COMMENTARY

Probiotics and Health

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Abstract

Probiotics are described as live microbial food ingredients that are beneficial to health of the of host, especially by improving intestinal microbial balance. The major consumption of probiotics is in dairy-based foods form, which is containing intestinal species of *Lactobacillus* and *Bifidobacterium*. A number of potential benefits of probiotics have been proposed, including: adherence to cells; exclusion or reduction of pathogenic adherence; production of acids, hydrogen peroxide, and bacteriocins antagonistic to pathogen growth; safe, noninvasive, noncarcinogenic and nonpathogenic characteristics; and congregation to form a normal balanced flora. The interrelation between probiotics and health are reviewed in this article.

Key Words: probiotics - health - dairy food - lactobacilli - bifidobacteria

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Introduction

Elie Metchnikoff first introduced the probiotic concept in 1908, which observed the long life of Bulgarian peasants who consumed fermented milk foods. He suggested that lactobacilli might counteract the putrefactive effects of gastrointestinal metabolism (Metchnikoff, 1907). In the century which is elapsed since Metchnikoff's work, scientists and consumers have accepted the probiotic concept throughout the world (Fuller, 1997). In the world, the concept of providing functional foods including beneficial components rather than removing potentially harmful components is gaining ground in recent years. It may consider a functional food with the special property of containing live, beneficial microorganisms (Melntosh, 1996). Functional foods and nutraceuticals can prevent and treat diseases. Yogurt and other fermented milks containing probiotics may be considered the first functional foods. More specifically, Fuller defined probiotics as a live microbial feed supplement that beneficially affects the host beyond correcting for traditional nutrient deficiencies by improving the intestinal balance (Fuller, 1992).

The first clinical trials in the 1930s focused on the effect of probiotics on constipation, and research has steadily increased since then. Today probiotics are available in a variety of food products and supplements. Food products containing probiotics are almost dairy products that due to the historical association of lactic acid bacteria with fermented milk. The most frequently used bacteria in these products include the *Lactobacillus* and *Bifidobacterium* species (Anon., 2000). The probiotic species (bacteria and yeasts) are listed in Table 1.

Beneficial and nutritional effects of probiotics

The colonic microflora is important to health. The growth and metabolism of the many individual bacterial species

Table 1. The Probiotic Species (bacteria and yeasts)

Names of bacteria and yeasts	
Lactobacillus species	*Bifidobacterium species*
L. acidophilus	*B. bifidum*
L. casei/L. Paracasei	*B. breve*
L. fermentum	*B. lactis*
L. bulgaricus	*B. longum*
L. cremoris	*B. infantis*
L. gasseri	*B. adolescentis*
L. johnsonii	
L. lactis	*Streptococcus species*
L. plantarum	*S. thermophilus*
L. reuteri	
L. rhamno sus	*Saccharomyces species*
L. salivarius	*S.boulardii*
	S cerevisiae
Enterococcus species	
E.faecium	

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exerting protective effects in the large bowel depend primarily on the substrates available to them, most of which come from the diet (Oksanen et al., 1990; Siitonen et al., 1990). This has led to attempts to modify the structure and metabolic activities of the community through diet using probiotics. These organisms are non pathogenic and nontoxigenic, retain viability during storage, and survive passage through the stomach and small bowel. In addition, lactic acid bacteria may improve intestinal mobility and relieve constipation, particularly in seniors.

Probiotics are live microbial food supplements that are widely used in yogurts and other dairy products. Some commercial fermented dairy products which has probiotic properties are given in Table 2. The nutritional effects of probiotics have been shown by the fermentation of food with lactic acid bacteria which increased folic acid content of yogurt, bifidus milk and kefir and to increase niacin and riboflavin levels in yogurt, vitamin B_{12} in cottage cheese and vitamin B_6 in Cheddar cheese (Alm, 1982; Shahani and Chandan, 1979). In addition to nutrient synthesis, probiotics may improve the digestibility of some dietary nutrients such as protein and fat (Friend and Shahani, 1984). Short-chain fatty acids such as lactic acid, propionic acid and butyric acid produced by lactic acid bacteria may help maintain an appropriate pH and protect against pathological changes in the colonic mucosa (Anon., 2000).

