

PROBIOTICS

Probiotics means good bacteria. Lactobacillus and Bifidobacteria strains are the main ones in this category. Their function is vital to health, providing about 80% of the total immune system.

Probiotic colonization is severely reduced when a number of factors are present: sugar (glucose, fructose, sucrose etc.), fluoride, alcohol, and antibiotics, for example.

Lactobacillus strains

- about 56 species are known
- gram-positive facultative anaerobes
- non-spore forming
- non-flagellated, rod or coccobacilli
- help keep the vagina free from infection by producing hydrogen peroxide, a substance that is highly acidic. When the vaginal microflora is disrupted through infection, douching, or poor hygiene, for example, *Lactobacilli* can die off, leading to a condition known as bacterial vaginosis.

L. acidophilus

- found mainly in the small intestine
- breaks down food, producing byproducts hostile to common pathogens including *Salmonella*, *Shigella*, *Enterococcus faecalis*, *Staphylococcus aureus*, *Candida albicans*, and *E. Coli*
- implants itself on intestinal walls and vaginal linings, cervix, and urethra thus preventing infections
- helps control and prevent diarrhea
- helps control serum cholesterol levels
- produces *lactase*, the enzyme that breaks down milk sugar. Those who are lactose intolerant do not produce this enzyme.
- protects and strengthens the immune system
- produces natural antibiotic and antiviral compounds (lactocidin, acidophilin)
- helps produce at least three B vitamins: niacin (B3), folic acid (B9), and pyridoxine (B6)
- inhibits the formation of some cancers
- the DDS strain is especially able to resist the destructive effects of antibiotics
- NOTE: the acidophilus used in most commercial yogurts cannot survive stomach acids

L. amylovorus

- found normally in the intestinal tract of animals and humans as well as in the human mouth and vagina
- sometimes found in commercial acidophilus milk
- being studied as a potential commercial producer of lactic acid

L. brevis

- produces lactic acid which is hostile to pathogens
- helps synthesize vitamins D and K
- effective against *H. pylori* (the bacteria that causes stomach ulcers)
- improves intestinal micro flora and the intestinal immune system
- helps decrease intestinal permeability (leaky gut syndrome)

L. bulgaricus

- important in fermenting yogurt
- forms a hostile environment for pathogens, removing them from the GI tract
- fast-growing, it produces lactic acid which helps promote beneficial bacteria
- resistant to stomach acids and bile salts
- improves digestion, lactose tolerance, and cholesterol levels
- assists in the metabolism of lipids (fats)
- enhances immunity by stimulating production of interferon and tumor necrosis factor
- corrects both diarrhea and constipation by regulating peristalsis
- has anti-tumor properties
- produces natural antibiotic substances
- as a transient microorganism, it does not implant itself in the intestinal tract but roams throughout providing an important protective role

L. caseii

- closely related to *L. rhamnosus* and *L. acidophilus*
- secretes peptidoglycan, which supports natural body defences and stimulates immune responses in the intestinal tract
- increases circulating IgA in infants infected with rotavirus, shortening the duration of associated diarrheal episodes
- produces bacteriocins (inhibit growth of pathogenic bacteria in the small intestine)
- proven to lessen winter infections in the elderly
- has strong resistance to digestive enzymes
- produces lactic acid
- reduces lactose intolerance
- inhibits tumors by stimulating natural killer cells
- encourages proper GI function and elimination
- helps treat allergies

L. caseii rhamnosus / Lactobacillus GG

- discovered in 1985 by Gorbach and Golden, becoming the GG strain
- has an exceptional ability to adhere to the intestinal mucosa and proliferate
- reduces the number and severity of rotavirus-associated diarrhea
- used successfully in eradicating *Clostridium difficile* in patients with relapsing colitis
- has the ability to inhibit chemically induced intestinal tumors
- binds to some chemical carcinogens
- with *Bifidobacterium lactis*, produces significant improvement of atopic eczema in children with food allergies
- has an anti-oxidative ability, especially the chelation of metal ions, particularly iron and copper

L. caucasicus

- commonly found in kefir

L. crispatus

- an important part of the normal vaginal microflora
- along with *L. acidophilus* and *L. delbrueckii*, *L. crispatus* inhibits bacterial vaginosis-associated species

