

## Probiotics – Friendly Bacteria with a Host of Benefits

“Let food be thy medicine and medicine be thy food,” the age-old quote by Hippocrates, is certainly the tenet of today. With the growing interest in self-care and integrative medicine coupled with our health-embracing baby boomer population, recognition of the link between diet and health has never been stronger. As a result, the market for functional foods, or foods that promote health beyond providing basic nutrition, is flourishing. Within the functional foods movement is the small but rapidly expanding arena of probiotics – live microbial food supplements that beneficially affect an individual by improving intestinal microbial balance. The consumers’ overwhelming interest in and demand for functional foods, including probiotics, make it imperative that health professionals stay abreast of the latest research findings and available products. This monograph provides a summary of research on the health benefits of probiotics and offers practical information to help the clinician make appropriate recommendations to clients.

### History

Microbial cultures have been used for thousands of years in food and alcoholic fermentations, and in the past century have undergone scientific scrutiny for their ability to prevent and cure a variety of diseases. This has led to the coining of the term probiotics, or “pro-life.” 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. In the United States, food products containing probiotics are almost exclusively dairy products – fluid milk and yogurt – 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. **Table 1** lists other commercially available probiotic species.

### Nutritional Effects

**Table 2** lists some of the alleged health benefits of consuming probiotics. Those that have significant research to back up the claims are discussed in more depth below.

#### Intestinal tract health

A number of studies have found probiotic consumption to be useful in the treatment of many types of diarrhea, including antibiotic-associated diarrhea in adults, travellers’ diarrhea, and diarrheal diseases in young children caused by rotaviruses (1-3). The most commonly studied probiotic species in these studies have been *Lactobacillus GG*, *L. casei*, *B. bifidum* and

*S. thermophilus*. Because diarrhea is a major cause of infant death worldwide and can be incapacitating in adults, the widespread use of probiotics could be an important, non-invasive means to prevent and treat these diseases, particularly in developing countries. Probiotic bacteria have also been shown to preserve intestinal integrity and mediate the effects of inflammatory bowel diseases, irritable bowel syndrome, colitis, and alcoholic liver disease (4-6). In addition, lactic acid bacteria may improve intestinal mobility and relieve constipation, particularly in seniors (7).

#### Nutrient synthesis and bioavailability

Fermentation of food with lactic acid bacteria has been shown to increase folic acid content of yogurt, bifidus milk and kefir and to increase niacin and riboflavin levels in yogurt, vitamin B<sub>12</sub> in cottage cheese and vitamin B<sub>6</sub> in Cheddar cheese (8,9). In addition to nutrient synthesis, probiotics may improve the digestibility of some

dietary nutrients such as protein and fat (10). 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.

## Immune system

Evidence from in vitro systems, animal models and humans suggests that probiotics can enhance both the specific and nonspecific immune response, possibly by activating macrophages, increasing levels of cytokines, increasing natural

killer cell activity, and/or increasing levels of immunoglobulins (11). In spite of limited testing in humans, these results may be particularly important to the elderly, who could benefit from an enhanced immune response.

## Lactose intolerance

Several lines of evidence show that the appropriate strains of lactic acid bacteria, such as *S. thermophilus*, *L. bulgaricus* and other lactobacilli in fermented milk products, can alleviate symptoms of lactose intolerance by providing bacterial lactase to the intestine and

stomach. Because lactose intolerance affects almost 70% of the population worldwide, consumption of these products may be a good way to incorporate dairy products and their accompanying nutrients into the diets of lactose intolerant individuals.

## Allergy

Probiotics may exert a beneficial effect on allergic reaction by improving mucosal barrier function. In addition, probiotic consumption by young children may beneficially affect immune system development. Probiotics such as *Lactobacillus GG* may be helpful in alleviating some of the symptoms of food allergies such as those

associated with milk protein (12). Probiotic consumption may thus be a means for primary prevention of allergy in susceptible individuals. This could play a key role in minimizing allergy at a time when the prevalence of allergic disease in Western societies has increased dramatically over the past 40 years.

