

Probiotics: Current Knowledge Update

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Abstract

Probiotics are dietary supplements containing potentially beneficial bacteria or yeasts. They are administered in different quantities that allow for colon colonization. These products help in stimulating health promoting flora and also suppressing the pathologic colonization and disease spread. Probiotics are “live microorganisms, which, when administered in adequate amounts, confer a health benefit on the host.” The term “probiotic” was first used in 1965, by Lilly and Stillwell, to describe substances secreted by one organism which stimulates the growth of another. The use of antibiotics, immunosuppressive therapy, and irradiation, among other means of treatment, may cause alterations in the composition and have an effect on the gut flora. Therefore, the introduction of beneficial bacterial species to gastrointestinal tract may be a very attractive option to reestablish the microbial equilibrium and prevent disease. Probiotics are not the same thing as prebiotics – nondigestible food ingredients that selectively stimulate the growth and/or activity of beneficial microorganisms already in people’s colons. When probiotics and prebiotics are mixed together, they form a symbiotic. The use of probiotic plays an important aspect in dentistry too ever since the oral infections occupied the prime space among the other infections effecting the humans. This concept of microbial ecologic change both for medical and dental changes has accumulated a lot of evidence in recent times. However, to date, no substantial literature and use have been postulated.

Key words: Current update, dental, oral health, prebiotics, probiotics

INTRODUCTION

The concept of probiotics is very old and way back in 1908 Metchnikoff suggested that the long life of Bulgarian peasants resulted from their consumption of fermented milk products.^[1] The term “probiotic” was first used in 1965, by Lilly and Stillwell for describing substances secreted by one organism which stimulates the growth of another.^[2] 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.”^[3] The human gut contains ten times more bacteria than cells elsewhere. The enormous biomass consists of over 400 known bacterial species that generate intense metabolic activity and are of key importance for human health. This ecosystem gets disrupted when exposed to toxics in the form of polluted water and food as well as injudicious use of antibiotics.^[1-3] This causes the destruction of beneficial bacteria leaving the resistant ones, pathogenic. Of late, it has been realized by health-care professionals and prompted them to seek alternative therapeutic options. One such alternative is the use of beneficial bacteria, the probiotics, which stimulate health-promoting indigenous flora and reverting back the change.^[1,2,4] Recent experimental studies

and results from randomized controlled trials have shown that certain gut bacteria, in particular species of *Lactobacillus* and *Bifidobacterium*, may exert beneficial effects in the oral cavity by inhibiting cariogenic *Streptococci* and *Candida* sp.^[5] The mechanisms of probiotic action appear to link with colonization resistance and immune modulation. Lactic acid bacteria can produce different antimicrobial components such as organic acids, hydrogen peroxide, carbon peroxide, diacetyl, low molecular weight antimicrobial substances, bacteriocins, and adhesion inhibitors, which also affect oral microflora.^[5]

Here, we also have to know another entity, prebiotics. A prebiotic is a nondigestible food ingredient that beneficially affects the host by selectively stimulating the growth, activity, or both of one or a limited number of bacterial species already resident in the colon.^[6] Although any food ingredient that enters the large intestine is a candidate prebiotic, it

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is the selectivity of the fermentation in the mixed culture environment that is critical. Bifidobacteria are reasonable target organisms for prebiotics. *Bifidobacterium infantis* and *Bifidobacterium breve* are thought to be predominant in infants, whereas *Bifidobacterium adolescentis* and *Bifidobacterium longum* are prevalent in adults.^[7] Prebiotics, unlike probiotics, are not destroyed in the body. They are not affected by heat or bacteria.

The main purpose of this review is to throw some light on the overall benefits of probiotics in general and oral health.

PROPERTIES OF PROBIOTICS

An ideal probiotic preparation should have the following properties:^[8]

1. High cell viability
2. Ability to persist in the intestine even if the probiotics strain cannot colonize the gut
3. Adhesion to the gut epithelium to cancel the flushing effects of peristalsis
4. They should be able to interact or to send signals to the immune cells
5. They should be of human origin
6. Should be nonpathogenic
7. Resistant to processing
8. Must have the capacity to influence local metabolic activity.

For adequate amount of health benefits, a dose of 5 billion colony forming units (CFUs) a day (5×10^9 CFU/day) has been recommended, for at least 5 days.^[8]

USES OF PROBIOTICS

Some of the probiotic effects are (1) prevention and/or reduction of duration and complaints of rotavirus-induced or antibiotic-associated diarrhea as well as alleviation of complaints due to lactose intolerance.^[9] (2) Reduction of the concentration of cancer-promoting enzymes and/or putrefactive (bacterial) metabolites in the gut.^[10] (3) Prevention and alleviation of unspecific and irregular complaints of the gastrointestinal (GI) tracts in healthy people.^[11] (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.^[12] (5) Normalization of passing stool and stool consistency in patients suffering from constipation or an irritable colon.^[13] (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.^[13] Insufficient or at most preliminary evidence exists with respect to cancer prevention, a so-called hypocholesterolemic effect, improvement of the mouth flora, and caries prevention or prevention or therapy of ischemic heart diseases or amelioration of autoimmune diseases (e.g., arthritis) [Table 1].^[14]

