Probiotics: the next savior in oral diseases
Prashanthi Reddy, Rajeev Srivastava

Abstract

The increasing use of functional foods by the public to improve their general health and prevent the incidence of chronic diseases has become a major area of interest within the nutrition community. Bacteria known as probiotics have been added to various foods because of their beneficial effects for human health. The potential application of probiotics for oral health has recently attracted the attention of several teams of researchers. This article summarizes the currently available data on the potential benefits of probiotics for oral health.

Key Words: Probiotics; Oral health; Lactobacillus

The concept of probiotics probably dates back to 1908, when Nobel Prize winner Eli Metchnikoff suggested that the long life of Bulgarian peasants resulted from their consumption of fermented milk products. The term "probiotic" was first used in 1965, by Lilly and Stillwell for describing substances secreted by one organism which stimulate the growth of another. Marteau et al, in 2002 defined them as "microbial preparations or components of microbial cells that have a beneficial effect on health and well-being". (1) WHO has defined probiotics as 'live microorganisms which when administered in adequate amounts confer a health benefit on the host'. (2)

The term probiotics differs from prebiotics which is defined as "a selectively fermented ingredient that allows specific changes, both in the composition and/or activity in the gastrointestinal microflora that confers benefits upon host well-being and health," whereas synergistic combinations of pro and prebiotics are called symbiotic. (3)

Humans live in close association with vast numbers of micro-organisms present on the skin, in the mouth and in the gastro-intestinal tract (GI tract). The greatest concentration of commensal organisms is found in the GI tract, which has more than 400 m$^2$ of surface area. The gut flora is acquired rapidly after birth, remains relatively stable throughout the life and is essential for human homeostasis. When the intestinal microflora is developing, the interactions between this microflora with the host results in evolution of a unique and distinct intestinal immune system. The challenge facing this host mucosal immune system is to discriminate between pathogens and benign organisms by stimulating protective immunity without excessive inflammatory response that may disrupt the integrity of the GI mucosa. (3)

Modulation of the immune system or changed gut permeability as a result of consuming probiotics might eventually become an important primary or adjunctive therapy in some of these disorders. (4)

Lactic acid bacteria are known to have a wide range of effects on the immune system. They may have general immune-enhancing effects, which include augmentation of phagocytic function, i.e., neutrophils, monocytes, macrophages, and natural killer cells. Specific immune responses, both humoral and cellular, can also be enhanced by lactobacilli. Perhaps some of the modulation of the inflammatory response may be more related to regulating or modulating the immune system. (4)

The use of antibiotics, immunosuppressive therapy and irradiation, amongst other means of treatment, may cause alterations in the composition and have effect on the flora. Traditionally, probiotics have been associated with gut health, and most clinical interest has been focused on their use for prevention or treatment of gastrointestinal infections and diseases. However several investigators have also suggested probiotics for oral health purposes.

Action of Probiotics: Several mechanisms have been proposed to explain the action of probiotics:

- The (transient) modulation of the intestinal microflora of the host.
- Capacity to stimulate the nonspecific immunity and modulating the humoral and cellular immune response. They are supported by an increasing number of in vitro and in vivo experiments using conventional and molecular biologic methods.
- These bacteria secrete various antimicrobial substances such as organic acids, hydrogen peroxide and bacteriocins.
- They compete with pathogenic agents for adhesion sites on the mucosa.
• Modifies the surrounding environment by modulating the pH and/or the oxidation-reduction potential, which may compromise the ability of pathogens to become established.(5)

**Probiotics in general health**

1. Prevention and/or reduction of duration and complaints of rotavirus-induced or antibiotic-associated diarrhoea as well as alleviation of complaints due to lactose intolerance.
2. Reduction of the concentration of cancer-promoting enzymes and/or putrefactive (bacterial) metabolites in the gut.
3. Prevention and alleviation of unspecific and irregular complaints of the gastrointestinal tracts in healthy people.
4. Beneficial effects on microbial aberrancies, inflammation and other complaints in connection with: inflammatory diseases of the GI tract, Helicobacter pylori infection or bacterial overgrowth.
5. Normalization of passing stool and stool consistency in subjects suffering from obstipation or an irritable colon.
6. Prevention or alleviation of allergies and atopic diseases in infants.
7. Prevention of respiratory tract infections (common cold, influenza) and other infectious diseases as well as treatment of urogenital infections.(3)

**Probiotics in oral health**

Given the widespread emergence of bacterial resistance to antibiotics, the concept of probiotic therapy has been considered for application in oral health. Dental caries, periodontal disease and halitosis are among the oral disorders that have been targeted. An essential condition for a microorganism to represent a probiotic of interest for oral health is its capacity to adhere to and colonize various surfaces of the oral cavity. The mechanism of adhesion to oral surfaces is an issue of importance for the long term probiotic effect of the microorganisms. The pattern of adhesion of different probiotic strains to oral epithelial cells has been tested as well. Most of the experiments on adhesion have been carried out with strains broadly used as probiotics in dairy products such as yogurt and cheese.(6)

