

Probiotics and oral health

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ABSTRACT

Probiotics utilize the naturally occurring bacteria to confer health benefits. Traditionally, probiotics have been associated with gut health, and are being mainly utilized for prevention or treatment of gastrointestinal infections and disease; however, recently, several studies have suggested the use of probiotics for oral health purposes. The aim of this review is to understand the potential mechanism of action of probiotic bacteria in the oral cavity and summarize their observed effects with respect to oral health.

Key words: Bifidobacterium, lactobacillus, probiotics

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INTRODUCTION

Not all the bacteria are harmful to the human body. In fact, some microbes can have beneficial health effects on the host. Such live microbes are termed as probiotics. The term 'probiotic' was derived from the Greek word meaning "for life".^[1] This term was first used in 1965, by Lilly and Stillwell for describing substances secreted by one organism which stimulate the growth of another.^[2] An expert panel commissioned by the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) defined probiotics as "live micro-organisms", which when administered in adequate amounts confer a health benefit on the host. The bacterial genera most commonly used in probiotic preparations are Lactobacillus and Bifidobacterium [Table 1].

Probiotics by definition are the non-digestible food ingredient that confers benefits on the host by selectively stimulating the growth and/activity of one bacterium or a group of bacteria in the colon, and thus improve the host health.^[3] Oligosaccharides in the group of fructo-oligosaccharides and galactosaccharides are the commonly studied probiotics. They escape digestion in the upper gastrointestinal tract so that they can

be released in the lower tract and used by beneficial microorganisms in the colon, mainly bifidobacteria and lactobacilli.

Traditionally, probiotics have been associated with gut health, however, during the last decade, an increasing number of established and proposed health effects of probiotic bacteria have been reported, including enhancement of the adaptive immune response, treatment or prevention of urogenital and respiratory tract infections, and prevention or alleviation of allergies and atopic disease in infants. Recently, their beneficial effects on oral health have been suggested. A few reports have suggested the role of lactobacilli and bifidobacteria in the prevention of oral infectious diseases such as caries and periodontal disease. The aim of this review is to discuss the distribution of probiotic bacteria in the oral cavity, their potential mechanism of action and their observed effects in the oral cavity.

DISTRIBUTION OF PROBIOTIC BACTERIAL STRAINS IN THE ORAL CAVITY

Some probiotic Lactobacillus, Bifidobacterium and Streptococcus strains seem to be able to colonize in the oral cavity during the time that products containing them are in active use. Salivary and gingival crevicular fluid (GCF) samples are often used to evaluate the microbial composition in the oral cavity. Hojo *et al.*, found *L. salivarius*, *L. gasseri*, and *L. fermentum* to be among the most prevalent species in the mouth, but no significant difference in their number was found between groups of healthy patients and patients with periodontitis.^[4]

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Conversely, the study suggested Bifidobacterium to be associated with periodontal health as their composition varied among these study groups. Nearly similar results regarding Lactobacillus were concluded by Koll-klais *et al.*^[5] Lactobacilli are rarely detected in the subgingival sample and they could not be found in any patients with chronic periodontitis. *L. rhamnosus* GG and two different *L. reuteri* strains have been reported to colonize the oral cavity for a short time after their use.

POTENTIAL MECHANISM OF PROBIOTIC EFFECTS IN THE ORAL CAVITY

The general mechanism of action of probiotics can be divided into three main categories-

1. normalization of intestinal microbiota
2. modulation of the immune response and
3. metabolic effect

The mechanism of action of probiotic bacteria in the oral cavity could be analogous to that described in the gut. The bacterial biofilm formation in the oral cavity is considered to be the principal etiological agent in many pathological conditions in the mouth. Once oral biofilm reaches maturity a dynamic interplay between the host and microbial species is established. The inflammatory byproducts, along with bacterial endotoxin and metabolic products are mainly responsible for periodontal destruction. Probiotic therapy could be considered as a means of inhibiting oral biofilm development and reducing the cascade of harmful immune-inflammatory reactions [Figure 1].