PROBIOTICS IN ORAL HEALTH

Most probiotics are in dairy forms that contain high calcium, so possibly reducing demineralization of teeth. It is possible that these act as biofilm to keep pathogens away and occupy a space that might otherwise be occupied by a pathogen. Probiotics should adhere to dental tissues to establish a cariostatic effect and thus should be a part of the biofilm to fight the cariogenic bacteria.^[14] The duration of their stay locally also is important for beneficial effect. Some hypothetical mechanisms are.^[14-16]

- Direct interaction in dental plaque
- Involvement in binding of oral microorganisms to proteins
- Action on plaque formation and on its complex ecosystem by competing and intervening with bacterial attachments.

Lactic acid bacteria are considered detrimental to dental health because they ferment sugars and lower pH of these bacteria. When lactic acid bacteria are consumed in milk products, the buffering capacity of milk influences the acidity. The presence of calcium and other constituents may also protect tooth surfaces and inhibit the adherence of dental pathogens.^[17] Russian scientists have reported that probiotic *Bifidobacterium* sp. reduce gingival and periodontal inflammation.^[18] Probiotic *Lactobacillus reuteri* reduces gingivitis and decreases gum bleeding.^[19] Research has revealed that even after the aggressive process of scaling to clean out the periodontal pockets, the future oral health of the patient is determined by the type of bacteria that colonize first in the base of that clean pocket. If the harmful bacteria are first to colonize, the disease condition will quickly return. If the beneficial bacteria are first, then good oral health will be established, and the dental office procedure will have been successful.^[20] Existing mouthwashes and toothpastes that typically contain an antibacterial agent are able to only affect those areas of the mouth that the rinse is able to directly contact, which limits their effectiveness to contact with plaque above the gum line.^[21] Furthermore, the antibacterial agent is quickly washed from the mouth while the probiotic bacteria have high substantivity, i.e. they have a prolonged duration of contact with disease-susceptible surfaces in the mouth and thus a prolonged beneficial activity. In one recent study, the prevalence of lactobacilli, particularly *Lactobacillus gasseri* and *Lactobacillus fermentum*, in the oral cavity was greater among healthy participants than among patients with chronic periodontitis.^[22] Various studies have reported the capacity of lactobacilli to inhibit the growth of periodontopathogens including *Porphyromonas gingivalis*, *Prevotella intermedia*, and *Aggregatibacter actinomycetemcomitans*. Krasse *et al.* assessed the beneficial effect of *L. reuteri* against gingivitis. After 14 days of ingesting the probiotic incorporated into chewing gum, the oral cavity of patients with a moderate to severe form of gingivitis had been colonized by *L. reuteri* and the plaque index had been reduced.^[23] During the fermentation process in milk, *Lactobacillus helveticus* produces short peptides that act on osteoblasts and increase their activity in bone formation. These bioactive peptides could thereby

Table 1: The use of probiotics in general and oral health

Various probiotics and their uses		
Name	Work	Best used
<i>Lactobacillus</i> species		
<i>L. acidophilus</i>	This bacteria colonizes the small intestine and it maintains the integrity of wall, can boost immune system and maintain vaginal health in females	Good in overall digestion, relief from cramps, and stomach discomfort
<i>L. fermentum</i>	This strain produces superoxide dismutase and glutathione, both powerful antioxidants that help neutralize some of the toxic products made in the gut during digestion	Overall digestion Detoxification
<i>L. plantarum</i>	Produces hydrogen peroxide that helps to neutralize toxic products produced during digestion	Overall digestion Immunity
<i>L. rhamnosus</i>	Best strain for vaginal health, prevents travelers' diarrhea	Vaginal health in women Travelers' diarrhea
<i>L. salivarius</i>	Can grow in less than ideal conditions, found in oral cavity, intestine, vagina	Immune health Oral health
<i>L. paracasei</i>	This strain has a protective role for liver	Liver health
<i>L. gasseri</i>	Vaginal health	Occasional gastric discomfort Vaginal health
<i>L. reuteri</i>	Colonizes oral and intestinal cavity	Oral health Overall digestion
<i>Bifidobacterium</i> species		
<i>B. bifidum</i>	One of the first to colonize intestine of babies prevents growth of unwanted bacteria, breakdown of nutrients	Overall digestion Nutrient absorption
<i>B. longum</i>	Digestive benefits, immune support	Detoxification Immune health
<i>B. infantis</i>	This probiotic strain is the largest population of beneficial bacteria in babies, prevents bloating	Overall digestion Prevents bloating and constipation
<i>Bacillus</i> species		
<i>B. coagulans</i>	<i>B. coagulans</i> , such as other lactic acid-producing bacteria, produces enzymes that assist in the digestion of lactose. It also improves the body's ability to use calcium, phosphorus, and iron, and stimulates both gastric juices and gastric motility	Overall digestion Prevents constipation
Streptococcus species		
<i>S. salivarius</i> K12	This probiotic strain is found in the oral cavity's mucus membranes and is known for its ability to produce BLIS, which inhibit the ability of other undesirable bacteria to grow	Overall oral health Immunity
<i>S. salivarius</i> M18	<i>S. salivarius</i> M18 is also found predominantly in oral mucosa and, like the K12 strain, it also produces BLIS. <i>S. salivarius</i> M18 is most active in specific areas on the gums and teeth. <i>S. salivarius</i> M18 also promotes a healthy inflammatory response in the gums	Healthy gums and teeth

