

Review Article

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Probiotics and its Effects on Human Health-A Review

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ABSTRACT

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Probiotic is a live microbial food supplements with various beneficiary effects on human health. There are more evidence for the use of Probiotic as therapeutic substance for the treatment of different disorders like gastrointestinal infections, allergy, inflammatory bowel syndrome, pouchitis, Ulcerative Colitis, Crohn's disease, diarrhea, Colon cancer, etc., with dairy and non- dairy products. Probiotic not only beneficiary for humans, it is also used for animal health. This review reveals the uses of probiotics in human clinical traits.

Introduction

The intestinal track of humans is host to a vast ecology of microbes and harbors more than 500 identified species that can be cultured and many bacteria that cannot be cultured and properly identified. These bacteria which are necessary for health have the potential to contribute to the development of diseases also by a variety of mechanisms (Berg, 1996; Guarner and Malagelada, 2003). The peaceful coexistence of microbes with the host is referred to as host microbe cross-talk, implying a benefit of the microbial pressure to the host (Cebra, 1999).

Probiotics term derived from Greek word pro (favor) and bios (live). The word probiotics was introduced by Parker (1974).

Origin

The ancient records tells about the beneficial possessions of live microbial food supplements like fermented milks dates back many centuries and their usage in treatment of body ailments has been stated even in Biblical scriptures. Scientists of early ages, such as Hippocrates and others stated fermented milk not only a food product but a

medicine as well. They recommended sour milks for treating disorders of stomach and intestines (Oberman, 1985). At the commencement of the 20th century, the Russian bacteriologist Eli Metchnikoff (Pasteur Institute, France) was the pioneer to give a scientific explanation for the benefits of lactic acid bacteria present in fermented milk (Hughes and Hoover, 1991; O'Sullivan *et al.*, 1992). Metchnikoff described that owing to lactic acid and other yields produced by lactic acid bacteria in sour milks, the growth and toxicity of anaerobic, spore-forming bacteria in the large intestine are inhibited.

### **Probiotics Definition**

A probiotic is defined as a feasible microbial dietetic supplement that benefits the host through its effects in the intestinal tract and this definition, however, was primarily intended for use with animal feed products. For human diet, probiotics are defined as "live microbial food supplements or components of bacteria which have beneficial effects on human health" (Salminen *et al.*, 1998). A prebiotic is defined as "as non-absorbable food materials that beneficially arouse one or more gut-beneficial microbe groups and it have a positive effect on human health" (Gibson and Roberfroid, 1995). The most commonly used prebiotics are carbohydrate substances like dietary fiber with the capability to promote the components of the normal intestinal microflora which may exhibit a health benefit to the host. Symbiotic is the word coined for the mutual administration of precise prebiotics with probiotics to provide sure health benefits by synergistic action (Bached *et al.*, 2004)

### **Probiotic Organism**

Probiotics, specially *Lactobacillus* and *Bifidobacterium* have been advised to be

associated with improvement of lactose intolerance (Levri *et al.*, 2005); prevention and treatment of viral, bacterial and antibiotic or radiotherapy induced diarrheas (Guandalini, 2006; Szajewska and Mrukowicz, 2005; Parvez *et al.*, 2006); immunomodulation (Forsythe and Bienenstock, 2010); antimutagenic (Chalova, 2008) and anticarcinogenic effects (Liong, 2008) and even blood cholesterol decrease (Ooi and Liang, 2010). The optimism related with probiotics is, however, counter-balanced by skepticism as many "probiotic" products in the market are untrustworthy in content and unproven clinically (Hughes and Hillier, 1990; Hamilton-Miller *et al.*, 1999; Zhong *et al.*, 1998). Many probiotic strains used for several decades for their safety and efficiency and are therefore, safe to use (Salminen *et al.*, 1998; Adams and Marteau, 1995). Any new strain used as a probiotic should be evaluated for safety and efficacy.

### **Organisms**

Numerous microbial species have been used as probiotics (Table 1), includes *Bacillus*, *Bifidobacterium*, *Enterococcus*, *Escherichia coli*, *Lactobacillus*, *Lactococcus*, *Streptococcus*, and yeast species (Patterson and Burkholder, 2003) *Lactobacillus* and *Bifidobacterium* species used most extensively in human.

