In food system, the minimum number of 10^6 cfu/g probiotics present in foods can achieve its health goal [13-14]. In Japan, the standard probiotic amount in fresh milk is at least 10^7 cfu/ml or gram, and the concentration of 10^8 to 10^9 probiotic microorganisms has the therapeutic effects [14].

Table 1. The microorganisms belong to probiotics

Lactobacillus spp.	Enterococci	*Bifidobacterium* spp.	Other microorganisms
L. acidophilus	*E. faecium*	*B. adolescentis*	*Bacillus cereus* var.
L. amylovorus	*E. faecalis*	*B. animalis*	toyoi
L. crispatus		*B. bifidum*	*Escherichia coli*
L. delbrueckii ssp. *bulgaricus*		*B. breve*	strain Nissle
L. fermentum		*B. 'infantis'*[a]	*Saccharomyces*
L. gallinarum		*B. longum*	*cerevisiae* (*boulardii*)
L. gasseri			
L. helveticus			
L. johnsonii			
L. paracasei			
L. plantarum			
L. reuteri			
L. rhamnosus			
L. salivarius			

3. Advantages of probiotics

The benefits of probiotics are published by lots of documents and generally accepted by the public. For instance, the improvement of the human gut environment through the alteration of bacteria counts, preventing and relieving the occurrence of diarrhea [11, 15]. The several health advantages of probiotics are shown in the following figure.

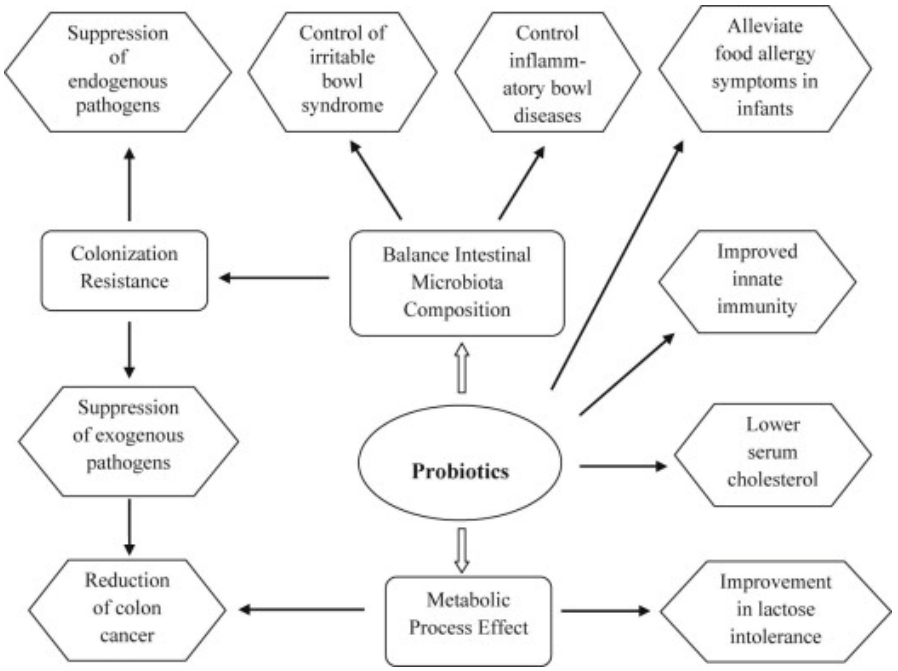

Figure 1. The health benefits of probiotics for human [16].

The antimicrobial properties of probiotics can prevent diarrhea. Several studies demonstrated that probiotic use is associated with a reduced risk of diarrhea, particular for infectious diarrhea which often occurred by rotavirus contamina-

tion [17]. The experiment of Savedra et al. [18] confirmed that the diarrhea rate was reduced in children who were consumed the milk added with *B. bifidum* and *St. thermophilus*. Further, other probiotics such as *L. rhamnosus* GG and *B. animalis* Bb12 have effectiveness in shortening acute rotavirus diarrhea period [17].

In addition, the anticarcinogenic activeness of probiotics was verified by Goldin and Gorbach [19]. Introducing *L.acidophilus* into foods could reduce the incidence of colon cancer in rats. The Lactobacillus *acidophilus* and *L. casei* decrease the concentration of active carcinogen, therefore minimize the risk of cancer for human [15]. Besides, the Lactobacillus *acidophilus* also found affect the level of blood cholesterol. Grunewald [20] pointed out the concentration of serum cholesterol in rats declined naturally with the introduction of Lactobacillus *acidophilus* into the diet. Other workers acknowledged the lower cholesterolemia in humans may be achieved by the consumption of probiotic foods [21-22].