L. fermenti

- commonly found in kefir but also used to make sourdough bread and yogurt
- useful in protecting the vaginal area from vaginitis

L. gasseri

- the main *Lactobacillus* species in the human gastrointestinal tract
- has a good survival rate, even in the elderly
- plays a significant role in reducing gastric inflammation and suppressing *H. pylori*, the ulcer-causing bacterium

L. helveticus

- often used in making Swiss-type cheeses to enhance flavour
- added to certain fermented milks
- has proved to have significant effects on bone density
- has some effect in preventing trabecular bone loss when compared to other milk products that did not contain the organism
- increases bone formation of osteoblasts (bone cells) and serum calcium concentrations
- helps to lower blood pressure
- produces lactic acid
- has anti-microbial and anti-cancer effects

L. johnsonii

- survives passage through the digestive tract
- adheres to intestinal cells, blocking the colonization of potentially pathogenic bacteria, including *E. coli*
- stimulates the body's natural immune defences
- suppresses colonization of *C. perfringens* (a pathogen common in chickens)
- helps with lactose intolerance and traveller's diarrhea

L. lactis

- used in making some cheeses and fermented milk products
- has anti-microbial and anti-cancer effects
- helps decrease high blood pressure
- helps fight oral disease
- helps prevent urinary and vaginal infections
- inhibits both gram positive (eg. listeria) and gram negative (eg. *E. coli*) pathogens

L. leichmannii

- produces lactic acid
- often used to determine concentrations of vitamin B12 in products
- normally present in rye grain and used in making German rye bread

L. paracasei / F-19

- acid and bile resistant
- adheres to the colon
- effective in preventing & treating certain types of diarrhea & IBS (irritable bowel syndrome)
- has the ability to alter intestinal micro flora activity
- helps modulate the immune system
- helps reduce the risk of some cancers
- helps prevent colonization of *C. difficile* and *H. pylori*, especially in the elderly
- well tolerated by infants, adults, & the elderly
- helps increase in the numbers of other *Lactobacillus* strains
- its numbers are significantly reduced with the use of glucose, fructose, & sucrose

L. plantarum

- vegetable origin but still produces lactic acid
- inhibits growth of GI pathogens and eliminates them from the body
- used to treat recurrent *C. difficile*-associated diarrhea and Candida infections
- helps preserve key nutrients, vitamins, antioxidants
- manufactures vitamins A, B1, B2, B3, B5, B6, B12, K and short chains of fatty acids
- helps produce lactolin, a natural antibiotic
- helps destroy moulds, viruses, parasites
- eradicates such pathogens as *Staphylococcus aureus* from fermented food
- helps maintain healthy cholesterol and triglyceride levels
- increases the number of immune system cells
- provides protection from environmental toxins (eg. pesticides, pollutants)
- reduces toxic waste at the cellular level
- stimulates the repair mechanism of cells
- produces special enzymes that break down cyanogenic glycosides
- eliminates toxic components from food including nitrates
- helps prevent intestinal gas
- reduces IBS, allergies, arthritis, and infectious diseases
- produces *L-lysine*, an amino acid known for treating the Herpes virus

L. reuteri

- naturally found in the intestinal flora and breast milk of animals and humans
- more effective than *acidophilus* as an antibiotic
- helps strengthen the immune system
- produces reuterin, an antimicrobial substance
- protects infants and young children from developing allergies
- an effective treatment for rotaviral diarrhea in children
- not commonly found in supplements

L. rhamnosus

- produces lactic acid
- prevents and treats vaginal fungal or bacterial infections and some tumors
- closely related to *L. caseii* and *L. acidophilus* but more transient
- very resistant to stomach acids and bile salts
- colonizes easily in the intestinal lining and the vaginal tract
- reduces the severity of antibiotic-associated diarrhea
- increases immunity by increasing the response of T-lymphocytes
- has an anti-inflammatory effect
- helps decrease infant eczema
- grows rapidly in milk so found in many fermented dairy products
- helps prevent rotoviral or *C. difficile*-induced diarrhea
- helps treat and prevent food allergies, eczema, lactose intolerance
- stabilizes over a wide range of temperatures and pH levels
- inhibits the growth of bad bacteria, especially *Streptococci* and *Clostridia*

