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## Biotherapeutic Potential of *L. Acidophilus*

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Probiotic supplements are becoming increasingly popular in the United States and Europe. A probiotic is defined as "a live microbial food ingredient that is beneficial to health." Probiotic bacteria are used to treat disturbed intestinal microflora. Probiotics may help in vaginal bacterial infection, urinary tract infection, lactose intolerance, diarrhea, and colon cancer.

More than 400 different species of bacteria reside in the human gastrointestinal tract. The most researched probiotics belong to either the *Lactobacillus* or *Bifidobacterium* genera.

*Lactobacillus* is a genus of bacteria in the family *Lactobacteriaceae*, which are found in the intestinal tract, milk, and fermented products. The name *Lactobacillus* is derived from lactic acid, and *bacillus* (a large family of bacteria that has a rod-like shape). Lactic acid is formed by the reduction of pyruvate, a product of the breakdown of glucose.

*Acidophilus* is a member of *lactobacilli*. *Lactobacillus (L) acidophilus*, *L. plantarum*, *L. rhamnosus*, and *L. casei* are common in the human mucosa, from the mouth to the rectum. *L. acidophilus* is also present in the mouth, digestive tract, and vagina. Probiotics have the ability to survive passage through the gastrointestinal tract, and are usually considered to be non-pathogenic.

Probiotic species most frequently used in supplements include *Bifidobacterium (B) bifidum*, *B. longum*, *B. breve*, *B. adolescentis*, and *B. infantis*; *Lactobacillus (L) acidophilus*, *L. bulgaricus*, *L. thermophilus*, *L. sporogenes*, *L. plantarum*, and *L. casei GG*. Probiotics are usually measured in numbers of organisms per gram. Supplements typically contain four billion or more organisms per gram.

### Diarrhea

Diarrhea is one of the most common health problems in the world, in particular during childhood. Rotavirus and other viruses have been identified as a major cause of acute diarrhea in infants and young children. Antibiotics have also been associated with mild or severe episodes of diarrhea.

Nonpathogenic living organisms (such as selected strains of *Lactobacillus acidophilus*, *L. Bulgaricus*, *Bifidobacterium longum*), capable of re-establishing the equilibrium of the intestinal ecosystem, have been used in the prevention of viral or antibiotic associated diarrhea.

The efficacy of the addition of freeze-dried and inactivated *Lactobacillus acidophilus LB* to oral rehydration therapy in the treatment of diarrhea in children was demonstrated in a recent placebo-controlled trial. Seventy-three children, of whom 40 were on antibiotics, with acute diarrhea and mild dehydration (50 percent of the children had rotavirus) received oral rehydration therapy and either *L. acidophilus LB* or placebo twice a day for two and half days. *L. acidophilus* was found to markedly reduce the duration of diarrhea, in particular among children who were not on antibiotics, as compared to placebo. 1

Lactobacillus strain GG (Lactobacillus GG, a subspecies of Lactobacillus casei), which comes from a sterile form of the bacteria that grow in the human intestine, administered during acute rotavirus diarrhea, has been shown to enhance the immune system and reduce the duration of diarrhea. Thirty-nine infants with acute rotavirus diarrhea were randomly assigned to either fermented milk containing Lactobacillus GG or pasteurized yogurt (placebo). The Lactobacillus group showed an enhanced concentration of circulating immunoglobulin A (IgA), which correlated with shortened duration of diarrhea.<sup>2</sup>

In another study, researchers at the University of Nebraska gave Lactobacillus GG to children on antibiotics for bacterial infections, and to healthy children (placebo). Twenty-five percent of the placebo group contracted diarrhea during the course of the antibiotic treatment compared to just seven percent of the Lactobacillus GG group.<sup>3</sup> The study concluded that Lactobacillus GG reduces the incidence of antibiotic-associated diarrhea in children treated for common childhood infections.

A recent study reviewed human intervention trials published between 1988 and 1998 and found that intake of Lactobacillus GG shortened the diarrhea phase of rotavirus infection by one day.<sup>4</sup>

In an Italian study, 63 patients under four years old were divided into three groups: the first and second groups suffered an infective diarrhea, and received inactivated L. acidophilus LB and placebo, respectively; the third group had an antibiotic-associated diarrhea and were given L. acidophilus LB. L. acidophilus significantly improved symptoms in the first group as compared to the second group, and prevented diarrhea in the third group.<sup>5</sup>

Lactobacillus reuteri, originally derived from mother's milk, has been reported to survive the harsh stomach environment and maintain a healthy balance of friendly bacteria in the digestive tract. The therapeutic role of L. reuteri in treating rotavirus-induced acute diarrhea was demonstrated in a Finnish double-blind study on infants and toddlers admitted to hospital with acute diarrhea. The mean duration of watery diarrhea in the L. reuteri group was 1.7 days and 2.9 days in the placebo group.<sup>5a</sup>

### **Cancer**

The anticancer activities of probiotics have been demonstrated in a test-tube study. Live cells of probiotics, six strains of L. acidophilus and nine strains of bifidobacterium, showed higher anti-mutagenic activity against potent chemical mutagens, and their efficiency in inhibiting the mutagens was better than killed bacterial cells.<sup>6</sup>

An earlier animal study (1993) found that freeze-dried Bifidobacterium inhibited chemical substance-induced incidence of colon and liver tumors in rats.<sup>7</sup> In humans, the ingestion of probiotics resulted in the excretion of urine with low concentrations of components that are toxic to human colon cells,<sup>7a</sup> suggesting the possible role of acidophilus in reducing the incidence of colon cancer, the second to third most frequent type of cancer in Western countries.

