A Proactive Approach: Probiotics and Periodontal Wellness

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Abstract

Periodontitis, a frequently encountered chronic inflammatory condition, is thought to result from bacterial activity primarily and has been associated with various other bacterial ailments. The contemporary approach to managing periodontal disease has increasingly focused on the utilization of antibiotics and antimicrobial agents. Nevertheless, the rise of antibiotic resistance has sparked a heightened curiosity in exploring the potential advantages of probiotics as a means of periodontal care. Probiotics entail harnessing the beneficial bacteria inherent in healthy oral environments to safeguard against detrimental pathogens that may jeopardize dental and gum health. Although probiotics have traditionally been associated with improving gut health, recent research has shown that they can also effectively promote oral health. This review aims to explore the ways in which probiotics can positively impact the oral cavity and contribute to the maintenance of dental and periodontal health.

Introduction:

Bacteria have long been associated with diseases, causing significant distress to humanity. However, the concept of using microorganisms for health benefits holds a certain appeal. As antibiotic-resistant strains continue to increase, there is a growing need to investigate alternative approaches for treating infectious diseases.[1] In recent years, a notable change in how infections are treated has occurred. Instead of relying on broad-spectrum methods, healthcare professionals are increasingly turning to targeted and specific approaches. One such approach is the use of probiotics, which originated in the early 20th century when Ukrainian bacteriologist Elie Metchnikoff discovered the beneficial effects of bacteria found in fermented products.[2] While antibiotics are designed to kill harmful bacteria, probiotics work by replenishing the body with beneficial bacteria to help combat infections.[3] Specifically, when taken orally, probiotics can enhance oral health by reducing the presence of harmful microbiota and modulating mucosal immunity in the oral cavity, thus preventing infections while preserving the balance of healthy bacteria.

Mechanism of Action:

In the context of treating periodontal disorders, two primary techniques are considered: targeting specific bacteria and controlling the detrimental host response. The probiotic approach may prove beneficial in achieving these treatment objectives. The potential mechanisms through which probiotic organisms can improve periodontal health, including their ability to adhere and bind to oral surfaces[4,5,6], co-aggregate with Fusobacterium Nucleatum[7], inhibit pathogens through various substances[8,9], and modulate the equilibrium between pro-inflammatory and anti-inflammatory cytokines serve as a pivotal mechanism in regulating immune health.[10] (Figure 1)

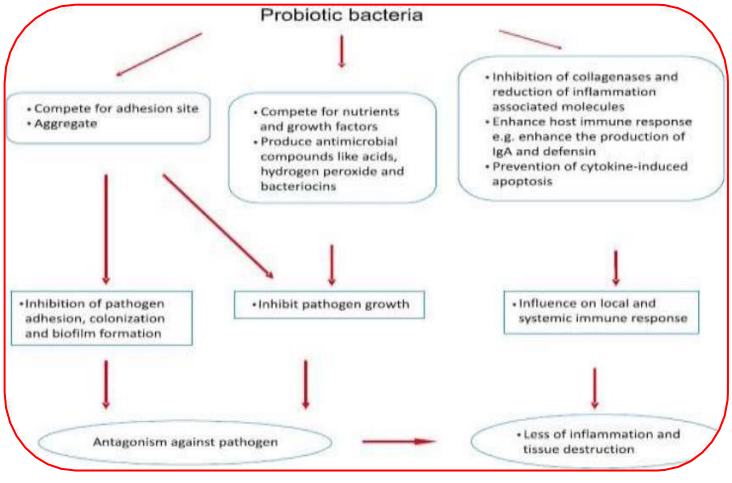

Figure 1: Mechanism of probiotics bacteria

Probiotics of Interest for Oral Health:

The rise of antibiotic-resistant bacteria has prompted an exploration of probiotic interventions for dental well-being. This strategy addresses oral concerns such as dental caries, periodontal disease, and halitosis. To qualify as a potential oral health probiotic, a microorganism must possess the ability to adhere to and colonize diverse surfaces within the oral cavity. Lactobacillus and Bifidobacterium are the most commonly employed bacterial strains for oral health probiotics. Lactobacilli constitute approximately 1% of the cultivable oral microflora in humans, with various species present in saliva and dairy products. Additionally, Weissella cibaria, previously classified as Lactobacillus, demonstrates the ability to secrete hydrogen peroxide and bacteriocins that combat gram-

positive bacteria, aggregate with Fusobacterium nucleatum, and adhere to epithelial cells, which could facilitate its colonization in the oral cavity and inhibit the proliferation of harmful bacteria.

