

Probiotics and Periodontal Disease: A Current Update

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ABSTRACT

Probiotics are live micro-organisms that when administered in adequate amounts confer health benefits upon the host. Although a lot of work has been done regarding the effects of probiotic applications on systemic health particularly gastrointestinal, the impact of probiotics on oral health is relatively new with lots of research going on; the area of probiotics and periodontal disease is still in its infancy. The present article summarizes the role of probiotics in periodontal health and disease and its effectiveness in periodontal therapy.

KEYWORDS: *Probiotics, Lactobacillus, Bifidobacterium*

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For several decades now bacteria called Probiotics have been added to some foods because of their beneficial effects for human health. The bacteria in yoghurt and fermented milk products constitute the most important source of probiotics for humans. The vast majority of Probiotic bacteria mostly belong to the genera *Lactobacillus*, *Bifidobacterium*, *Propionibacterium* and *Streptococcus* (1). With continued research going on in this new arena, novel species are likely to be added in the future. So far oral probiotics have been evaluated primarily in the management of dental caries (2). However there seems to be no reason why probiotic therapy might not also be applicable for controlling the periodontal disease. Taking into account the two major treatment strategies for periodontal disease viz, elimination of specific pathogens and suppression of destructive host response, the probiotic approach may add some value in achieving these treatment goals.

Essential requisites for micro-organisms to exert probiotic properties in the oral cavity: Evidences are there which proves that oral cavity is a natural habitat for some probiotic species. Hojo et al (3) have found that *Lactobacillus salivarius*,

Lactobacillus gasseri, *Lactobacillus fermentum* and *Bifidobacterium* are among the most prevalent species in the mouth and their presence may be associated with periodontal health status. Studies have shown that to be able to exert probiotic properties in the oral cavity it is essential for the micro-organisms (4).

- To resist the oral environmental conditions and defense mechanisms
- To adhere to the saliva coated surfaces
- To colonize and grow in the mouth
- To inhibit oral pathogens and
- To be also safe for the host.

How probiotics work with respect to periodontal disease? – Periodontal diseases are classified into two major types – gingivitis and periodontitis. Gingivitis is characterized by inflammation of gingiva, whereas periodontitis is a progressive, destructive disease that affects all supporting tissues of teeth, including the alveolar bone (5). The main pathogenic agents associated with periodontitis are *P. gingivalis*, *Treponema denticola*, *Tannerella forsythia* and *Aggregatibacter actinomycetemcomitans* (5). These bacteria have a variety of virulent characteristics allowing them to colonize the subgingival sites, escape the host

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defense system and cause tissue damage. The treatment strategies conferred by probiotics against periodontal diseases are mainly anticipated to be either by inhibition of specific pathogens or by altering the host immune response through multifactorial factors as summarized in Fig.1 (4).

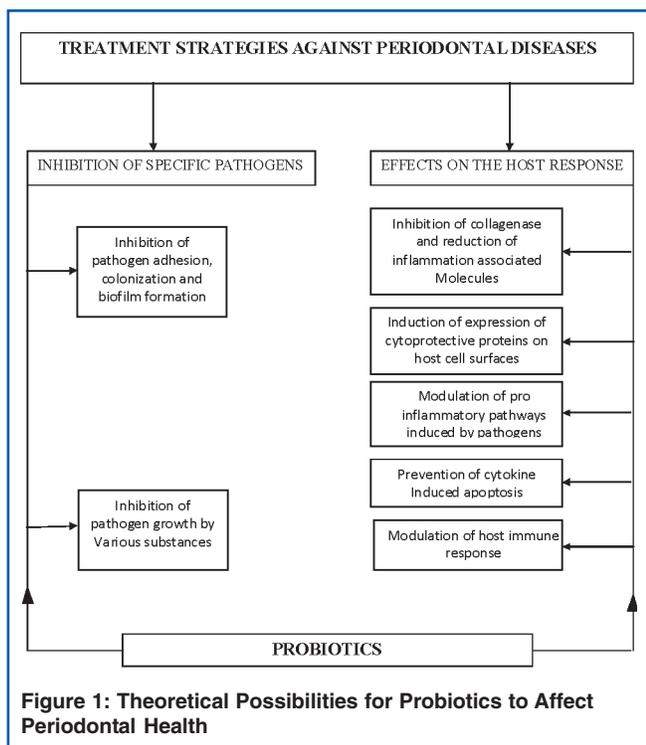
As stated above a probiotic candidate bacterium should be able to adhere to and successfully establish itself in the oral biofilm to exert health effects. The ability of probiotics to adhere to saliva coated surfaces varies among species and it has been reported that *L. rhamnosus* and *Lactobacillus paracasei* strains possess strong binding activity (6). Recently Haukioja et al (7) have shown that probiotic *Lactobacilli* (*L. rhamnosus* GG, *Lactobacillus casei*) may affect the oral ecology by specifically preventing the adherence of other bacteria and by modifying the protein composition of the salivary pellicle. Eventually when a species binds well to structures of the oral biofilm, it could be anticipated that this might affect the pathogenic potential of the species based on antimicrobial activity, which in fact is another evaluation criterion for probiotics. Antimicrobial activity of probiotics has been validated through various in-vitro and in-vivo studies. Sookhee and colleagues (8) isolated 3,790 strains of lactic acid bacteria from 130 individuals and found that the isolates identified as *Lactobacillus paracasei* and *Lactobacillus rhamnosus* had a high capacity to antagonize important oral pathogens, including *Streptococcus mutans* and *Porphyromonas gingivalis*. *Weissella cibaria*, a gram positive facultative anaerobic lactic acid bacterium that has been isolated from humans, is present in fermented foods and is considered a potential probiotic agent (9). *W. cibaria* secretes a significant quantity of hydrogen