The claims of beneficial effects of probiotic consumption, which the researchers support, are including intestinal, immune system and the other effects (Dugas et al., 1999; Kaur et al., 2002):

* Increased nutritional value (better digestibility, increased bioavailability of minerals and vitamins)
* Promotion of intestinal lactose digestion (reducing symptoms of lactose intolerance and malabsorption)
* Promotion recovery from diarrhea (rotavirus, travelers)
* Positive influence on intestinal flora (antibiotics or radiation induced colitis)
* Inhibition of pathogen growth and translocation
* Prevention of intestinal tract infections (bacteria or virus induced, *Candida* enteritis, *Helicobacter pylori* ulcus/ neoplasia)
* Regulation of gut motility (constipation, irritable bowel syndrome)
* Enhancing specific and nonspecific immune response system
* Stimulation of gastrointestinal immunity
* Improved urogenital health
* Prevention of cancer and suppressing tumors
* Detoxification of carcinogens
* Reduction of catabolic products eliminated by kidney and liver
* Prevention of arteriosclerosis (reduction of serum cholesterol)
* Prevention of osteoporosis
* Better development (growth)
* Improved well-being
* Synthesized nutrients (folic acid, niacin, riboflavin, vitamins B_6 and B_{12})
* Increasing nutrient bioavailability
* Decreasing prevalence of allergy in susceptible individuals
* Decreasing lower serum cholesterol concentrations
* Reduction of blood pressure in hypertensives

Mechanisms of Probiotic Activity

The mechanism of action of probiotic strains is likely to be multifactor and, from existing evidence, appears to be strain specific. Enhancement of colonization resistance and/ or direct inhibitory effects against pathogens is likely to be important in situations in which probiotics have reduced the incidence and duration of gastroenteritis. Probiotic strains have inhibited pathogenic bacteria both *in vitro* and *in vivo* through several different mechanisms. Probiotics exert their effects on the host but the mechanisms are still speculative. They may antagonize pathogens directly through production of antimicrobial and antibacterial compounds such as cytokines and butyric acid (De Vuyst and Vandamme, 1994;

Table 2. Some Commercial Probiotic Products (Akalın and Ötles, 2002; Miller, 1996; Robinson, 1989; Salji, 1994)

Product	Microorganism
Acidophilus milk	*L. acidophilus*
Sweet Acidophilus milk	*L. acidophilus*
Acidophilus churn out	*L. acidophilus, Lactococcus lactis, Lac. Lactis subsp. cremoris, Lac. Lactis biovar diacetylactis, Leuconostoc mesenteroides subsp. cremoris*
Acidophilus-yeast milk	*L. acidophilus, Saccharomyces fragilis, S. cerevisiae*
Acidophilus yogurt	*L. acidophilus, L. delbrueckii subsp. bulgaricus, Streptococcus salivarius subsp. thermophilus*
Acidophilus-bifidus yogurt	*L. acidophilus, Bifidobacterium bifidum, L. delbrueckii subsp. bulgaricus, S. salivarius subsp. thermophilus*
Biogarde	*L. acidophilus, B. bifidum, S. Salivarius subsp. thermophilus*
Bioghurt	*L. acidophilus, S. salivarius subsp. thermophilus*
Cultura	*L. acidophilus, B. bifidum,*
Yakult	*L. acidophilus, B. bifidum, B. breve, L. casei*

Kailasapathy and Chin, 2000), reduce gut pH by stimulating the lactic acid to produce microflora (Langhendries et al., 1995), compete for binding and receptor sites that pathogens occupy (Fujiwara, 1997; Kailasapathy and Chin, 2000), improve immune function and stimulate immunomodulatory cells (Isolauri et al., 1991 and 1995; Rolfe, 2000), produce lactase which aids in lactose digestion, compete the nutrients and adhere the sites on the gut wall and regulate colonocyte gene expression (e.g. expression of mucin genes) (Fooks and Gibson, 2002; Mack et al. 1999; Steer et al., 2000;). A group of requirements have been identified for a microorganism to be defined as an effective probiotic (Salminen et al., 1996). These are:

1. Adhere to cells;
2. Exclude or reduce pathogenic adherence;
3. Persist and multiply;
4. Produce acids, peroxide, and bacteriocins antagonistic to pathogen growth;
5. To be safe, noninvasive, noncarcinogenic and nonpathogenic;
6. Coaggregate to form a normal balanced flora.

