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The Role of Probiotics and Prebiotics in Periodontal Health: A Literature Review

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Abstract | **Review Article**

This review thoughtfully consolidates the current evidence regarding the efficacy of probiotics and prebiotics in the prevention and treatment of periodontal diseases. It is observed that, as an adjunct to scaling and root planing (SRP), specific probiotic strains, particularly *Lactobacillus reuteri*, present moderate-certainty evidence for enhancing probing depth (PPD), clinical attachment level (CAL), and bleeding on probing (BOP). While the evidence for the prevention of gingivitis is less robust, it is worth noting that data on prebiotics appear promising, although they remain somewhat limited.

Keywords: Probiotics, Periodontal Diseases, Scaling and Root Planing (SRP), *Lactobacillus reuteri*, Prebiotics.

BACKGROUND

Periodontal health is defined by the absence of inflammatory periodontal disease, with clinical indicators including minimal bleeding on probing (BOP), no signs of inflammation, and no loss of periodontal tissue support [1]. Gingivitis, a reversible inflammatory condition localized to the gingiva, results from the accumulation of microbial biofilms [2]. If not addressed, gingivitis may progress to periodontitis, an irreversible condition marked by the progressive destruction of the tooth-supporting structures, including the periodontal ligament and alveolar bone, leading to clinical attachment loss (CAL) and the deepening of periodontal pockets[3]. Management strategies range from prevention through effective oral hygiene to both non-surgical and surgical interventions, with scaling and root planing (SRP) recognized as the gold standard for non-surgical treatment [4].

Evidence on Probiotics

Probiotics as Adjunct to SRP in Chronic Periodontitis

The application of probiotics as an adjunct to scaling and root planing (SRP) has been the most thoroughly investigated. A network meta-analysis conducted by de Mendonça et al. in 2025, which included 33 randomized controlled trials (RCTs), demonstrated that the combination of professional mechanical plaque removal (PMPR) with probiotics was more effective in enhancing PPD) and CAL than PMPR alone [5]. The analysis identified Lactobacillus species, particularly L. reuteri, as the most efficacious probiotic intervention for improving PPD, CAL, and bleeding on probing (BOP) in both short-term (≤3 months) and long-term (>3 months) follow-ups [5].

Similarly, a 2025 meta-analysis by Benavides-Reyes *et al.,* encompassing 24 studies, reported that the adjunctive use of probiotics in patients with periodontitis resulted in significant reductions in Plaque Index (PI) (Standardized Mean Difference [SMD] = -0.35) and BOP (SMD = -0.32) [4]. Although the overall reduction in PPD was not statistically significant in their primary analysis, it achieved significance in studies with shorter follow-up durations[6]. However, the authors assessed the overall certainty of this evidence as low, attributing this to a high risk of bias across the included studies[6].

Key RCTs provide strain-specific insights:

- ***Lactobacillus reuteri* (DSM 17938 & ATCC PTA 5289):**

  A systematic review conducted in 2023, which examined nine randomized controlled trials (RCTs) concerning L. reuteri, affirmed its clinical efficacy as an adjunctive treatment to scaling and root planing (SRP). The review demonstrated significant improvements in all clinical parameters over time[7]. Lozenges containing these strains have been shown to yield statistically significant

reductions in PPD and gains in CAL when compared to SRP alone.

- ***Bifidobacterium animalis* subsp. *lactis* HN019:**

  An influential randomized controlled trial conducted by Invernici *et al.,* in 2018 demonstrated that the use of lozenges containing this strain, as an adjunct to SRP for a duration of 30 days, resulted in significantly greater reductions in probing depth PPD and gains in CAL at 90 days when compared to a placebo group[8]. Additionally, the probiotic group exhibited a significant reduction in red and orange complex pathogens and a favorable immunomodulatory effect, characterized by increased levels of the anti-inflammatory cytokine IL-10 and decreased levels of the pro-inflammatory cytokines IL-1β and IL-8 [8].

- ***Lactobacillus plantarum*:**

  Research on various strains of L. plantarum has demonstrated potential, with certain strains showing improvements in clinical parameters and a reduction in key pathogens[9].

Probiotics for Gingivitis and Periodontal Health (Prevention)

Evidence supporting the use of probiotics in the management of gingivitis or the maintenance of periodontal health in healthy individuals is not particularly robust. The meta-analysis conducted by Benavides-Reyes et al. reported only non-significant improvements in PI and BOP in studies on gingivitis[6]. Similarly, a 2020 systematic review by Akram et al. concluded that there is weak evidence to support the use of probiotics for reducing inflammatory parameters in gingivitis[10]. Although some studies indicate potential benefits, the overall evidence is characterized by low certainty, and the clinical significance of the observed changes is often minimal.

