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Probiotics in Periodontal therapy: A Narrative Review

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ABSTRACT: Probiotic micro-organisms commonly used to bolster gut health, might also have benefits for dental health. Probiotics (PBs) are associated with reducing cariogenic pathogens and protecting against periodontal diseases, although their mechanism of action is not clearly understood. PBs aim to improve oral health, focusing on issues such as cavities, periodontitis , halitosis, mucositis and peri-implantitis. Although probiotic micro-organisms have been found to haven proven therapeutic benefits, their application in dental health is not solidly backed by evidence as yet. Further research is necessary to thoroughly understand the long term effects of probiotic bacteria in the oral environment including their ability to colonize and form biofilms. This article will highlight the various PBs available , the mechanism of action and its uses in clinical dental practice.

1. INTRODUCTION

Probiotics have come to be seen as essential and integral parts of modern methods of preventive care as well as treatment of oral health conditions. Probiotics serve as powerful agents against oral health problems and are defined by the World Health Organization as live microorganisms, which when taken in adequate amounts can offer health benefits to the host. Their use poses great promise as an adjunct or alternative strategy to traditional management of periodontal disease. The use of probiotics traces back to so many cultures where consumption of fermented foods containing beneficial bacteria was a common practice. The scientific interest in probiotics was so much enhanced by Ilya Metchnikoff, a Nobel laureate of Pasteur Institute in Paris who suggested that substituting harmful microbes with useful ones can extend one's lifespan. His pioneering ideas established the conceptual basis for probiotics as we know today.

'Probiotic' is a term that was first introduced by Lilly and Stillwell in 1965 to refer to substances from microorganisms which promote the growth of other beneficial microorganisms: a shift towards cultivation rather than destruction. At present, probiotics are utilized in almost every field of health care, with an emphasis on supporting the oral microbiome and preventing or treating oral pathological conditions.

Key terminologies

A detailed comprehension of the probiotic environment involves understanding related terms such as prebiotics.

Prebiotics are particular dietary constituents that with the help of useful microbes are fermented in the mouth and hence stimulate beneficial outcomes and growth. Notably, prebiotic foods comprise garlic, onions, bananas, asparagus, and whole grains such as oats and barley. These compounds serve as sustenance for existing probiotic bacteria aiding in the restoration of oral health.

Postbiotics: Also known as biogenics or metabiotics, postbiotics are non-living bacteria or bacterial byproducts that can provoke an immune response. They confer similar advantages as live probiotics but in a more stable and safe form for individuals that are more susceptible to infections or injuries.

Synbiotics: Synbiotics are mixtures of prebiotics and probiotics that aim to work together in promoting the positive bacteria's survival and colonization in the individual. The prebiotic part of the combination enhances the activity of probiotics, which leads to restoration of oral health and has a profound impact on human health.

2. MATERIALS AND METHODS

Mechanism of action in oral health:

The human body harbors trillions of microorganisms that colonize diverse anatomical sites such as the skin, gastrointestinal tract, vagina, and oral cavity. The ratio of human cells to microbial cells is approximately 1:10, underscoring the vast influence of the microbiome on health and disease. The oral cavity alone comprises niches like the tongue, hard and soft palate, gingival sulcus, teeth, and tonsils, making it one of the most densely populated microbial habitats (Gao et al.,2018). The stability of the oral microbiome is crucial for health. Disruption of this balance, or dysbiosis, often results in conditions such as gingivitis, periodontitis, and dental caries (Wang et al.,2013; Abebe et al.,2021). Key influencing factors include diet, oral hygiene practices, smoking, systemic health, and medications.

Probiotics contribute to oral health through several mechanisms:

1. Competitive Exclusion: Probiotic bacteria can outcompete pathogenic species for adhesion sites on the tooth surface and oral tissues.
2. Antimicrobial Production: Many probiotics synthesize bacteriocins and other inhibitory substances that suppress the growth of pathogens like Porphyromonas gingivalis and Aggregatibacter actinomycetemcomitans.
3. Biofilm Modulation: Probiotics disrupt pathogenic biofilm formation and promote the development of a beneficial biofilm.
4. Immunomodulation: By influencing cytokine profiles, probiotics can attenuate inflammation and enhance host defense mechanisms.
5. Barrier Reinforcement: Certain strains promote epithelial barrier integrity and stimulate the production of protective proteins, enhancing resistance to microbial invasion.

Although Lactobacillus species are not commonly found in the gingival crevice, they have been effective in delivering antibodies against specific periodontal pathogens, indicating their therapeutic versatility. The ability of probiotics to function within biofilms and alter microbial ecology, positions them as ideal candidates for periodontal therapy. Probiotics help in maintaining oral homeostasis by synthesizing cytpprotective proteins, antioxidant products and regulatory metabolites on the surface of oral cells (Chugh et al.,2020).