### **Inflammatory Bowel Disease**

Incorporation of probiotic bacteria has an ability to become stable the immunological barrier in the gut mucosa by declining the generation of local proinflammatory cytokines. Probiotics is used for treatment of the inflammatory bowel disease, such as ulcerative colitis, crohn's disease, and pouchitis. Absence of high-quality information of the causal factors, drugs that

alleviate symptoms such as mesalazine, antibiotics, corticoids, anti – diarrheal drugs and immunosuppressants have been used for action. The etiology of inflammatory bowel infections is not clear yet now and frequent factors are involved in the injury to the mucosa, including microorganisms, psychological factors and nutritional habits. Some results indicate that Inflammatory Bowel disease patients host an intestinal micro flora containing few lactobacilli (Fabia *et al.*, 1993) and a decrease in *Bifidobacteria* fecal concentration. (Favier *et al.*, 1997 and Ruseler – Van Embden *et al.*, 1994).

### **Pouchitis**

Pouchitis is acute or chronic inflammation of the ileal reservoir formed after colectomy and ileal pouch anal anastomosis. Ileal pouch – anal anastomosis is the preferential replacement to protocolectomy with everlasting ileostomy in ulcerative colitis and familial adenomatous polyposis. A randomized placebo – meticulous study encompassed 40 adult patients with history of chronic relapsing pouchitis who conquered clinical and endoscopic remissions with antibiotics. Patients were randomly assigned to probiotic or placebo.

After 9 months, 15% of patients getting VSL number 3 experienced a deterioration, whereas 100% of patients suffering placebo relapsed. Within 3 months of discontinuing the probiotic, all patients in the probiotic group deteriorated (Gionchetti *et al.*, 2000).

Patients who suffered with pouchitis had a low amount of bacterial colonization and a high fungal diversity. Bacterial diversity was increased, and fungal diversity was abridged when patients were maintained in remission with VSL number 3 (Kuehbacher *et al.*, 2006). In contrast, *Lactobacillus rhamnosus*

GG was not positive in a small controlled study of adult patients in pouchitis (Kuisma *et al.*, 2003).

### **Ulcerative Colitis**

One large randomized study of 116 patients with ulcerative colitis established that non pathogenic *E.coli* (Nissle, 1917) was correspondingly effectual as mesalamine in preventing relapse (Rembacken, 1999). In this study, reduction was induced with corticosteroids and patients were randomized to get hold of either probiotic or mesalamine. The median time to relapse was 206 days in mesalamine group and 221 days in the *E.Coli* group. However, the upkeep dose of mesalamine used in this test was little (1500 mg daily). Thus it is doubtful from this particular study whether probiotics would be more actual than low – dose mesalamine as a maintenance agent. The pouch surgery of ulcerative colitis is often complicated by a non – specific inflammation of the ileal reservoir. Bacteriotherapy by oral intake using a mixture of probiotic bacteria has newly been revealed to be effectual in stopping relapses of chronic pouchitis (Gionchetti *et al.*, 2000).

### **Crohn Diseases**

Oral uptake of *Lactobacillus rhamnose* (GG) in patients with Crohn's disease resulted in promote of the IgA immune retort (Malin *et al.*, 1996). A preliminary study in four children with gentle Crohn's disease recommended that L.GG may increase the gut barrier function and clinical status, but double blind placebo controlled trials have to substantiate these results.

### **Diarrhea**

Probably the study potentially reveals

helpful effect of probiotics is mild to sensible infectious diarrhea. Probiotics plays an imperative role in preventing nosocomial infectious diarrhea has shown challenging confirmation. A double blinded randomized control experimental using *Lactobacillus* GG in 81 children ages 1 to 36 months revealed a significant decrease in the menace of rotavirus gastroenteritis (2.2% vs 6.7%) (Szajewska *et al.*, 2001) (NR). For a longtime, the consumption of bacteria by oral therapy in the healing of acute diarrhea (Peneet *al.*, 1996; Caamtte, 1966; Perdigonet *al.*, 1986).

Human isolates of *Lactobacillus rhamnosus* strain GG (LGG) widely used to give confidence recovery from acute rotavirus diarrhea in children. LGG when used as bacteria supplemented milk or freeze dries powder, is efficient in reduction the course of acute diarrhea.