L. rhamnosus GG

- superior ability to prevent and treat GI disorders, especially diarrhea
- enhances the immune system by treating and preventing viral and bacterial infections
- resists stomach acids and bile salts

L. salivarius

- most abundant in the mouth as well as the small intestine
- important for normalizing gut flora, especially in those with chronic bowel disorders
- prevents gas by inhibiting undesirable bacteria
- antibiotic-resistant
- helps break down undigested protein
- breaks apart toxins produced by protein putrefaction
- produces lactic acid
- inhibits the growth of *H. pylori*
- very resilient, doubling its population every 20 minutes
- a facultative bacterium that survives and grows in both anaerobic (without oxygen) and aerobic (with oxygen) environments, unlike *L. acidophilus*, which has little or no growth in an aerobic environment

Bacillus strains

- found in soil, manure, and plant matter
- most species are harmless but some can be deadly
- some strains are used to make antibiotics while others are used as insecticides
- Two that are considered to be beneficial to humans are:

B. lichenformis

- a soil-based organism used to inactivate such lipid (fat)-enveloped viruses as:
 - HIV (human immunodeficiency virus)
 - SIV (simian immunodeficiency virus)
 - HHV-6 [A and B] (human herpes virus)
 - EBV (Epstein-Barr virus)
 - CMV (Cyto-megalo-virus – related to herpes)
- effective against other organisms including bacteria, mycoplasmas (a type of bacteria), and fungi
- produces surfactin, an antibiotic substance

B. subtilis

- a non-pathogenic bacterium that is widespread in soil, water, air
- able to grow in various habitats including the GI tracts of animals and humans
- inhibits or controls the growth of harmful bacteria and fungi
- helps normalize intestinal microflora
- source of the enzyme *nattokinase* which supports cardiovascular health
- secretes large amounts of enzymes including α -amylase, arabinase, cellulase, dextranase, levansucrase, maltase, alkaline protease, neutral protease, b-glucanase, Dnase, and other enzymes with N-acetylmuramidase activity

Bifidobacterium strains

- about 30 species are known and makes up about 90% of the beneficial bacteria
- common in the natural flora of human & animals
- some strains inhibit the growth of such harmful bacteria as *Salmonella*
- stimulates the immune system
- help the digestion by improving the absorption of food ingredients and nutrients
- synthesize some vitamins
- are gram-positive anaerobes; non-motile, non-spore forming and catalase-negative
- have various shapes (short, curved rods, club-shaped rods, bifurcated Y-shaped rods)

- the name is derived from the way they exist (Y-shaped or bifid form)
- lactic acid producers
- breastfed newborns begin to colonize bifidobacteria within days of birth
- populations begin to decline with advancing age unless supplemented
- influenced by many factors, including diet, antibiotics, and stress

B. adolescentis

- inhabits the lower large intestine
- has anti-tumor effects
- shares similar characteristics as *B. breve*
- along with *B. infantis* and *B. longum*, *B. adolescentis* accounts for almost 99% of the natural flora
- has strong effects against gram negative bacteria
- helps prevent the colonization of invading pathogens by competing for nutrients and attachment sites
- increases vitamin production and calcium absorption
- helps ferment over 20 kinds of carbohydrates into lactic acid

B. bifidum

- also known as *Bacillus bifidus*, *Bacterium bifidum*, *Lactobacillus bifidus*, and *Lactobacillus parabifidus*
- resides mainly in the lining of the large intestine and vaginal tract
- used in the production of certain fermented foods and therapeutic preparations
- used to treat digestive disorders, enterocolitis, constipation, cirrhosis of the liver, imbalance of intestinal flora following antibiotic therapy, and to promote peristalsis
- most prolific in forming lactic and acetic acids
- digests lactose
- ferments indigestible fibers, thereby producing more energy and less gas
- synthesizes some vitamins, especially several of the B vitamins
- assists in mineral absorption, especially iron, calcium, magnesium, and zinc
- inhibits the growth of *Salmonella*, *Bacillus cereus*, *Staphylococcus aureus*, *Candida albicans*, *Campylobacter jejuni*, *Listeria*, *Shigella*, *E. coli* and *Clostridium* by crowding them out and eating the nutrients they need
- fights bad bacteria by lowering the intestinal pH through the production of fatty acids, lactic acid, and acetic acid
- absorbs large quantities of ferrous ions, thereby inhibiting the growth of bad bacteria that use it for food
- helps decompose nitrosamines (cancer-causing substances)
- helps lower serum cholesterol