Applying probiotics to stimulate immune function, especially in individuals with underdeveloped or dysregulated immune function, appears to be sound, considering the positive outcomes of feeding studies targeting viral infections, Inflammatory Bowel Disease (IBD) and allergic diseases. It is still unclear which mechanism or, more probably, which spectrum of mechanisms, is used by probiotics within the human gut microbiota to bring about improved health. Further human feeding studies are required to confirm probiotic efficacy in specific disease states such as IBD, colon cancer and gastroenteritis. Probiotic activity is likely to be strain specific and that these disease states are of multifactor etiology (Tuohy et al., 2003). The suggested mechanism of probiotic activity are summarized in Figure 1.

Probiotics and Cancer

Probiotics plays an important role at the intestinal flora in the induction and development of colon cancer by reducing the incidence and number of tumors. The endogenous flora and the immune system take part on the modulation of carcinogenesis. Probiotics may influenced both and this led to trials investigating the role of probiotics in preventing or curing tumors on animals (Wollowski et al., 2001). The probiotic effect that remains the most controversial is the anticancer activity attributed to certain lactic acid bacteria which is reduced cancer risk possibly by counteracting mutagenic and genotoxic effects which are evident by in *vitro* and *in vivo* animal models studies; dietary intervention studies in humans and epidemiological studies correlating cancer to certain dietary regimes. Studies of the effect of probiotic consumption on cancer appear promising.

Several studies showed that some probiotics may decrease the fecal concentrations of enzymes, mutagens, and secondary bile salts that may be involved in colon carginogenesis (Wollowski et al., 2001).One clinical study showed an increased recurrence-free period in subjects with bladder cancer (Aso and Akazan , 1992*). B. longum* has also been shown to inhibit the incidence of colon, liver, small intestinal and mammary tumors in rats (Reddy and Rivenson, 1993). Another study showed that *Lactobacillus GG* reduces the incidence and number of tumors in animals artificially induced with colon cancer (Goldin et al., 1996). And also one recent study found that dietary supplementation with a strain of *Lactobacillus acidophilus* significantly suppressed the total number of colon cancer cells in rats in a dose-dependent manner (Rao et al., 1999).

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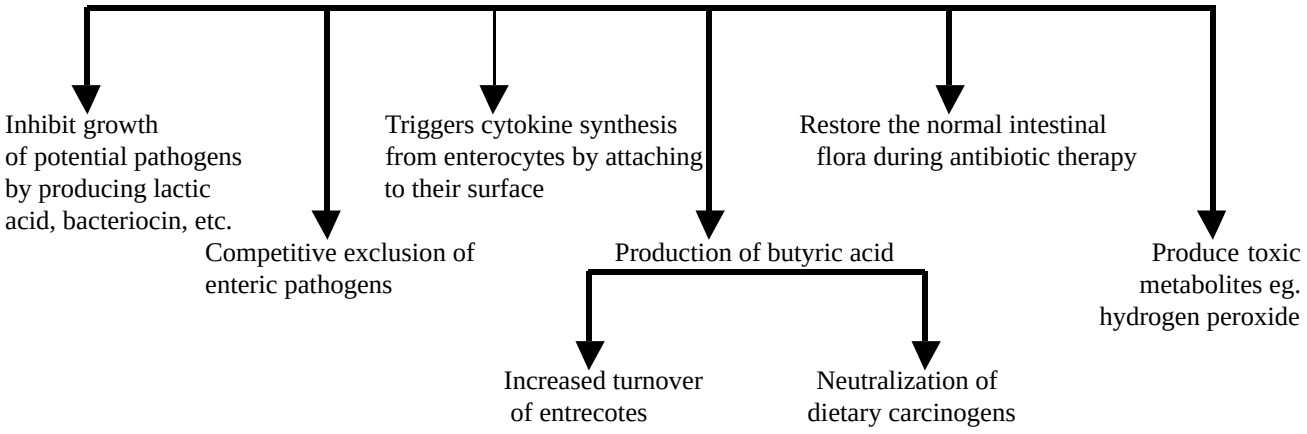

Figure 1. The Suggested Mechanisms Underlying Probiotic Activity (Kaur et al., 2002)

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