The most commonly used probiotic bacterial strains belong to the genera *Lactobacillus* and *Bifidobacterium.*(7) Both lactobacilli and bifidobacteria can be found in breast milk, suggesting early exposure of the oral cavity to these bacteria. Bifidobacterial species isolated from oral samples include *B. bifidum, B. dentium,* and *B. Longum.*(8)

**Various clinical conditions**

1. Halitosis results from the action of anaerobic bacteria that degrade salivary and food proteins to generate amino acids, which are in turn transformed into volatile sulphur compounds. It

![Diagrammatic representation of possible mechanism of Probiotic Bacteria](https://example.com/diagram.png)

*Diagrammatic representation of possible mechanism of Probiotic Bacteria*(7)
was found that *Streptococcus salivarius* strains appear to be excellent candidates for an oral probiotic, since they are colonizers of oral surfaces and are amongst the numerically predominant members of the microbiota of healthy individuals. They have great potential for the control of halitosis and prevention of a variety of oral bacterial infections.(6) 
It was also found that gargling with a solution containing *Weissella cibaria* was associated with a net reduction in the production of hydrogen sulphide and methanethiol and consequently a reduction in bad breath. However, the few studies published on the role of probiotics in the treatment of halitosis do not entitle any evidence based conclusions.(9)

2. The impact of oral administration of probiotics on dental caries has been studied in several experiments utilizing different test strains. *Lactobacillus rhamnosus* GG and *L. Casei* have proved their potential to hamper growth of oral streptococci. Considering the growing body of evidence about the role of probiotics on caries pathogens, however, it has been suggested that the operative approach in caries treatment might be challenged by probiotic implementation with subsequent less invasive intervention in clinical dentistry. More studies are definitely needed before this goal could be achieved.(10)

3. The main pathogenic organisms associated with periodontitis include *Prevotella gingivalis, Treponema denticola, Tannerella forsythia* etc. Various studies have reported the capacity of lactobacilli to inhibit the growth of periodontal pathogens, including *P. gingivalis, Prevotella intermedia* and *A. actinomyctem comitans*. Together, these observations suggest that lactobacilli residing in the oral cavity could play a role in the oral ecological balance. The beneficial effect of *L. reuteri* against gingivitis was assessed. Probiotic strains included in periodontal dressings at optimal concentrations of $10^8$ CFU ml were shown to diminish periodontal pathogens. Nevertheless, similar to the case with dental caries, however, there is not yet any true evidence on the effect of probiotics on periodontal diseases.(11)

4. A reduction in the prevalence of *C. Albicans* in the elderly after consumption of probiotic cheese containing *L. Rhamnosus* and *Propionibacterium freudenreichii* sp. has been registered which was an interesting observation in a randomized placebo-controlled trial. A concomitant feature of the probiotic activity observed in this study was the diminished risk of hyposalivation and the feeling of dry mouth of the subjects. This could be hypothesised that extending research on yeast infections, with respect to probiotics, and analysing the molecular mechanisms of probiotic activity, might further broaden the field of their potential applications.(8)

**Administering Probiotics:** One of the primary questions that need to be answered is the appropriate means of administering probiotics. Probiotics can currently be administered in the form of sachets or capsules, or can be added to the food supply. Some data show that adequate colonization may be achieved at a lower dose if probiotics are administered in food. More data is needed to firmly establish whether this is true and to establish the exact ratios indicating adequate colonization corresponding to these difficult vehicles of administration for each probiotic organism intended for prophylactic or therapeutic use. It is quite likely we will find that certain foods may be superior vehicles relative to others for disseminating probiotics. It is also possible that not all probiotics will be able to colonize the gastrointestinal tract when administered in food, whereas some strains may actually work best when administered in this fashion. All of these possibilities will require careful documentation. (12)

**Conclusion**

Preliminary data from several recent studies suggest the possible wide-range beneficial effects of probiotics. Potential future uses of probiotics include inflammatory disease control, the treatment and prevention of allergies, cancer prevention, immune stimulation, and a reduction in respiratory disease. Such effects could justify the addition of not one but potentially several probiotics to commonly consumed foods, which could achieve population-wide health benefits.

Altering the composition of the flora with probiotics may indeed change it enough to reduce the production of carcinogenic compounds. The role of the intestinal flora in colon carcinogenesis and other forms of cancer is an important area for study.

Different modes of administering probiotics are currently being investigated, which may ultimately lead to the widespread use of probiotics in functional foods. It is important that such practices be directed by carefully controlled clinical studies.

**Authors Affiliations:** 1. Dr. Prashanthi Reddy, MDS, Senior Lecturer, Oral Medicine, Diagnosis and Radiology, 2. Dr. Rajeev Srivastava, MDS, Professor Prosthodontics, Modern Dental College and Research Centre. Indore, M.P., India.

**References**


Address for Correspondence
Dr. Prashanthi Reddy, MDS,
Senior Lecturer,
Oral Medicine and Radiology
Modern Dental College and Research Centre,
Indore, M.P, India.
Ph: +91.9926430661
E mail: drprashanthireddy@rediffmail.com

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