B. breve

- most common in infants but remains in adult small and large intestine
- produces lactic acid
- produces the natural antibiotic lactobrevin
- has an affinity for absorbing carcinogenics especially those produced by charred meats
- survives stomach acids and bile salts
- shares common characteristics with *B. Adolescentis*
- adept at absorbing carcinogenics, especially those produced by charred meats
- survives bile acids

- able to eradicate *Campylobacter jejuni* from children with enteritis

B. infantis

- also known as *B. lactentis*, *B. liberorum*, and *Actinomyces parabifidus*
- found mainly in the large intestines of infants but also in adults and the vagina
- stimulates production of such immune agents as cytokines
- produces acids that retard colonization of certain foreign or harmful bacteria including *Clostridia*, *Salmonella*, & *Shigella*

B. lactis

- also known as *Bifidobacterium animalis* subsp *lactis*
- found in large numbers in the large intestine
- resistant to stomach acids and bile salts
- lowers body pH
- produces hydrogen peroxide (H₂O₂) which kills pathogens
- proving helpful in those with eczema
- increases natural killer cells and T-lymphocytes thus helping the immune system, especially in the elderly
- helps relieve constipation and prevent diarrhea, especially in children
- decreases chronic inflammation of the colon
- has anti-microbial properties
- has anti-microbial properties that decrease the effect of negative bacteria, especially *Clostridium*

B. longum

- found in high concentrations in the large intestine
- produces lactic & acetic acids that lower pH & inhibits pathogens
- resistant to stomach acids & bile salts
- stimulates the immune system
- has strong antitumor activity
- improves the nutritional value of foods
- produces some B vitamins, lysozyme enzymes, digestive enzymes, & casein phosphatase
- increases calcium absorption

OTHER PROBIOTICS and PREBIOTICS

Enterococcus strains

- found in the intestines of animals & humans
- gram-positive, facultative anaerobic cocci of the Streptococcaceae family
- are spherical to ovoid in shape; occur in pairs or short chains; are catalase-negative; non-spore forming; usually nonmotile
- usually cause no harm, but in some, can cause serious infections of the urinary tract (UTIs), in wounds, and the blood

E. faecalis TH10

- highly effective against even the most deadly antibiotic-resistant bacterial strains, including MRSA (methicillin-resistant *Staphylococcus aureus*)

E. faecium

- should not be confused with the pathogenic strain **E. faecalis** (found mainly in animals but is a pathogen in humans). Because of concerns over similarities in the strains and the names, many fermented food manufacturers have stopped adding *E. faecium* to their products.
- normally found in the intestinal tracts of animals and humans
- only temporary colonization
- effective in treating diarrhea, especially when associated with the rotavirus
- able to withstand high stomach acids and temperatures
- antibiotic resistant
- helps lower cholesterol levels

E. faecium SF68

- used to manage several diarrheal illnesses

Lactococcus strains

- lactic acid producers
- commonly used to sour milk
- gram-positive facultative anaerobes
- several strains are being used or are being developed as probiotics

L. lactis

- formerly known as *Streptococcus lactis*
- able to synthesize both folic acid and riboflavin, two important B vitamins
- one of the most important microorganisms used in the dairy industry, particularly in cheese making, since it produces copious amounts of lactic acid
- NOTE: Scientists are now experimenting with it by creating a genetically modified version which secretes “interleukin 10”

Leuconostoc strains

- found in various environments
- belongs to the lactic acid-producing family of bacteria used to ferment foods which increases their nutritive quality
- some strains produce the characteristic flavor in cultured milk products and vegetables

