

Probiotics and Periodontal Health

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ABSTRACT

Researchers have been keenly investigating the beneficial effects of probiotics on the human health since several decades focusing on the different types of mechanism, such as their ability to compete with pathogenic microorganisms for adhesion, to antagonize these pathogens, or to modulate the host's immune response. This has led to a widespread use of probiotics in the management of systemic infections and disease. And lately, there has been a growing interest in the use of probiotics in the field of dentistry, particularly periodontics. This article reviews the recent data on the role of probiotics for the management of periodontal diseases.

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INTRODUCTION

Microorganisms (pathogenic) are capable of causing disease, but there are some that are actually beneficial to humans. This concept of beneficial microorganisms for health was first put forward by a Ukrainian bacteriologist and Nobel laureate Elie Metchnikoff, who proposed through his research that the Bulgarians had longer longevity due to consumption of fermented milk containing viable bacteria.¹

Almost after around half a century later (1965), the term "probiotics" was coined to reflect Metchnikoff's idea by Lilly and Stillwell stating probiotics as substances produced by microorganisms that promote the growth of other microorganisms.²

The first probiotic species to be introduced in research was *Lactobacillus acidophilus* by Hull et al in 1984, followed by *Bifidobacterium bifidum* by Holcomb et al in 1991.³

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According to the currently adopted definition by the Food and Agriculture Organization/World Health Organization (FAO/WHO), "probiotics are living organisms, principally bacteria that are safe for human consumption and when ingested in sufficient quantities, have beneficial effects on human health, beyond the basic nutrition."⁴

The interest in probiotics and the modulation of the microbiota for restoring and maintaining health have gained a lot of attention over the past decade, and since then probiotics are being deliberately added to commercially available products owing to their beneficial effects for human health.⁵

The vast majority of probiotic bacteria mostly belong to the genera *Lactobacillus*, *Bifidobacterium*, *Propionibacterium*, and *Streptococcus*.⁶

Probiotics Guidelines

- Probiotic organisms must be living
- They must identify the organism(s) to species level
- They must have proven safety data
- They must show physiological benefits when using a defined viable count of probiotics in a defined delivery vehicle (food, capsule, or whatever) in a defined patient population, controlled by a placebo and/or standard therapy option if the end outcome is to treat a disease.

Probiotics Origin and Identity

- The origin of the probiotic strain is not relevant if it confers a health benefit.
- Strains should be speciated using DNA-DNA hybridization or the equivalent molecular method.
- Each strain should have a number or letter designation.

Safety of Probiotics

- Properly tested and prepared probiotic strains are, for the most part, extremely safe for human oral and extraoral use.
- New strains and products wishing to be designated as probiotics should be proven in human studies to be safe.
- Clear labeling is recommended when a strain, for example, *S. boulardii* (*S. cerevisiae*), has some limitations in its use, such as for patients with a leaky gut or at risk of bloodborne infection.

Probiotics Efficacy and Effectiveness

- Carefully designed, and sized, placebo-controlled, statistically significant human efficacy or effectiveness studies are required to prove that probiotic strains in their product formulation confer specific disease reduction or clinical treatment benefits.
- Regulatory agencies need to develop new criteria that allow food and dietary supplement products to make health claims that are informative and useful for consumers and that can be substantiated by appropriately designed and completed clinical studies.⁷

Probiotics may also help in combatting the problems associated with rapidly increasing resistance to antibiotics. And hence new concepts have made way for application of probiotics in medicine and dentistry.⁸⁻¹⁰

PROBIOTICS IN SYSTEMIC HEALTH

Probiotics have proven to be effective in the treatment of several systemic and infectious diseases, such as Crohn's disease, cancer, hyperlipidemia, immunodepressive states, acute diarrhea, inadequate lactase digestion, liver diseases, infections with *Helicobacter pylori*, and genitourinary tract infections.¹¹

PROBIOTICS IN ORAL CAVITY

Dental caries, periodontal disease, and halitosis are among the major areas of concern in dentistry.