In adult volunteers given orally with *E.coli* strains producing heat stable and heat labile enterotoxins, the course of the diarrhea was not improved by a marketable preparation containing dried *L.acidophils* and *L.bulgaricus* (Clements *et al.*, 1983; Clements *et al.*, 1981). Chronic diarrhea associated with bacterial overgrowth in adults, a crossover randomized test confirmed that a 7 day antibiotic treatment was successful in dipping daily stool frequency, whereas *Saccharomyces boulardii* had negative response on its parameters, atleast during this short period of treatment (Attar *et al.*, 1999).

Acute diarrhea fallout mostly in about half of travelers who visit high risk areas. Although in most cases, acute diarrhea is meek and self-limiting, there is a widespread illness. Antibiotics are actual prophylaxis but are not recommended for widespread use and thus there is a need for cost effective another treatments. Several studies were

done with the use of probiotics. Among the five double blind controlled test shows that, only one trial showed important advantage using *Saccharomyces boulardii* (Kollaristsch, 1993; Katelaris, 1995; Oksanen, 1990). *S. boulardii* seems to have very good effects on bacterial diarrhea, whereas *Lactobacillus* GG has to be more effective against viral and idiopathic diarrhea.

### Allergy

Probiotics reduce the inflammatory cytokines and intestinal permeability in vitro such a consequence would be beneficial in allergic disorder. Several studies prove the effectiveness of probiotics in allergic conditions, such as eczema, allergic rhinitis and food allergies. The results of these studies are promising, but a definitive role is yet to be confirmed. When *Lactobacillus* GG or placebo was to pregnant mothers with a strong family history of eczema, allergic rhinitis asthma and to their infants for the first 6 months after delivery, the frequency of developing atopic dermatitis in the offspring was significantly reduced (Kalliomaki, 2001 and Kalliomaki, 2003).

Intestinal microorganism plays an important role in the process of food antigens in the gut and food hypersensitivity (Fig. 1), of which atopic disease is an expression. Probiotics modify the structure of antigens reduce their immunogenicity, intestinal permeability and the generation of proinflammatory cytokines that are eminent in patients with a diversity of allergic disorders. Number of studies proved that evaluated probiotics in allergic conditions including rhinitis, atopic dermatitis and food allergy.

Theories like “hygiene hypothesis” have recommended that a modern style of life could increases the development of allergic

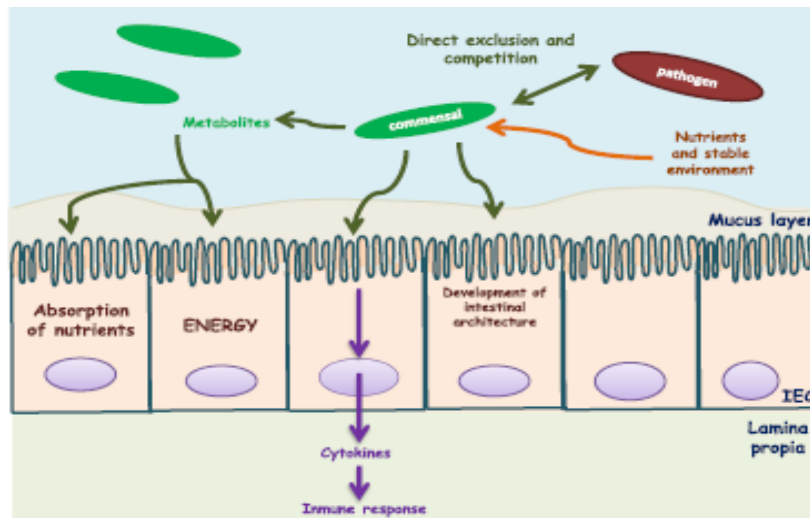
diseases. In most developed countries, the immune system is much less challenged as it used to be in the past by infectious diseases of different origins. The contact to infectious agents generally leads to stimulation of type 1 helper (Th1) lymphocytes and to the release of cytokines such as IFN -  $\gamma$ . T cells are classically classified as Th 1, Th 2, or Th 3 types according to their profile of cytokine secretion. Th 1 cells produce IFN -  $\gamma$ , IL -

2 and TNF -  $\beta$ , which activate macrophages and are responsible for cell - mediated immunity. Type 2 cells produce IL - 4, IL - 5, IL - 10, and IL 13, which are responsible for antibody production (IGE mainly) and eosinophil activation. Th 3 cells are regulatory cells mainly secreting suppressive cytokines such as transforming growth factor (TGF -  $\beta$ ).