peroxide as well as bacteriocin that acts against gram positive bacteria (9, 10). This bacterial species has the capacity to coaggregate with *Fusobacterium nucleatum* and to adhere to epithelial cells. These properties could enable *W. cibaria* to effectively colonize the oral cavity and limit the proliferation of pathogenic bacteria.

The mechanisms by which probiotics modulate host immunity have been broadly studied, but mostly on gastrointestinal structures (11, 12). Probiotic species have shown their ability to alter the balance of pro-inflammatory and anti-inflammatory cytokines, secreted by epithelial cells. Elevated levels of tumour necrosis factor alpha, interleukin-1, interleukin-6 and interleukin-8 are regarded as hallmarks of the inflammatory response in the intestine. The potentially protective role of probiotics in periodontal disease might benefit from adopting methods from studies in the gastro-intestinal tract, however so far there are no studies in this interesting area.

EVIDENCE BASED PROBIOTIC EFFECTIVENESS IN PERIODONTAL DISEASE

Probiotics for periodontal therapy have not been extensively studied. Clinical studies where probiotic species have been investigated specifically from a periodontal disease perspective are sparse. *Lactobacillus reuteri* and *Lactobacillus brevis* are among the species able to affect gingivitis and plaque composition positively as well as being specific markers for periodontal disease (13,14). A significant decrease in gingival bleeding and a reduction in gingivitis were observed after a two week intake of probiotic species. The observed improvements in clinical status may be attributed to the effective colonization of the probiotic bacteria within the oral cavity. The oral administration of a tablet containing *L. salivarius* WB21 was able to decrease the plaque index significantly, and the pocket probing depth markedly, in subjects who were smokers(15). Another finding in this clinical trial was the ability of *L. salivarius* WB21 to successfully reduce the prevalence of periodontal pathogens. This study stresses that a probiotic intervention could be a useful tool for the treatment of inflammation and the clinical symptoms of periodontitis. *L. acidophilus* contained in a tablet named Acilact was first clinically tested by pozharitskaia et al in 1994 (16) and they found improved clinical parameters in periodontitis patients and shifts in local microflora towards gram positive cocci and lactobacilli. Later in the year 2002 Grudianov et al (17) also carried out a clinical study where they obtained a probiotic mix in the tablet forms, viz Acilact and Bifidumbacterin and found normalization of micro flora and reduction of signs of gingivitis and periodontitis. Recently Shimazaki and colleagues(18) used epidemiological data to assess the relationship between periodontal health and the consumption of dairy products such as cheese, milk, and yoghurt. The authors found that individuals, particularly nonsmokers, who regularly consumed yoghurt or beverages containing lactic acid exhibited lower probing depths and less loss of clinical attachment than individuals who



consumed few of these dairy products. By controlling the growth of the pathogens responsible for periodontitis, the lactic acid bacteria present in yoghurt would be in part responsible for the beneficial effects observed. Longitudinal studies are required however to clarify the observed relationship between regular consumption of products containing probiotics and periodontal health.

A particular concern when evaluating probiotic effects on periodontal disease relates to the means of administration of these bacteria. Generally probiotics are delivered in dairy products (mainly fermented milks), as food supplements in tablet forms or in soft drinks. However these routes of administration cannot provide prolonged contact with oral tissues, facilitating probiotic adhesion to saliva coated surfaces. A lozenge form or chewing gum tablet or gum might better serve the needs for periodontal health prophylaxis. Controlled clinical trials and long term studies are required to investigate the concentration of probiotic bacteria in the specific means of administration.

CONCLUSION

Probiotics represent a new area of research in periodontal therapy. The existence of probiotics in the indigenous oral micro flora of humans warrants exploration because these bacteria offer the advantage of being perfectly adapted to the human oral ecosystem. Based on current research data the effects of probiotics on periodontal health and its maintenance are not clear. Preliminary data obtained by various research workers have been encouraging but numerous properly controlled, randomized long term clinical trials will be required to clearly establish the potential of probiotics in preventing and treating periodontal diseases. Much more scientific developments are needed to have a better understanding of these tiny forms of lives in order to broaden their potential applications.

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