About more than 700 species of oral microbiota have been identified in the human mouth and the resident microbiota of one individual may consist around 30 to 100 species.¹²

PROBIOTICS AND PERIODONTAL DISEASE

Periodontitis describes a group of related inflammatory diseases resulting in the destruction of the tissues that support the tooth. The main pathogenic agents associated with periodontitis are *Porphyromonas gingivalis*, *Treponema denticola*, *Tannerella forsythia*, and *Aggregatibacter actinomycetemcomitans*. These bacteria have a variety of virulent characteristics allowing them to colonize the subgingival sites, escape the host defence system, and cause tissue damage.

For the microorganisms to exert their probiotic properties in the oral cavity, they have to

- Resist the oral environmental conditions and defense mechanisms
- Adhere to the saliva-coated surfaces
- Colonize and grow in the mouth
- Inhibit oral pathogens
- Be safe for the host.¹³

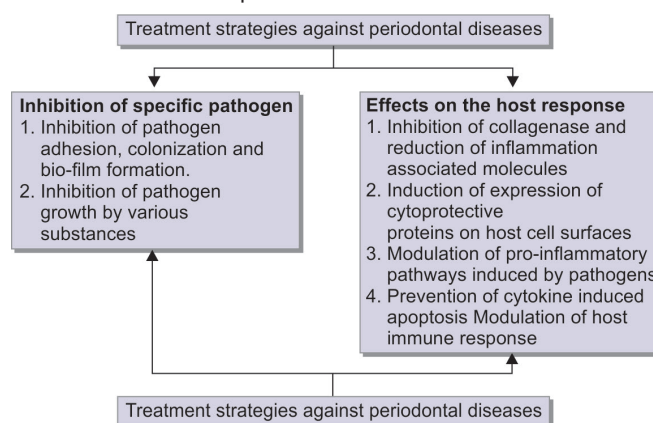
Currently, the etiology of periodontitis is based on the concept of three major factors: a susceptible host,

the presence of pathogenic species, and the absence of so-called beneficial bacteria.¹⁴

Considering the two major treatment strategies for periodontal disease, i.e., elimination of specific pathogens and suppression of destructive host response, the probiotic approach may enhance the chances of these treatment goals (Flow Chart 1).

MECHANISM OF ACTION OF PROBIOTICS

Flow Chart 1: Theoretical possibilities for probiotics to affect periodontal health¹⁵



EFFECT OF PROBIOTICS IN PERIODONTAL DISEASE

Currently, only a few clinical studies have evaluated the efficacy of probiotic species in the management of periodontal disease.

The primary etiological factors for the development of periodontal disease are bacteria in supra- and subgingival biofilm. Probiotics lower the pH so that plaque bacteria cannot form dental plaque and calculus that cause the periodontal disease. They make an excellent maintenance product because they produce antioxidants. Antioxidants prevent plaque formation by neutralizing the free electrons that are needed for the mineral formation.¹⁶

Shimauchi et al reported significant decrease in plaque index and pocket depth in smokers after the oral administration of a tablet containing *Lactobacillus salivarius* WB21 and also recorded marked reduction in salivary lactoferrin at the end of an 8-week trial.¹⁷

Grudianov et al also carried out a clinical study using a probiotic mix of Acilact and Bifidumbacterin in tablet forms and found that there was normalization of micro-flora and reduction in signs of gingivitis and periodontitis.¹⁸

Krasse et al assessed the effect of the probiotic *L. reuteri* against gingivitis, which was incorporated into chewing gum, and it was noticed after 14 days of ingestion that moderate to severe form of gingivitis had been colonized by *L. reuteri*, and the plaque index had reduced.¹⁹

A study conducted by Riccia et al showed a significant reduction in salivary levels of PGE2 and MMPs and improvement in gingival index on assessing the beneficial anti-inflammatory effects of *L. brevis* on a group of patients with chronic periodontitis.²⁰

In a guided pocket recolonization approach performed by Teughels et al, subgingival application of a mixture including *Streptococcus sanguis*, *S. salivarius*, and *S. mitis* after scaling and root planing significantly suppressed the re-colonization of *P. gingivalis* and *P. intermedia*.²¹

Twetman et al studied the short-term effect of probiotic-containing chewing gum on the gingival inflammation and the levels of selected inflammatory mediators in gingival crevicular fluid (GCF) and found that GCF volume and the levels of TNF and IL-8 decreased significantly in the probiotic group.²²

PROBIOTIC PRODUCTS

Probiotics in the form of tablets, lozenges, chewing gums, or tooth pastes that are currently available are discussed in the following sections.