## Cancer

Studies of the effect of probiotic consumption on cancer appear promising. Animal and *in vitro* studies indicate that probiotic bacteria may reduce colon cancer risk by reducing the incidence and number of tumors. One clinical study showed an

increased recurrence-free period in subjects with bladder cancer (13). Results, however, are too preliminary to develop specific recommendations on probiotic consumption for preventing cancer in humans.

## Future Implications

There is considerable potential for the benefits of probiotics consumption over a wide range of clinical conditions. On-going research will continue to identify and characterize existing strains of probiotics, identify strain-specific outcomes, and determine optimal doses needed for certain results. According to Barry Goldin, Ph.D., professor at Tufts University School of Medicine, *“The full potential of probiotics can only be realized when their benefits can be established scientifically. It is highly likely that benefits from current and future probiotics have gone undetected and, therefore, full utilization of these organisms has not been achieved.”*

Daniel O’Sullivan, Ph.D, assistant professor in the Department of Food Science and Nutrition at the University of Minnesota, says regarding yogurt consumption, *“At best, your intestinal health is greatly improved and the immune system is strengthened. At worst, there are no adverse effects and you get some nutrients in the bargain.”*

With the current focus on disease prevention and the quest for optimal health at all ages, the probiotic market potential is enormous. Health professionals are in an ideal position to help guide their clients toward appropriate prophylactic and therapeutic uses of probiotics that deliver the desired beneficial health effects.

## ***Commonly asked Questions & Answers on Probiotics***

### **◆ Q: Is it better to get probiotics from foods or from supplement sources?**

Foods are a better choice due to the synergistic effect between components of foods and probiotic cultures. The natural buffering of stomach acid by food also enhances the stability of consumed probiotics. Dairy products containing probiotics provide a number of high quality nutrients including calcium, protein, bioactive peptides, sphingolipids, and conjugated linoleic acids. Taking supplements, although convenient, has always posed the problem of long-term compliance, whereas incorporating foods containing probiotics into daily food choices can become a lifestyle habit.

### **◆ Q: What level of probiotic consumption is needed to realize the desired benefits?**

Many studies of probiotic bacteria on physiological effects such as diarrhea, lactose intolerance, and colon cancer biomarkers show an effect using a daily dose of  $10^9 - 10^{10}$  organisms per day. This corresponds to an intake of about 3-1/2 cups of acidophilus milk or yogurt per day, formulated at the typical level of  $2 \times 10^6$  cfu/ml. Effects of consuming lower levels have not been documented in research studies but may also be beneficial. Encourage your clients to check labels or contact the manufacturer to determine levels of probiotics that specific products provide.

### **◆ Q: How long does one need to take probiotics for the effects to last?**

It is believed that most probiotics do not permanently adhere in the intestine, but exert their effects as they metabolize and grow during their passage through the intestine (colonization). Thus, daily consumption of these bacteria is probably the best way to maintain their effectiveness.

### **◆ Q: What are some good food sources of probiotics?**

Yogurt and milk to which probiotic bacteria have been added, such as acidophilus milk, and fermented milk products, such as kefir, are the primary food sources of probiotics in the United States. Some researchers believe that a synergistic effect exists between components in dairy foods and probiotic cultures, and that there are components in milk that “turn on” the beneficial genes in probiotic bacteria, making dairy foods an excellent vehicle for introducing these bacteria into the gut. Europe and Asia lead the rest of the world in offering a variety of other food products containing probiotics. We will probably see products such as probiotic-fortified energy bars, juices, cereals, and cheeses introduced into the United States over the next few years as well.

### **◆ Q: What kind of information on probiotics can be found on food labels?**

The shelf life and species of probiotic bacteria included in dairy products are generally listed on product labels. The specific strain and levels of viable cells, however, are not typically shown. As the probiotic industry matures and the consumer requests more detailed information, labeling will likely become more routine and even mandatory. Major brand names generally can be counted on for higher reliability in formulation and labeling of their products. On yogurt labels look for the “Live Active Culture” seal, which assures the consumer that viable lactic acid bacteria are in the product. Yogurt probably has the most reliable reported levels of probiotics due to its short shelf life and because it is refrigerated.