L. acidophilus: *Lactobacillus acidophilus*, *L. fermentum*: *Lactobacillus fermentum*, *L. plantarum*: *Lactobacillus plantarum*, *L. rhamnosus*: *Lactobacillus rhamnosus*, *L. salivarius*: *Lactobacillus salivarius*, *L. paracasei*: *Lactobacillus paracasei*, *L. gasseri*: *Lactobacillus gasseri*, *L. reuteri*: *Lactobacillus reuteri*, *B. bifidum*: *Bifidobacterium bifidum*, *B. longum*: *Bifidobacterium longum*, *B. infantis*: *Bifidobacterium infantis*, *B. coagulans*: *Bacillus coagulans*, *S. salivarius*: *Streptococcus salivarius*, BLIS: Bacteriocin-like inhibitory substances

contribute to reducing the bone resorption associated with periodontitis. Recently, a study evaluated epidemiological data to assess the relationship between periodontal health and the consumption of dairy products such as cheese, milk, and yogurt. The authors found that individuals, particularly nonsmokers, who regularly consumed yogurt or beverages containing lactic acid exhibited lower probing depths and less loss of clinical attachment than individuals who consumed few of these dairy products.^[24]

Probiotics in preventing dental caries have been reported. The well publicized of these efforts is a substitution strategy developed by Hillman.^[25] They have genetically modified a *Streptococcus mutans* organism so that it no longer

produces acid while competing aggressively for the ecologic niche where the wild type *S. mutans* is found. Once this substitute organism is introduced, it entirely displaces the disease-causing wild-type *S. mutans*.^[25] Several studies have talked about the role of *Lactobacillus* reducing the number of *S. mutans* in saliva.^[26,27] One study reported that of 23 bacterial strains used in the dairy industry, *Streptococcus thermophilus* and *Lactobacillus lactis* ssp. *lactis* were the only ones with the capacity to integrate into a biofilm present on a hydroxyapatite surface and to interfere with the development of the cariogenic species *Streptococcus sobrinus*. More recently, it was demonstrated that isolates of *Weissella cibaria* had the capacity to inhibit, both *in vitro* and *in vivo*, biofilm formation by *S. mutans* and to prevent proliferation of this

bacterial strain.^[28] More specifically, it was reported that consumption of yogurt containing *L. reuteri* over a period of 2 weeks reduced the concentration of *S. mutans* in the saliva by up to 80%.^[29]

A natural by-product of *Streptococcus oralis* and *Streptococcus uberis* is a low dose of hydrogen peroxide. As this good bacterium is replenished daily, it creates gradual teeth whitening with the full benefits of long contact times, delivering 24 h/day coverage of balancing and brightening.^[30]

Antibacterial mouthwashes and breath fresheners promote killing up to 99.9% of bacteria and germs in the mouth. These products indiscriminately wipe out both the essential, good bacteria along with the harmful bacteria. *S. oralis* and *S. uberis* are natural antagonists to the malodor-creating bacteria, quickly colonizing to create a healthy balance of microflora and resulting in longer lasting, truly fresher breath.^[31] Kang *et al.* reported the capacity of various strains of *W. cibaria* to inhibit the production of volatile sulfur compounds by *Fusobacterium nucleatum*. They concluded that this beneficial effect resulted from the production of hydrogen peroxide by *W. cibaria*, which inhibited the proliferation of *F. nucleatum*. Another species, *Streptococcus salivarius*, was detected most frequently among people without halitosis and is therefore considered a commensal probiotic of the oral cavity.^[32]

CONCLUSION

Probiotics have been extensively studied for their health-promoting effects. The main field of research has been in the GI tract. However, in the past few years, probiotics have also been investigated in the oral health perspective. Probiotic therapy has already made its way in the treatment of a number of conditions - infectious, inflammatory, neoplastic, and allergic. However, before bringing probiotics into routine usage, proper evaluation of these products is essential. Several important criteria and standards regarding quality and reliability have to be met. Thus, future well-designed placebo controlled studies with validated results are required for ascertaining the true health benefits of these products.

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Conflicts of interest

There are no conflicts of interest.

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