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. casei**
- 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. casei 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

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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 (e.g., 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. casei* 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 putrification
- 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. licheniformis**
- 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 a-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 (meticillin-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 wiener

**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. salivarus 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
Lactitol

- 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 putrification

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