**Table 1: Commercially used probiotic species**

**Lactobacillus species**

*L. acidophilus*  
*L. casei*  
*L. fermentum*  
*L. gasseri*  
*L. johnsonii*  
*L. lactis*  
*L. paracasei*  
*L. plantarum*  
*L. reuteri*  
*L. rhamnosus*  
*L. salivarius*

**Bifidobacterium species**

*B. bifidum*  
*B. breve*  
*B. lactis*  
*B. longum*

**Streptococcus species**

*S. thermophilus*

**Table 2: Alleged health effects of probiotics**

**Intestinal effects**

- Relieve effects, promote recovery from diarrhea (rotavirus, travelers' and antibiotic-induced)
- Produce lactase, alleviate symptoms of lactose intolerance and malabsorption
- Relieve constipation
- Treat colitis

**Immune system effects**

- Enhance specific and nonspecific immune response
- Inhibit pathogen growth and translocation
- Stimulate gastrointestinal immunity
- Reduce chance of infection from common pathogens (Salmonella, Shigella)

**Other effects**

- Reduce risk of certain cancers (colon, bladder)
- Detoxify carcinogens
- Suppress tumors
- Lower serum cholesterol concentrations
- Reduce blood pressure in hypertensives
- Treat food allergies
- Synthesize nutrients (folic acid, niacin, riboflavin, vitamins B<sub>6</sub> & B<sub>12</sub>)
- Increase nutrient bioavailability
- Improve urogenital health
- Optimize effects of vaccines (e.g. rotavirus vaccine, typhoid fever vaccine)

**References**

1. Siitonen S, Vapaatalo H, Salminen S, Gordin A, Saxelin M, Wikberg R, Kirkkola AL. Effect of Lactobacillus GG yoghurt in prevention of antibiotic associated diarrhoea. *Ann Med* 1990;22:57-59.
2. Oksanen PJ, Salminen S, Saxelin M, Hamalainen P, Ihantola-Vormisto A, Muurasniemi-Isoviita L, Nikkari S, Oksanen T, Porsti I, Salminen E. Prevention of travelers diarrhea by Lactobacillus GG. *Ann Med* 1990;22:53-56.
3. Isolauri E, Juntunen M, Rautanen T, Sillanaukee P, Koivula T. A human Lactobacillus strain (Lactobacillus casei sp. Strain GG) promotes recovery from acute diarrhea in children. *Pediatrics* 1991;88:90-97.
4. Nanji AA, Khettry U, Sadrzadeh SMH. Lactobacillus feeding reduces endotoxemia and severity of experimental alcoholic liver (disease). *Proc Soc Exp Biol Med* 1994;205:243-7.
5. Kruis W, Schutz E, Fric P, Fixa B, Judmaier G, Stolte M. Double-blind comparison of an oral Escherichia coli preparation and mesalazine in maintaining remission of ulcerative colitis. *Aliment Pharmacol Ther* 1997;11:853-8.
6. Gade J, Thorn P. Paraghurt for patients with irritable bowel syndrome. *Scan J Prim Health Care* 1989;7:23-26.
7. Seki M, Igarashi T, Fukuda Y, Simamura S, Kaswashima T, Ogasa K. The effect of Bifidobacterium cultured milk on the "regularity" among an aged group. *Nutr Foodstuff* 1978;31:379-87.
8. Shahani KM, Chandan RC. Nutritional and healthful aspects of cultured and culture-containing dairy foods. *J Dairy Sci* 1979;62:1685-94.
9. Alm L. Effect of fermentation on B-vitamin content of milk in Sweden. *J Dairy Sci* 1982;65:353-9.
10. Friend BA, Shahani KM. Nutritional and therapeutic aspects of lactobacilli. *J Appl Nutr* 1984;36:125-53.
11. Sanders ME. Probiotics. *Food Technology* 1999;53(11):67-77.
12. Majamaa H, Isolauri E. Probiotics: a novel approach in the management of food allergy. *J Allergy Clin Immun* 1997;99:179-85.
13. Aso Y, Akazan H. Prophylactic effect of a Lactobacillus casei preparation on the recurrence of superficial bladder cancer. *Urol Int* 1992;49:125-9.