### **Eczema**

In the United States, 10 percent of infants and three percent of adults have eczema (define). In mild forms, the skin is dry and itchy; in severe cases, the skin becomes broken and starts bleeding. It is normally treated with moisturizers and antibiotics.

Allergic conditions such as eczema have been linked to failure of the immune system. It is theorized that probiotics may prevent the intestinal growth of certain germs thought to be involved in eczema. Probiotics are also thought to improve the balance of germs in the intestines, which may enhance the immune system.

In a Finnish study published in Lancet (2001), 159 pregnant women with a family history of allergies were randomly given either Lactobacillus GG or placebo twice a day for three weeks before they gave birth. After they delivered, breast-feeding mothers took the probiotic capsules for six months, while bottle-fed babies were fed the contents of the capsules mixed with water for the same amount of time. At the age of two, 23% of those fed probiotics have developed eczema, compared with 46% of the infants given placebo treatment.<sup>8</sup>

### **Lactose Intolerance**

Lactose intolerance is a problem for people who have a low amount of intestinal beta-galactosidase activity and for whom lactose behave like non-digestible carbohydrate. Lactose is a substance found in milk and milk products. Probiotics have been shown to improve lactose digestion by reducing the intolerance symptoms.<sup>9</sup>

Research has indicated that bile sensitivity and acid tolerance may be important factors in selecting Lactobacillus acidophilus strain for improving lactose digestion and tolerance. In a randomized double-blind trial,<sup>11</sup> lactose-intolerant subjects consumed acidophilus milk containing four different strains (B, N1, E and ATCC 4356) of *L. acidophilus*. Acidophilus strain N1 was the most effective of the four acidophilus in improving lactose digestion and tolerance <sup>9a</sup>. A recent study reported that the ingestion of *L. acidophilus* strain BG2FO4 twice per day for a week failed to treat lactose intolerance.<sup>10</sup>

### **Immune System**

Lactic acid bacteria, Bifidobacterium, Lactobacillus acidophilus (*L. acidophilus*), *L. bulgaricus*, *L. casei*, *L. gasseri*, and *L. reuteri* were shown in vitro to stimulate macrophages and possibly other immune cells to produce proinflammatory cytokines and nitric oxide.<sup>11</sup>

A study of 4,718 women found low levels of Lactobacilli in the vaginal tract with increased incidence of HIV in younger women, indicating the importance of healthy flora in the immune system.<sup>12</sup>

### **Helicobacter pylori**

Almost half of the world's population is infected with prevalent bacteria called *Helicobacter pylori* (*H. pylori*), known to cause inflammation of the stomach lining and ulcers. *H. pylori* begins to colonize the digestive tract at an early age and the infected individuals often exhibit no symptoms until a number of years later.

Eradication of *H. pylori* infection with a combination of antibiotics, antacids, and anti-microbial agents often cures the *H. pylori* associated ulcer. However, this therapy also eliminates "friendly" bacteria necessary for normal function of the gastrointestinal tract, leading to side effects such as bloating, diarrhea, and taste disturbance.

In a recent pilot study, 120 *H. pylori*-positive patients were randomly given either an antibiotic therapy or the same treatment supplemented with *L. acidophilus* GG for 14 days. The Lactobacillus group showed a 60 percent lower risk of bloating and a 70 percent lower risk of diarrhea or taste disturbance than those who received only antibiotics. The *L. acidophilus* group also showed a significant increase in the eradication rate, suggesting that *L. acidophilus* could be effective in increasing eradication rates of a standard anti-*H. pylori* therapy.<sup>13</sup>

### **Vaginal Bacterial Infection**

Vaginal bacterial infection (VBI) is one of the most common infectious disorders affecting women. Women with VBI diagnosed during the second trimester of pregnancy are 40 percent more likely to give birth to a premature, low birth-weight infant than women without VBI.

VBI is characterized by a disturbance in the normal vaginal flora, Lactobacilli. Vaginal Lactobacilli are thought to play an important role in resistance to infection via production of lactic acid and acidification of the vagina or by production of anti-microbial products, such as hydrogen peroxide, which is linked to a decreased frequency of VBI.

In a small clinical trial, 32 non-menopausal women with VBI received either tablets containing 50 mg of *L. acidophilus* or placebo. After four weeks, the acidophilus group had a cure rate of 88 percent compared to only 22 percent in the placebo group.<sup>14</sup>

### **Urinary Tract Infection**

Urinary tract infection (UTI) is common in both pre- and post-menopausal women. It is estimated that between 10 and 20 percent of females will develop a UTI during their life. Treatment of UTI is often achieved with antibiotics. Analysis of the urogenital flora after antibiotics therapy revealed that uropathogenic bacteria dominate the urethra; and it was suggested that administration of *Lactobacillus* may restore the balance of flora in the urinary tract. Forty-one women with UTI were first treated for three days with antibiotics. Post-therapy vaginal administration of *Lactobacillus* suppositories resulted in UTI recurrence in 21 percent of patients as compared to 47 percent recurrence rate in those who received no *Lactobacillus* treatment.<sup>15</sup>

### **Summary**

Human studies suggest that probiotics may alleviate lactose intolerance, facilitate treatment of vaginal bacterial infection, enhance immune system, and reduce the risk of rotavirus- and antibiotic-induced diarrhea and colon cancer. *Acidophilus* taken as a tablet, powder, or extract may help bring back beneficial bacteria after a bout of diarrhea. VR