L. mesenteroides

- most often used in fermenting vegetables where it initiates the desirable lactic acid
- initiates growth in vegetables more rapidly over a range of temperatures and salt concentrations than any other lactic acid bacteria
- used to ferment sour dough bread, sorghum beer, all fermented milks, and cassava
- differs from other lactic acid species in that it can tolerate fairly high concentrations of salt and sugar (up to 50% sugar)
- produces carbon dioxide and acids which rapidly lowers pH, inhibiting the development of undesirable micro-organisms while increasing the proper environment for lactobacillus species
- removes oxygen, helping to preserve the colour of vegetables and stabilizing any ascorbic acid (vitamin C) that is present

Pediococcus strains

- found in foods, on plants, and to prevent spoilage in beer
- produces inactive lactic acid
- used mainly for making fermented vegetables, mashes, beer, and wort

P. acidilactici

- a specific strain of lactic acid-producing bacteria
- helps to keep a proper balance of microflora in the digestive system
- used to control *Listeria monocytogenes* in temperature-abused vacuum-packed wieners

Saccharomyces strains

- beneficial yeast organisms used in making beer, bread, and nutritional supplement

S. boulardii

- non-pathogenic
- closely related to brewer's yeast but NOT AT ALL to *Candida* yeast
- fast-growing, it helps eliminate harmful yeasts, including *Candida*, in the GI tract
- produces lactic acid and some B vitamins
- helps treat diarrhea caused by antibiotics and *C. difficile* (secretes protease enzymes which digest exotoxins known to cause diarrhea and colitis caused by *C. difficile*)
- helps ease Crohn's disease
- survives gastric acidity
- not adversely affected or inhibited by antibiotics
- does not alter or adversely affect the normal flora in the bowel
- can be taken with other friendly probiotic organisms
- protects the gut from amebas and cholera
- NOTE: Do not take at the same time as prescription antifungals as this organism will be killed as well. Alcohol also kills this organism.

S. cerevisiae

- commonly known as baker's, budding, or brewer's yeast, which refers to its use or how the yeast multiplies
- used in making bread and beer
- does not contribute to *Candida* yeast infections
- NOTE: Some nutritional yeasts are derived from by-products of breweries or paper mills. A superior kind is grown on molasses, giving it a higher nutrient content

Streptococcus strains

- known mostly as pathogens causing illnesses that range from sore throats to rheumatic fever
- beneficial strains are usually found in cultured milk products

S. thermophilus

- with *L. bulgaricus*, is used commercially to produce yogurt & other fermented milk products including mozzarella cheese
- produces large quantities of lactase, the enzyme needed to break down lactose
- classified as a lactic acid bacteria
- has the ability to produce *methanol acetone*, a potent anti-pathogenic agent which destroys such pathogens as *Pseudomonas*, *E. coli*, *Staphylococcus aureus*, *Salmonella*, & *Shigella*

- stimulates the production of cytokines which are involved with the immune system
- improves the nutritional value of foods by making micronutrients available
- a gram-positive facultative anaerobe
- cytochrome-, oxidase- & catalase-negative
- nonmotile, non-spore forming & homofermentative
- an alpha-hemolytic species of the viridans group

S. salivarius subsp thermophilus type 1131

- a probiotic strain

FOS (fructo-oligosaccharides)

- a PREbiotic, meaning it feeds friendly flora
- derived from sugar cane via a fermentation process
- resistant to digestion in the upper GI tract and thus able to stimulate the growth of *Bifidobacterium* and *Lactobacillus* strains farther down in the large intestine
- does not support the growth of pathogens
- increases absorption of calcium and magnesium
- decreases triglyceride levels
- has anticancer effects, significantly reducing the incidence of colon tumors
- uptake is reduced by 60% when glucose, fructose, sucrose, and fluoride are consumed
- found naturally in such foods as Jerusalem artichokes, yacon, onions, leeks, garlic, chicory, and barley
- resistant to digestive juices