Though no *in-vivo* studies have been reported in this area *in-vitro* studies have claimed the antimicrobial role of probiotics. *In-vitro* antimicrobial activity of

lactobacillus species against oral microbial species including *Actinobacillus actinomycetemcomitans* and *Porphyromonas gingivalis* has been studied.^[6] *Actinobacillus actinomycetemcomitans* were the most susceptible species to lactobacilli under the conditions of this experiment. All the four tested strains of lactobacilli, namely *L. rhamnosus* 5.1a, *L. rhamnosus* 5.3a, *L. rhamnosus* 5.5a and *L. rhamnosus* Lc705 were found to inhibit all three periodontal pathogens investigated.

To exert their action in the oral cavity, the probiotic microorganism should be able to resist the oral environmental conditions and defense mechanisms, be able to adhere to saliva-coated surface, colonize and grow in the mouth and to inhibit oral pathogens. So there is a need to develop the probiotic strain and species that can resist oral environmental conditions and can bring their antimicrobial action.

OBSERVED EFFECTS ON PERIODONTAL DISEASE

The initial studies of the use of probiotics for enhancing oral health were for the treatment of periodontal inflammation. *Lactobacillus reuteri* brought about a significant reduction in gingivitis in a study done by Krasse *et al.* The oral administration of tablet containing *L. salivarius* WB21 was found to be able to decrease the periodontal index and pocket probing depth (PD) in smokers specifically. Various means of probiotics' administration and their effect are mentioned in Table 2.

OBSERVED EFFECTS ON CARIES AND CARIES-ASSOCIATED MICROBES

The fact that caries is a bacterially-mediated process

Table 1: Microorganisms used as probiotics

Lactobacillus species	Bifidobacterium species	Streptococcus species	Saccharomyces species	Others
<i>L. acidophilus</i>	<i>B. bifidum</i>	<i>S. thermophilus</i>	<i>S. boulardii</i>	<i>Bacillus cereus</i>
<i>L. casei (rhamnosus)</i>	<i>B. breve</i>	<i>S. salivarius</i>		<i>Escherichia coli</i>
<i>L. fermentum</i>	<i>B. lactis</i>			<i>Enterococcus</i>
<i>L. gasseri</i>	<i>B. longum</i>			<i>Propionibacterium</i>
<i>L. lactis</i>	<i>B. infantis</i>			<i>freudenreichii</i>
<i>L. salivarius</i>	<i>B. adolescentis</i>			
<i>L. reuteri</i>				
<i>L. bulgaricus</i>				

Table 2: Various studies on potential beneficial effects of probiotics on periodontal disease

Study	Strains	Means of administration	Effects
Krasse <i>et al.</i> ^[7]	<i>L. reuteri</i>	Chewing gum	Reduction in gingivitis
Volozhin <i>et al.</i> ^[8]	<i>L. casei</i>	Periodontal dressing	Reduction of periodontal pathogens
Grudianov <i>et al.</i> ^[9]	<i>L. salivarius</i>	Tablets 'Acilact' and 'Bifidumbacterin'	Reduction in signs of gingivitis and periodontitis
Pozharitskaia <i>et al.</i> ^[10]	<i>L. acidophilus</i>	Tablet 'Acilact'	Improvement in clinical parameters and shift in local microbiota towards Gram +ve cocci and lactobacilli
Riccia <i>et al.</i> ^[11]	<i>L. brevis</i>	Lozenges	Amelioration of periodontitis-associated signs and symptoms