**Table.1** Most Frequently used Probiotic Microorganisms (Heyman and Ménard, 2002)

<i>Lactobacillus</i> species	<i>Bifidobacterium</i> species	Others
<i>L. acidophilus</i>	<i>B. bifidum</i>	<i>Streptococcus thermophilus</i>
<i>L. rhamnosus</i>	<i>B. longum</i>	<i>Escherichia coli</i>
<i>L. gasseri</i>	<i>B. breve</i>	<i>Bacillus cereus</i>
<i>L. reuteri</i>	<i>B. infantis</i>	<i>Clostridium butyricum</i>
<i>L. bulgaricus</i>	<i>B. lactis</i>	<i>Enterococcus faecalis</i>
<i>L. plantarum</i>	<i>B. adolescentis</i>	<i>Enterococcus faecium</i>
<i>L. johnsonii</i> <i>L. paracasei</i> , <i>L. casei</i> Yeast		VSL#3 (four strains of lactobacilli, three strains of bifidobacteria, one strain <i>Streptococcus salivarius</i> sp. <i>thermophilus</i> )
<i>L. salivarius</i>		<i>Saccharomyces boulardii</i>
<i>L. lactis</i>		<i>Saccharomyces cerevisiae</i>

**Figure.1** Commercial Bacteria Supply the Host with Essential Nutrients and Defined the Host against Opportunistic Pathogens (Marin et al., 2013)



## Colon Cancer

Due to somatic mutation in colon cells results in the colon cancer during the life time of an individual. Genotoxic carcinogens including heterocyclic aromatic amines, which are fashioned during the cooking of meat, are a potential risk factor of colon cancer in high – meat eaters. In vitro studies proved that the cell wall of lactic acid bacteria can adhere heterocyclic amines. Lactic acid bacteria or milk – fermented products shown to exhibit anti – mutagenic effects in the *S. typhimurium* mutagenicity assay (Renner and Munzner, 1991). In deed the link between high fat, low fiber western diets and colon cancer can be partially explained by the alterations in fecal bacterial enzymes. The mechanisms by which lactic bacteria hold back colon cancer may comprise modification of the metabolic activities of intestinal micro flora, alteration of physicochemical conditions in the colon, binding and degradation of potential carcinogens, quantitative and or qualitative alterations in the intestinal micro flora incriminated in the production of carcinogens, production of anti tumorigenic or antimutagenic compounds, enhancing the hosts immune response and effects on the physiology of the host. There is important indirect and mechanistic confirmation, based largely on laboratory animal and in vitro studies (Rafter, 2003; Rafter, 2002).

The Carcinogenic outcome of endogenous toxic and genotoxic compounds hypothetical to be inclined by the action of bacterial enzymes such as NADPH dehydrogenase, nitroreductase,  $\beta$  – glucosidase,  $\beta$  – glucuronidase or 7 –  $\alpha$  – dehydroxylase, which are more heavily expressed by enterobacteria, bacteroides and clostridia than by lactobacilli and *Bifidobacteria*. In fact such enzymes are harmful to the colon mucosa since they

engage in the production of toxic compounds that have been detoxified by the liver (Hawksworth *et al.*, 1971).

In conclusion, Probiotic are used commercially in many different products in the world. Probiotics shows various beneficial effects on humans, animal health. The organism that used as probiotic should have the characteristics like adhere ability, colonizing and balancing the gastrointestinal tract. Organisms like *Lactobacillus*, *Bifidiobacterium*, *Enterobacter* and *E. coli* are most widely used as probiotic with dairy and non- dairy products to treat various disease like gastrointestinal infections, allergy, inflammatory bowel syndrome, pouchitis, Ulcerative Colitis, Crohn's disease, diarrhea, Colon cancer.

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