Inulins

- a group of non-digestible carbohydrates called *fructans* (also known as *levans*)
- not an FOS because the majority of its chains exceed 10 units
- Inulin-producing plant species include those from the family Liliaceae, Amaryllidaceae, Gramineae, and Compositae, especially chicory, onions, leeks, garlic, bananas, asparagus and artichokes
- NOTE: only chicory (*Cichorium intybus*) and Jerusalem artichokes (*Helianthus tuberosus*) are used to produce Inulin commercially
- stimulates the growth of *Bifidobacterium* in the large intestine
- bind minerals in the small intestine which is a GOOD thing because they are then released into the large intestine where they are better absorbed than in the small intestine; a beneficial activity in the prevention of osteoporosis
- have a sweet taste so often added to foods as sugar substitutes, fat replacers, providing texture, stabilizing foam, or improving feeling in the mouth in a wide variety of miscellaneous foodstuffs, including fermented dairy products, desserts, bakery products, spreads, and infant formulas
- comprised mainly of fructose units
- has the ability to hold water, replace fat, and contribute minimal calories

Isomalto-oligosaccharides

- a mixture of glucose and other saccharide molecules
- produced by various enzyme processes
- ultimately form several sugar molecules and other higher branched oligosaccharides
- help stimulate the growth of *Bifidobacterium* and *Lactobacillus* species in the large intestine

Lactilol

- a disaccharide alcohol analogue of lactulose
- used in many countries for treating constipation and hepatic (liver) encephalopathy
- in Japan, used as a prebiotic because it is resistant to digestion in the upper gastrointestinal tract and fermented by a limited number of colonizing friendly bacteria. However, it is not approved as a prebiotic in the United States
- Should be avoided by those who are lactose intolerant

Lactosucrose

- a trisaccharide comprised of galactose, glucose, and fructose molecules
- produced through enzyme action, resulting in sucrose
- resistant to digestion in the stomach and small intestine
- acts on the intestinal microflora to increase the growth of the *Bifidobacterium* species
- widely used in Japan as a dietary supplement and in functional foods, including yogurt

Lactulose

- a semisynthetic disaccharide of lactose and fructose
- resistant to human digestive enzymes
- fermented by a limited number of bacteria in the colon
- currently, a prescribed drug in the US for the treatment of constipation and hepatic encephalopathy
- has some ability in reducing infectious inflammatory bowel disorders and some colon tumors
- shown to improve glucose tolerance and carbohydrate metabolism
- significantly stimulates calcium absorption in postmenopausal women
- NOTE: contains galactose, therefore, contraindicated in those who require a low galactose diet
- NOTE: Should be avoided by those who are lactose intolerant

Oligofructose

- derived from native inulin
- about 30-60% as sweet as sugar
- found commercially as an oligosaccharide because it consists mainly of fructose units with some glucose-terminated chains (unbound fructose chains have prebiotic properties)
- also available as a mixture with inulin to reduce the amount of non-glucose terminated chains
- has a different fermentation profile than inulin or FOS
- fermented by a wider variety of probiotic bacteria than inulin
- has the ability to brown, making it a valuable addition to baked products

Pyrodextrins

- a mixture of glucose-containing oligosaccharides derived from starch
- resistant to digestion in the upper gastrointestinal tract
- promotes the growth of *Bifidobacterium* in the large intestine

Soy oligosaccharides

- derived mainly from soybeans, but can also be found in other legumes
- there are two main soy oligosaccharides
 - trisaccharide *raffinose* (comprised of one molecule each of galactose, glucose and fructose)
 - tetrasaccharide *stachyose* (comprised of two molecules of galactose, one molecule of glucose and one molecule of fructose)
- acts to stimulate the growth of *Bifidobacterium* in the large intestine

TOS (transgalacto-oligosaccharides)

- a mixture of glucose and galactose oligosaccharides
- produced from lactose via enzyme action obtained from *Aspergillus oryzae* (which can also be a pathogen)
- resistant to digestion in the upper gastrointestinal tract
- able to stimulate the growth of *Bifidobacterium* in the large intestine
- has a positive effect on calcium absorption
- has some ability to lower triglycerides
- should be avoided by those who are lactose intolerant

Xylo-oligosaccharides

- comprised of oligosaccharides containing beta-linked xylose residues
- obtained from enzymatic action
- resists digestion in the upper gastrointestinal tract
- able to function in the large intestine to increase the growth of *Bifidobacterium* species, thus improving gastric function
- helps improve blood sugar levels and fat metabolism
- restores normal intestinal flora following antibiotic, chemo, or radiation therapies
- increases mineral absorption and vitamin B production
- reduces intestinal putrefaction

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