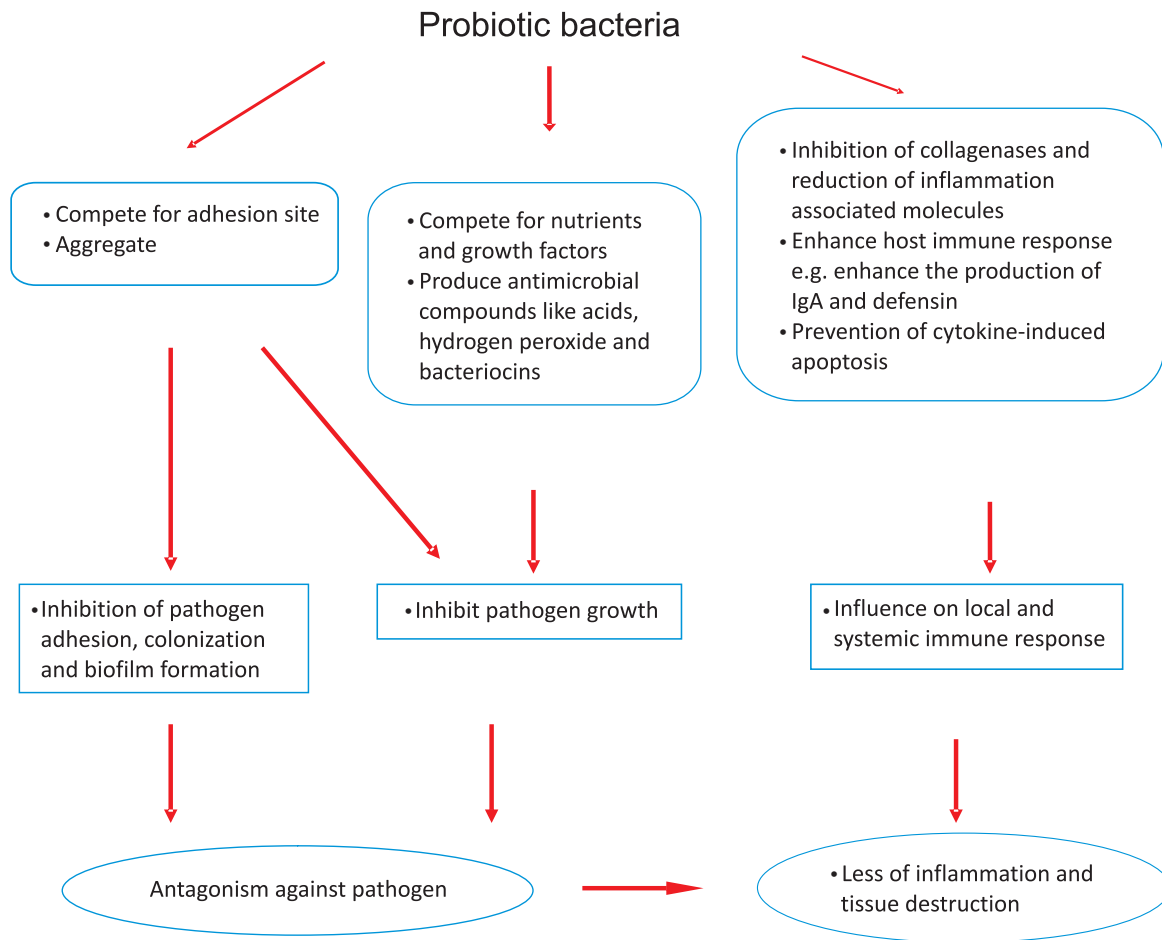


Figure 1: Various mechanism of action of probiotic bacteria

has been known for more than 115 years. Currently, the host, bacteria and nutrients are required for fermenting the product of organic acids and the subsequent demineralization activity. According to this model all the three elements must be present to initiate the disease. To overcome the limitation of traditional caries management strategies, the use of probiotics has been tried to treat caries by preventing oral colonization of cariogenic pathogens. Several studies suggest that consumption of products containing lactobacilli or bifidobacteria could reduce the number of *Streptococcus mutans* in the saliva. In a study by Nase *et al.*,^[12] the administration of dairy products containing *L. rhamnosus* reduced the risk of dental caries and lowered the level of *S. mutans* in patients after seven months of intake of *L. rhamnosus*.