4. The challenges of probiotics in food production

In recent years, fruit, vegetable and/or other materials based beverages are becoming popular as probiotic carriers. The combination of the nutritional value of fruit juice and probiotics' health benefit is an attraction point for customers consuming. Since fruit juice is a non-dairy product, it does not cause lactose intolerance and allergic reactions such as milk protein allergy. Therefore, many juice producers use this feature to attract the consumption of vegetarians, hypercholesterolemia patients and other special needs.

However, the introduction of probiotics into beverages faces some challenges. In the juice processing, there are several factors could kill the activity and viability of probiotics. For example, the high acid environment, the presence of oxygen, and the scarcity number of peptides and free amino acids [23].

pH is one of the vital parameters that determine the survival of probiotics in juice. The juice contains a lower pH due to the high organic acids content. Vasudha and Mishra (2013) pointed out that the low pH of fruit juices is a drawback for probiotic activity and total viable counts. For example, bifidobacteria is difficult to survive in the environment of a pH value of about 4.6 due to the poor acid resistance [24]. In general, the optimum value of pH for probiotics growth is 5 to 9, and probiotics hardly grow in environments below pH 4.5 [23]. Besides, the oxygen present in juice can cause the formation and accumulation of toxic substances, since the anaerobic feature of probiotics. Further, the existence of sugar, salt and chemical additives such as artificial flavoring and hydrogen peroxide in juices also limit the growth of probiotics [16].

Besides, the heating process in juice manufacture poses an adverse effect on probiotics survives because of thermosensitivity. Sheehan et al. [25] found that the number of probiotics contained in the juice after heat treatment (the 30s at 76℃ and 90℃ for 1 min) cannot meet the specified requirements. Therefore, in the industry, probiotics are usually added after the sterilization operation.

Additionally, the variation of product sensory caused by probiotic addition is also a major problem, which can affect the costumers' acceptance. Probiotics tend to make the juice taste sour or astringent, which is not acceptable to consumers. Adding aroma or volatile ingredients can mask the presence of probiotics. For example, the addition of sucrose at the beginning of the juice fermentation can effectively improve the flavor of the product and make it more acceptable [26]. Similarly, adding fruits such as mango, pineapple, or passion fruit has the same effect [27]. In the storage period of the product, the number of probiotics in the product need to maintain the standard level until the last date of preservation. The ingredients of beverage and storage condition can affect the survival rate of probiotics. The fruit juice with lactic acid bacteria genera added has strict requirements for storage temperature as lactic acid bacteria are sensitive to temperature changes. The physical method such as low temperatures can help them maintain or even prolong probiotic activity. Mortazavian et al. [28] suggested that the optimum temperature range of probiotic food reserve is 4-5℃. Also, the microencapsulation technologies used in beverage processing to resolve this issue. The microencapsulation technology provides an anaerobic condition for susceptible probiotic strains, as well as protects cells from damage in fruit juice [29].

5. Conclusion

In conclusion, probiotic food is a beneficial functional food that deserves to be developed in the future. It is reflected in many aspects of the health of the human body and is particularly conducive to the improvement of the intestinal environment. However, due to its instability, probiotics are difficult to survive long during food production and storage. For example, in juice processing, the inappropriate condition such as high acid concentration and low value of pH will damage the survival rate of probiotics. Those challenges will result in failure to provide the expected health benefits due to insufficient probiotics in the product. Although there are some techniques to alleviate these problems, such as microencapsulation technology, measures to improve the stability of probiotics require constant research.

References

[1] Roberfroid, M. (2002). Functional food concept and its application to prebiotics. *Digestive and Liver Disease*, *34*, S105-S110.

[2] Khan, S. H., & Ansari, F. A. (2007). Probiotics--the friendly bacteria with market potential in global market. *Pakistan journal of pharmaceutical sciences*, *20*(1), 76-82.

[3] Gur, J., Mawuntu, M., & Martirosyan, D. (2018). FFC's Advancement of Functional Food Definition. *Functional Foods in Health and Disease*, *8*(7), 385-297.

[4] Guarner, F., & Schaafsma, G. J. (1998). Probiotics. *International journal of food microbiology*, *39*(3), 237-238.

[5] Tannock, G. W. (Ed.). (2002). *Probiotics and prebiotics: where are we going?* Horizon Scientific Press.

[6] Saarela, M. (Ed.). (2011). *Functional foods: Concept to product*. Elsevier.

[7] Fuller, R. (Ed.). (2012). *Probiotics: the scientific basis*. Springer Science & Business Media.

[8] World health organization (WHO). (2002). Health and nutritional properties of probiotics in food including powder milk with live lactic acid bacteria, a joint FAO/WHO expert consultation. Cordoba, Argentina, 1-4 October 2001. *http://www. who. int/foodsafety/publications/fs_management/probiotics/en/index. html*.