3. DISCUSSION

The oral-gut microbiome axis

The gastrointestinal (GI) tract is a continuous mucosal surface extending from the mouth to the anus, and a significant level of microbial continuity exists along this axis. Though the mouth and gut are separated by several anatomical and biochemical barriers—including saliva, lysozymes, low gastric pH, pepsin, bile salts, and epithelial layers—microbial migration from the oral cavity to the gut can occur, especially when these barriers are compromised. There are two primary routes for this migration: 1. Haematogenous Route: Pathogens can enter the bloodstream through oral wounds or inflamed periodontal tissues and reach the gut or other organs.

2. Enteral Route: Oral bacteria may be swallowed and survive the acidic stomach environment, especially in individuals with low gastric acid or mucosal barrier dysfunction.

Once in the gut, oral microbes may interact with resident gut microbiota. While some transient bacteria are eliminated, others may establish themselves, altering gut microbial ecology. The gut microbiome is essential for preserving immune homeostasis as well as production of antimicrobial peptides and prevention of pathogen colonization (Park et al.,2021). Perturbations in this balance are associated with systemic conditions such as inflammatory bowel disease, cardiovasculardisease, and diabetes, which in turn, have bidirectional relationships with periodontal disease.

This oral-gut axis highlights the far-reaching impact of oral dysbiosis and further strengthens the case for probiotic therapy designed to target both oral and gut health simultaneously.

Need for probiotics in periodontal therapy:

Periodontitis is a chronic inflammatory disease that entails destruction of the periodontal ligament and the alveolar bone caused by microbial colonization wherein the host immune response may play a key role in its progression. Traditional therapy consists of surgical scaling and root planing (SRP) followed by systemic or local antibiotics. However, there exists a few drawbacks of conventional therapy such as:

- Bacterial re-colonization may occur within a few months.

- The frequent use of antibiotics has led to the development of resistant strains which are more difficult to treat.

- Mechanical therapy does not modulate the host immune response or the virulence of the microbes.

Clinical studies have shown probiotics to improve key periodontal parameters such as probing depth, clinical attachment level, and bleeding on probing. They help reestablish a balanced oral microbiota and mitigate inflammation (Baddouri and Hannig.,2024). Multiple delivery methods have been explored such as:

-Lozenges and Chewing Gums: Facilitate prolonged contact with oral tissues.

-Mouthwashes: Provide direct delivery to periodontal pockets.

-Toothpastes and Supplements: Support daily maintenance and systemic benefits.

Recent studies have shown promising results regarding the use of probiotics for the prevention and treatment of dental diseases. Krasse et al. demonstrated that Lactobacillus reuteri improved gingival health and reduced inflammation (Krasse et al.,2005). A study by Hillman et al found that probiotic administration reduced A. actinomycetemcomitans in animal models (Hillman and Shivers.,1988). Matsuoka and colleagues observed decreased P. gingivalis levels and reduced bleeding on probing in periodontitis patients (Matsuoka et al.,2006). A study involving Acilact, a lyophilized probiotic, showed significant clinical and microbial improvements in patients with gingivitis and mild periodontitis (Pozharitskaia et al.,1994). Probiotics have also shown efficacy in managing halitosis. Lactobacillus acidophilus and L. casei inhibit anaerobic bacteria responsible for the production of volatile sulfur compounds (VSCs) that cause halitosis (Shimazaki et al.,2008). Streptococcus salivarius, a commensal oral bacterium (Kazor et al.,2003), produces bacteriocins that neutralize VSC-producing microbes, enhancing oral freshness (Hyink et al.,2007).

Evidence from systematic reviews:

Numerous meta-analyses and systematic reviews underscore the promise of probiotics in periodontal therapy. Gheisary et al. concluded that probiotic supplementation leads to significant reduction in periodontal pathogens and pro-inflammatory cytokines (Gheisary et al.,2022). Ausenda et al. highlighted the clinical improvements when probiotics were used adjunctively with non-surgical periodontal therapy, emphasizing the importance of strain selection, dosage, and delivery method (Ausenda et al.,2023). Li et al. found better clinical outcomes in chronic periodontitis patients receiving probiotic therapy compared to controls (Li et al.,2023)]. However, the European Federation of Periodontology currently does not recommend probiotics as standard adjunctive therapy, citing insufficient long-term evidence (Sanz et al.,2020). More randomized controlled trials with larger sample sizes and standardized protocols are necessary to draw definitive conclusions.

4. CONCLUSION:

Probiotics represent a compelling addition to the periodontal therapeutic arsenal, offering anti-inflammatory, antimicrobial, and host-modulating effects. The reduction of pathogen colonization, improvement of clinical outcomes as well as the promotion of a balanced microbiome indicates the beneficial role of adjunctive probiotic therapy. However, probiotics need more validation to be fully integrated into standard practice. There is a need for longitudinal research with representative samples, defined dosage, and comprehensive safety assessment. At the same time, progressive development in the field of microbiome sequencing and individualized medicine could customize probiotic treatment for specific microbial profiles. With the right conditions, probiotics could transform periodontal treatment from focusing on eliminating pathogens to fostering balance and restoring health.

AUTHOR CONTRIBUTIONS

Deepak Moses Ravindran: Conceptualization, Writing—Review & Editing.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ETHICS STATEMENT

Ethical approval was not required for this study.

DATA AVAILABILITY STATEMENT

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

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