Gum PerioBalance (marketed by Sunstar, Etoy, Switzerland)

It is a lozenge with patented combination of two strains of *L. reuteri*, resulting in synergistic properties of fighting against cariogenic bacteria and periodontal pathogens.

One dose of lozenge = 2×10^8 living cells of *L. reuteri*. One lozenge every day should be consumed, after brushing the teeth, to allow the probiotics to spread throughout the oral cavity and to attach to the various dental surfaces.²³

Peribiotic (Designs for Health, Inc.)

It is an all-natural, fluoride-free toothpaste containing Dental-Lac, a functional *Lactobacillus paracasei* probiotics.²³

Bifidumbacterin, Acilact, Vitanar (marketed by Alfarm Ltd., Moscow, Russia)

It is a tablet with a complex combination of five live lyophilized lactic acid bacteria, to be dissolved in the mouth (two tablets), after routine mechanical debridement, three times a day for 20 to 30 days; it has been claimed that it improves both clinical and microbiologic parameters in gingivitis and mild periodontitis.¹⁸

Wakamate D (Wakamoto Pharmaceutical Co., Tokyo, Japan)

It is a single tablet that contains 6.5×10^8 colony-forming units (CFU) per tablet of *L. salivarius*.

WB21 and xylitol (280 mg/tablet) was originally prepared to contribute for the intestinal microbial balance by providing acid tolerant *L. salivarius* WB21.¹⁷

Prodentis (BioGaia, Stockholm, Sweden)

A probiotic lozenge contains a blend of two *L. reuteri* strains containing a minimum of 1×10^8 CFU for each of the strains DSM 17938 and ATCC PTA 5289.²⁴

Yakult

Staab et al showed that the probiotic *L. casei* strain Shirota was associated with reduction in elastase activity and matrix metalloproteinases-3 (MMP-3).²⁵

EFFECTS OF PROBIOTICS IN HALITOSIS

Halitosis or oral malodour refers to the foul and unpleasant odor volatile sulfur compounds (VSC) emanating from the oral cavity. The bacteria responsible for VSC production are *Fusobacterium nucleatum*, *Porphyromonas gingivalis*, *Prevotella intermedia*, and *Treponema denticola*.²⁶

Kang et al reported that a probiotics strain *Weissella cibaria* inhibited VSC production under both *in vitro* and *in vivo* conditions most probably due to its ability to co-aggregate with VSC-producing species like *F. nucleatum*, thus reducing the source for malodorous compounds in the oral cavity and also by producing hydrogen peroxide, which inhibits *F. nucleatum*.²⁷

Burton et al showed that lozenges and gum containing *S. salivarius* decrease VSC by producing bacteriocins, which inhibit bacteria-producing VSC.²⁸

SAFETY ASPECTS OF PROBIOTICS

Increased consumption of probiotic inevitably leads to increased concentrations of these species in the host organism, resulting in rare cases of probiotics-related bacteremia, lactobacillus endocarditis, and liver: Abscess secondary to *L. rhamnosus*.²⁹

CONCLUSION

Probiotics play an imperative role in combating concerns with overuse of antibiotics and antimicrobial resistance. Clinical trials should be directed to assess the method of probiotic administration in the oral cavity and dosages for different therapeutic uses. Further research should take place in the field of the use of probiotic bone grafts as well as periodontal surgical procedures.

Numerous randomized clinical studies are required to clearly establish the potential of probiotics in preventing and treating oral infections. And with further substantial growth, probiotics may have an important role to play in the near future within the periodontal arena.

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