



# Probiotics

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Lactobacilli and Bifidobacteria are “friendly” bacteria, meaning that they normally occur in the human gastrointestinal and genitourinary tracts and play important roles in promoting good health. They are also friendly because they are used therapeutically as *probiotics* (the opposite of antibiotics) for the purpose of recolonizing areas of the body where they may be depleted for one reason or another. This is important since the body relies on these probiotics for several functions including the absorption of nutrients, preventing colonization by pathogenic (harmful) bacteria, and metabolizing foods and certain drugs. Probiotic bacteria are found in some fermented food products (most commonly, yogurt) as well as in supplemental tablet, capsule and powder form.

## The Lactobacillus species

Lactobacillus refers to a group of lactic acid producing, friendly bacteria<sup>1 2</sup> that make up many of the 400 normal probiotic species in the human body.<sup>3 4 5 6 7</sup> Lactobacilli provide many benefits, including the following:

- Inducing growth factors and increasing the bioavailability of minerals.<sup>8</sup>
- Stabilizing the mucosal barrier and decreasing intestinal permeability.<sup>9 10</sup>
- Inhibiting bacterial pathogens by producing lactic acid and hydrogen peroxide.<sup>11 12 13</sup>

- Immunomodulating effects<sup>14 15 16</sup> such as stimulating immune function in healthy people, and down-regulating immune function in those with immune system hypersensitivity.<sup>17</sup>
- Inhibit *Candida albicans* and prolong survival in immune deficiency states.<sup>18</sup>

## The Bifidobacterium species

Bifidobacteria normally colonize in the human colon<sup>19 20</sup> and, like *Lactobacillus* species, also produce lactic acid. These probiotics appear to be the most important organisms in the intestine in helping to create a microbial barrier to infection. Specifically, Bifidobacteria produce antimicrobial substances that are effective against many harmful gram-positive and gram-negative bacteria.<sup>21 22</sup> In fact, some species of Bifidobacteria (including *B. infantis*, *B. breve* and *B. longum*) bind to the intestinal mucosa and prevent attachment of pathogenic coliform bacteria.<sup>23 24</sup>

Since Bifidobacteria disappear from the feces within 2 weeks after discontinuing supplementation, this suggests that there is no long-term colonization<sup>25 26</sup> so Bifidobacteria must be used regularly to achieve a continued benefit.

Research on individual *Lactobacillus* and *Bifidobacterium* species have demonstrated specific benefits, as indicated below.

## Lactobacillus rhamnosus

In clinical studies, *Lactobacillus rhamnosus* enhanced natural immunity in healthy adults by increasing the activity of certain white blood cells and enhancing natural killer cell tumor killing activity.<sup>27 28</sup> Natural killer cells are part of the immune system that plays a major role in the rejection of tumors and cells infected by

viruses. *L. rhamnosus* also seems to reduce the occurrence of diarrhea in travelers.<sup>29 30</sup>

In addition *L. rhamnosus* has been shown to increase the production of interferon-gamma, eliciting protective effects on the intestinal mucosa.<sup>31</sup> Interferons are natural proteins produced by the cells of the immune system in response to challenges by foreign agents such as viruses, parasites and tumor cells. Interferon-gamma has antiviral, immunoregulatory, and anti-tumor properties.<sup>32</sup>

When taken 2-4 weeks before delivery and continued for the first three to six months of breast-feeding, *L. rhamnosus* helps prevent atopic allergies (asthma, allergic rhinitis, and eczema) in infants. Apparently, it is equally effective when taken by the breast-feeding mother or the bottle-feeding infant.<sup>33 34 35</sup>

### **Lactobacillus acidophilus**

Bacterial vaginosis is the most common cause of vaginal infection. It is caused by an imbalance of naturally occurring friendly bacterial, and should not be confused with vaginal yeast infection (candidiasis). Research has shown that intravaginal suppositories containing *Lactobacillus acidophilus* improved resolution of infection in bacterial vaginosis compared to placebo.<sup>36</sup> In other research *L. acidophilus* vaginal tablets given with estriol (a type of estrogen), may also treat bacterial vaginosis<sup>37</sup>, and eating yogurt enriched with *Lactobacillus acidophilus* may decrease the incidence of recurrent bacterial vaginosis.<sup>38</sup> Also, laboratory research has found that *L. acidophilus* DDS-1 can inhibit the growth of the *H. pylori* bacterium<sup>39</sup>, which is implicated in peptic ulcers.

In irritable bowel syndrome (IBS), *L. acidophilus* has been shown to improve abdominal pain, bloating, number and quality of stools, and general physical state.<sup>40 41</sup>

In a small double-blind study examining the effect of a combination of *L. acidophilus* and *L. casei* on small intestinal bacterial overgrowth (SIBO), researchers found a significant decrease in breath hydrogen concentration as early as 1 week into treatment. This was evidence that this probiotic combination may be effective in the treatment of bacterial overgrowth.<sup>42</sup> In addition, *L. acidophilus* produces substances called

bacteriocins, which act as natural antibiotics to kill undesirable microorganisms.<sup>43</sup>

It is commonly thought that *L. acidophilus* supplements are not effective if taken during antibiotic therapy. The research<sup>44 45</sup>, however, supports the use of this probiotic during antibiotic administration. In fact, *L. acidophilus* has been shown to correct the increase of gram-negative bacteria which occurs following the use of broad-spectrum antibiotics given in the treatment of acute or chronic diarrhea.<sup>46 47 48</sup> Furthermore, reductions of friendly bacteria and/or advanced infection with antibiotic-resistant bacteria may be prevented by using *L. acidophilus* and antibiotics concurrently (a dosage of at least 15 to 20 billion probiotic organisms is required).<sup>49</sup> That being said, the probiotic supplements should still be taken as far away from the antibiotic as possible.