Observed effects on oral candida

Only a few studies have reported about the effect of probiotic bacteria on oral candida infection. In a study by Hatakka *et al.*, consumption of cheese containing *L. rhamnosus* strain GG and LC705 and *Propionibacterium freudenreichii* ssp. *shermanii* JS for 16 weeks, reduced

the number of high oral yeast counts, but no changes in mucosal lesion were observed.

Observed effects on halitosis

In approximately 90% of the cases of halitosis, the cause is confined to the oral cavity. The probiotic strains in the studies for the treatment of both mouth and gut-associated halitosis are *E. coli* Nisle 1917, *S. salivarius* K12, *Weissella confusa* and lactic acid-forming bacterial mixture.

CONCLUSION

Several health-promoting effects of probiotics are well documented, but their effect on oral health is not clear. Scientific evidence is poor in this area and their recommendation for oral health purposes is not yet justified. The main hurdle in this is the development of strains which can resist the oral environmental conditions and can stay there long enough to bring effect. Genetic modification of probiotic strains to suit the oral conditions is thus needed. Systematic studies

and randomized control trials are therefore needed to find out the best probiotic strains and means of administration in different oral health conditions.

REFERENCES

1. Reid G, Jass J, Sebelsky MT, McCormick JK. Potential use of probiotics in clinical practice. *Clin Microbiol Rev* 2003;16:658-72.
2. Lilly DM, Stillwell RH. Growth promoting factors produced by antibiotics. *Science* 1965;147:747-8.
3. Gibson GR, Roberfroid MB. Dietary modulation of the human colonic microbiota: Introducing the concept of prebiotics. *J Nutr* 1995;125:1401-12.
4. Hojo K, Mizoguchi C, Takemoto N, Oshima T, Gomi K, Arai T, *et al.* Distribution of salivary lactobacillus and bifidobacterium species in periodontal health and disease. *Biosci Biotechnol Biochem* 2007;71:152-7.
5. Koll-Klais P, Mandar R, Leibur E, Marcotte H, Hammarstrom L, Mikelsaar M. Oral lactobacilli in chronic periodontitis and periodontal health: Species composition and antimicrobial activity. *Oral Microbiol Immunol* 2005;20:354-61.
6. Stamatova I, Kari K, Vladimirov S, Meurman JH. *In vitro* evaluation of antimicrobial activity of putative probiotic lactobacilli against oral pathogens. *Int J Probiotics* 2008;2:225-32.
7. Krasse P, Carlsson B, Dahl C, Paulsson A, Nilsson A, Sinkiewicz G. Decreased gum bleeding and reduced gingivitis by the probiotic *Lactobacillus reuteri*. *Swed Dent J* 2006;30:55-60.
8. Volozhin AI, Il'in VK, Maksimovskii IuM, Sidorwnko AB, Istranov LP, Tsarev VP, *et al.* Development and use of periodontal dressing of collagen and *Lactobacillus casei* 37 cell suspension in combined treatment of periodontal disease of inflammatory origin. *Stomatologiia (Mosk)* 2004;83:6-8.
9. Grudianov AI, Dimitrieva NA, Fomenko EV. Use of probiotics Bifidumbacterin and Acilact in tablets in therapy of periodontal inflammation. *Stomatologiia (Mosk)* 2002;81:39-43.
10. Pozharitskaia MM, Morozova LV, Melnichuk GM, Mel'nichuk SS. The use of the new bacterial biopreparation Acilact in the combined treatment of periodontitis. *Stomatologiia (Mosk)* 1994;73:17-20.
11. Riccia DN, Bizzini F, Perilli MG, Polimeni A, Trinchieri V, Amicosante G, *et al.* Anti-inflammatory effects of *L. brevis* (DC2) on periodontal disease. *Oral Dis* 2007;13:376-85.
12. Nase L, Hatakka K, Savilahti E, Saxelin M, Pönkä A, Poussa T, *et al.* Effect of long term consumption of a probiotic bacterium, *Lactobacillus rhamnosus* GG, in milk on dental caries and caries risk in children. *Caries Res* 2001;35:412-20.

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