[9] Kociubinski, G., & Salminen, S. (2006). Probiotics: Basis, state of the art and future perspectives. In *Functional food network general meeting* (pp. 8-10).

[10] Shokryazdan, P., Faseleh Jahromi, M., Liang, J. B., & Ho, Y. W. (2017). Probiotics: from isolation to application. *Journal of the American College of Nutrition*, *36*(8), 666-676.

[11] Sarao, L. K., & Arora, M. (2017). Probiotics, prebiotics, and microencapsulation: A review. *Critical reviews in food science and nutrition*, *57*(2), 344-371.

[12] Siro, I., Kapolna, E., Kápolna, B., & Lugasi, A. (2008). Functional food. Product development, marketing and consumer acceptance—A review. *Appetite*, *51*(3), 456-467.

[13] Agrawal, R. (2005). Probiotics: an emerging food supplement with health benefits. *Food Biotechnology*, *19*(3), 227-246.

[14] Michael, M., Phebus, R. K., & Schmidt, K. A. (2010). Impact of a plant extract on the viability of Lactobacillus delbrueckii ssp. bulgaricus and Streptococcus thermophilus in nonfat yogurt. *International Dairy Journal*, *20*(10), 665-672.

[15] Nagpal, R., Kumar, A., Kumar, M., Behare, P. V., Jain, S., & Yadav, H. (2012). Probiotics, their health benefits and applications for developing healthier foods: a review. *FEMS microbiology letters*, *334*(1), 1-15.

[16] Tripathi, M. K., & Giri, S. K. (2014). Probiotic functional foods: Survival of probiotics during processing and storage. *Journal of functional foods*, *9*, 225-241.

[17] Kechagia, M., Basoulis, D., Konstantopoulou, S., Dimitriadi, D., Gyftopoulou, K., Skarmoutsou, N., & Fakiri, E. M. (2013). Health benefits of probiotics: a review. *ISRN nutrition*, *2013*.

[18] Saavedra, J. M., Bauman, N. A., Perman, J. A., Yolken, R. H., & Oung, I. (1994). Feeding of Bifidobacterium bifidum and Streptococcus thermophilus to infants in hospital for prevention of diarrhoea and shedding of rotavirus. *The lancet*, *344*(8929), 1046-1049.

[19] Goldin, B. R., & Gorbach, S. L. (1980). Effect of Lactobacillus acidophilus dietary supplements on 1, 2-dimethylhydrazine dihydrochloride-induced intestinal cancer in rats. *Journal of the National Cancer Institute*, *64*(2), 263-265.

[20] Grunewald, K. K. (1982). Serum cholesterol levels in rats fed skim milk fermented by Lactobacillus acidophilus. *Journal of Food Science*, *47*(6), 2078-2079.

[21] Mann, G. V. (1977). A factor in yogurt which lowers cholesteremia in man. *Atherosclerosis*, *26*(3), 335-340.

[22] Pulusani, S. R., & Rao, D. R. (1983). Whole body, liver and plasma cholesterol levels in rats fed thermophilus, bulgaricus and acidophilus milks. *Journal of Food Science*, *48*(1), 280-281.

[23] Pimentel, T. C. (2018). Fruit juices as probiotic carriers. *Journal of Plant Biotechnology and Microbiology*, *1*(1).

[24] Patel, A. R. (2017). Probiotic fruit and vegetable juices-recent advances and future perspective. *International Food Research Journal*, *24*(5), 1850-1857.

[25] Sheehan, V. M., Ross, P., & Fitzgerald, G. F. (2007). Assessing the acid tolerance and the technological robustness of probiotic cultures for fortification in fruit juices. *Innovative Food Science & Emerging Technologies*, *8*(2), 279-284.

[26] Sivudu, S. N., Umamahesh, K., & Reddy, O. V. S. (2014). A Comparative study on Probiotication of mixed Watermelon and Tomato juice by using Probiotic strains of Lactobacilli. *Int. J. Curr. Microbiol. Appl. Sci*, *3*, 977-984.

[27] Luckow, T., Sheehan, V., Fitzgerald, G., & Delahunty, C. (2006). Exposure, health information and flavour-masking strategies for improving the sensory quality of probiotic juice. *Appetite*, *47*(3), 315-323.

[28] Mortazavian, A. M., Ehsani, M. R., Mousavi, S. M., Rezaei, K., Sohrabvandi, S., & Reinheimer, J. A. (2007). Effect of refrigerated storage temperature on the viability of probiotic micro-organisms in yogurt. *International Journal of Dairy Technology*, *60*(2), 123-127.

[29] Ding, W. K., & Shah, N. P. (2008). Survival of free and microencapsulated probiotic bacteria in orange and apple juices. *Int Food Res J*, *15*(2), 219-32.