Note: *L. acidophilus* DDS-1 is a highly stable and potent strain of this common probiotic.

### **Lactobacillus brevis**

Research has demonstrated that *Lactobacillus brevis* increases the production of interferon-alpha.<sup>50</sup> Interferon-alpha is mainly involved in immune response against viral infection.

### **Lactobacillus bulgaricus**

*Lactobacillus bulgaricus* may have hypolipidemic and antiatherosclerotic effects. Research shows that it is effective in reducing total and low-density lipoprotein (LDL) cholesterol with no effect on high-density lipoprotein (HDL).<sup>51 52</sup> Also, as with *L. acidophilus* DDS-1, laboratory research has found that *bulgaricus* can inhibit the growth of *H. pylori*.<sup>53</sup>

### **Lactobacillus casei**

*Lactobacillus casei* may help reduce the frequency<sup>54</sup> or severity<sup>55</sup> of acute diarrhea in children aged 6-24 months. *L. casei* also adheres better to urogenital cells than other *Lactobacillus* species<sup>56</sup>, which may translate to preventing attachment by pathogenic bacteria. As noted previously a combination of *L. acidophilus* and *L. casei* may be effective in the treatment of small intestinal bacterial overgrowth.<sup>57</sup>

### **Lactobacillus plantarum**

In research, *Lactobacillus plantarum* can reduce the severity of chemotherapy-induced enterocolitis<sup>58</sup> (an inflammation of both the small and large intestine). *L. plantarum* has also been shown the ability to inhibit attachment of the *E. coli* bacterium to human colon cells.<sup>59</sup>

In a randomized, placebo-controlled trial<sup>60</sup>, *L. plantarum* was effective in significantly and rapidly reducing abdominal pain and flatulence in IBS patients. At 12-month follow-up, those same patients maintained their improvement in overall gastrointestinal function. This probiotic may also be used to help prevent traveler's diarrhea.<sup>61</sup>

### **Bifidobacterium breve**

When used as an adjunct to treatment with medication, a combination of *Bifidobacterium breve*, *Bifidobacterium bifidum* and *Lactobacillus acidophilus* was shown to help prevent relapse and reduce disease activity in patients with ulcerative colitis.<sup>62 63</sup>

### **Bifidobacterium infantis**

Within one week of treatment, *Bifidobacterium infantis* was shown to significantly reduce symptoms of IBS, including abdominal pain, bloating, and bowel movement difficulty; although it did not reduce bowel movement frequency.<sup>64</sup>

### **Bifidobacterium lactis**

In healthy middle-aged and elderly people, *Bifidobacterium lactis* enhances cellular immunity, improving the function of phagocytes and natural killer cell activity, while increasing production of interferon-alpha.<sup>65 66</sup>

### **Bifidobacterium longum**

Some research indicates that taking *Bifidobacterium longum* can reduce stool frequency, abdominal discomfort, and stool clostridial spore count in antibiotic-associated diarrhea<sup>67</sup>; although other research did not find the same significant reduction in diarrhea.<sup>68</sup>

### **Safety & Drug interactions**

When used orally and appropriately, many *Lactobacillus* and *Bifidobacteria* species have a good safety profile and are well tolerated as evidenced throughout studies in which they were used up to nine months and one year, respectively. The most common side effect is flatulence, which is usually mild and subsides as

supplementation continues. In children, bifidobacteria can cause diarrhea. There are no known drug interactions with these probiotic species.<sup>69 70</sup>

### **Supplementation and dosing**

Given the many types of probiotic species, there are many potential supplements from which to choose. To provide comprehensive benefits, products offering combinations of these probiotics may make the most sense. In terms of daily dosage, at least 10 billion "colony forming units" (CFU) is often recommended<sup>71</sup>, although 14 billion CFU may be more desirable. This dosage range can easily be achieved in one or two tablets/capsules.

### **Fructooligosaccharides**

Fructooligosaccharides (FOS) are plant sugars that occur in a wide variety of fruits, vegetables, and cereals. Fructooligosaccharides are "prebiotics" that promote the growth and activity of probiotic bacteria that produce acids, such as *Lactobacilli* and *Bifidobacteria* in the gut.<sup>72 73 74 75 76</sup> FOS may even help relieve constipation by increasing fecal mass.<sup>77</sup> Probiotic supplements that contain FOS provide a distinct advantage over those that do not.

### **Conclusion**

*Lactobacilli* and *Bifidobacteria* species normally occur in the human gastrointestinal and genitourinary tracts and play important roles in promoting good health. These probiotics may be used concurrently with conventional antibiotics. In addition, the ongoing use of probiotics prophylactically to help prevent colonization by pathogenic (harmful) bacteria, promote positive immune function, and generally support a healthy environment in the gut.

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