Evidence on Prebiotics

- Prebiotics are substrates that are selectively utilized by host microorganisms, thereby conferring a health benefit. In the context of the oral cavity, research has concentrated on substances capable of modulating biofilm ecology to promote health-associated species.
- Arginine: This amino acid is metabolized by certain commensal oral bacteria, such as Streptococcus sanguinis, through the arginine deiminase system, resulting in the production of ammonia. This metabolic process aids in neutralizing plaque acids, thereby creating an environment that is less conducive to aciduric, cariogenic bacteria and potentially some periodontopathogens[11]. Although most of the research has been directed towards caries prevention, the concept of altering biofilm ecology to favor a healthier state is also pertinent to periodontal health. Some studies have investigated its use in conjunction with probiotics[12].
- Xylitol: This sugar alcohol is non-fermentable by most oral bacteria, including periodontal pathogens. Its primary mechanism involves the reduction of plaque accumulation and the inhibition of pathogenic bacterial growth. While it has been extensively studied for caries prevention, its direct impact on periodontal parameters remains less clear, although it is frequently included in oral hygiene products that may indirectly benefit gingival health[13].

Synbiotics

Synbiotics are formulations that consist of live microorganisms and substrate(s) selectively utilized by host microorganisms, which confer health benefits to the host. A review conducted by Twetman *et al.,* in 2025 indicated that, for adults with periodontitis, the adjunctive use of synbiotic products appeared to enhance the outcomes of conventional SRP[14]. A 2023 trial that combined prebiotic arginine with two probiotic strains in a lozenge demonstrated potential for caries prevention. Although direct evidence is limited, the ecological principle underlying this approach could be extended to periodontal health[12].

The beneficial effects of probiotics

The beneficial effects of probiotics in the periodontal context are multifactorial:

1. **Biofilm Modulation:** Probiotics have the capacity to competitively inhibit the adhesion and proliferation of periodontal pathogens such as Porphyromonas gingivalis and Tannerella forsythia[8].
2. **Production of Antimicrobials:** Certain probiotic strains are known to produce bacteriocins and hydrogen peroxide, which exhibit direct antimicrobial activity against pathogens[9].
3. **Immunomodulation:** Probiotics are capable of modulating the host immune response. Empirical studies have demonstrated a reduction in pro-inflammatory cytokines (e.g., IL-1β, TNF-α, IL-8) and an increase in anti-inflammatory cytokines (e.g., IL-10) in the gingival crevicular fluid following probiotic administration[8].
4. **Ecological Shift:** Prebiotics, such as arginine, can facilitate the growth of beneficial arginolytic bacteria, thereby increasing the local pH and creating an environment less conducive to dysbiotic communities[11].

Safety and Practical Considerations

Probiotics are generally regarded as safe for the general population, with adverse events in clinical trials being infrequent and typically mild, such as minor gastrointestinal disturbances[15]. Nevertheless, caution is advised for severely immunocompromised or critically ill patients, as rare instances of bacteremia or fungemia have been documented. The efficacy of probiotics is

highly strain-specific, and findings from one strain cannot be generalized to others. Lozenges and tablets, which extend contact time in the oral cavity, are the most extensively studied delivery forms. Dosing typically ranges from 1x10^8 to 1x10^10 colony-forming units (CFU), administered once or twice daily for durations of 30 to 90 days, usually commencing immediately after SRP.

Limitations of the Evidence

The primary limitation is the considerable heterogeneity among studies concerning probiotic strains, dosage, delivery format, duration of use, and follow-up periods. Numerous studies exhibit a high risk of bias, resulting in low-to-moderate certainty in the evidence for many outcomes[6]. Additionally, publication bias may be present. The long-term durability of the clinical and microbiological effects following the cessation of probiotic use remains inadequately established.

CONCLUSIONS

There is evidence of moderate certainty indicating that specific probiotics, notably Lactobacillus reuteri (DSM 17938 & ATCC PTA 5289) and Bifidobacterium lactis HN019, when used as an adjunct to SRP, confer additional clinical and microbiological benefits in the treatment of periodontitis. The evidence supporting the use of probiotics for managing gingivitis is of low certainty. The evidence concerning the application of prebiotics and synbiotics in periodontal therapy is currently of very low certainty, yet it represents a promising avenue for future research.

For Clinicians

The optimal approach involves the adjunctive use of probiotics in conjunction with SRP for patients with periodontitis. The strains Lactobacillus reuteri (DSM 17938 & ATCC PTA 5289) and Bifidobacterium lactis HN019 demonstrate the most robust evidence of efficacy. This intervention is particularly applicable to generally healthy adults suffering from chronic periodontitis. It is recommended to initiate probiotic lozenges or tablets (administered 1-2 times per day) immediately following the completion of SRP, continuing for a duration of at least 30 to 90 days. In conclusion, while probiotics can serve as a beneficial adjunct to enhance clinical outcomes such as PPD), CAL, and BOP, they should not be considered a substitute for mechanical debridement.

For Researchers

- **Identified Research Gaps**: There is a need for direct comparative randomized controlled trials (RCTs) evaluating various strains and delivery systems.
- **Durability**: Longitudinal studies exceeding one year are necessary to evaluate the persistence of benefits following the discontinuation of probiotics.
- **Mechanisms**: Additional research employing multi-omics methodologies is required to elucidate the specific microbiological and immunological mechanisms involved.
- **Standardization**: The development of standardized intervention protocols and outcome reporting, including core outcome sets, is crucial.
- **Special Populations**: Research focusing on specific subgroups, such as smokers, individuals with diabetes, and those with peri-implant diseases, is warranted.

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