Probiotics in Periodontal Disease:

Periodontitis comprises a collection of interconnected inflammatory conditions that result in the deterioration of tissues supporting the teeth. Pathogenic agents such as Porphyromonas gingivalis, Treponema denticola, Tannerella forsythia, and Aggregatibacter actinomycetemcomitans are commonly linked to periodontitis. These bacteria possess pathogenic attributes, enabling them to colonize subgingival regions, evade the host's defense mechanisms, and induce tissue damage. The robustness of the host's immune response also plays a crucial role in the progression of the disease. Research indicates a higher prevalence of lactobacilli, particularly Lactobacillus gasseri and Limosilactobacillus fermentum, in the oral cavity of healthy individuals compared to those with chronic periodontitis. This leads to the inhibition of Porphyromonas Gingivalis and Prevotella Intermedia growth. Notably, patients with periodontal disease who incorporated probiotic-containing chewing gum or lozenges into their routine experienced significant enhancements in their periodontal health. Moreover, additional research has shown decreased gingival index and bacterial plaque deposition among patients undergoing treatment with specific probiotics.

Koll-Klais et al. observed a higher prevalence of Lactobacilli, specifically L. gasseri and L. fermentum, in the oral cavity of healthy individuals compared to those with chronic periodontitis. Their study revealed that elevated levels of Lactobacillus in the microbiota led to an 82% inhibition of Porphyromonas Gingivalis growth and a 65% inhibition of Prevotella Intermedia growth.[9]

Individuals with periodontal disease who incorporated probiotic chewing gum or lozenges into their routine reported significant improvements in their periodontal health. In a study conducted by Krasse et al., patients treated with Limosilactobacillus reuteri-infused chewing gum exhibited notably lower gingival index and bacterial plaque levels compared to those who did not receive this treatment. The study involved 25 individuals with moderate-to-severe gingivitis and concluded that the probiotic was beneficial in reducing both gingivitis and bacterial plaque deposition.[10,11]

Riccia et al. employed lozenges containing L. brevis to investigate its anti-inflammatory effects in a cohort of patients with chronic periodontitis. The study demonstrated noteworthy enhancements not only in the plaque index, gingival index, and bleeding on probing for all participants but also a substantial decrease in salivary levels of prostaglandin E2 (PGE2) and matrix metalloproteinases (MMPs).[12,13]

In an epidemiological study, Shimazaki et al. found that individuals who regularly consumed yogurt or beverages containing lactic acid exhibited lower probing depths and less clinical attachment loss than those who consumed minimal

amounts of these dairy products. Notably, no similar effect was observed with the consumption of milk or cheese.[14]

Teughels et al. investigated the hypothesis that incorporating beneficial bacteria as an adjunct to scaling and root planing could diminish the recolonization of periodontopathogens in periodontal pockets. The study not only substantiated the hypothesis but also demonstrated the feasibility of a Guided Pocket Recolonization (GPR) method for treating periodontitis. Additionally, Oliveira et al. conducted a randomized preclinical trial in rats using Bifidobacterium animalis subspecies lactis, revealing a substantial increase in bone density and a reduction in bone loss.[15] Ricoldi et al. conducted a randomized preclinical experiment in rats, employing Bifidobacterium lactis SRP and topical irrigation with probiotics. The study revealed a significant reduction in bone resorption and attachment loss, highlighting the potential efficacy of this approach in mitigating periodontal issues.[16] Gatej and colleagues conducted a randomized preclinical experiment in rats using Lactobacillus rhamnosus GG. Their findings indicated that probiotic pretreatment, whether through oral gavage or oral inoculation, significantly reduced bone loss. This suggests a potential protective effect of Lactobacillus rhamnosus GG in the context of bone health in the studied rat model.[17] Khasenbekova et al. conducted a trial using Lacticaseibacillus casei subspecies pseudoplantarum, Lacticaseibacillus casei subspecies casei, Limosilactobacillus fermentum, and Lactobacillus helveticus through oral mucosal inoculation. The study reported a notable outcome with complete clearance of periodontal pockets, suggesting the potential effectiveness of this probiotic combination in managing periodontal health.[18] (Figure 2)

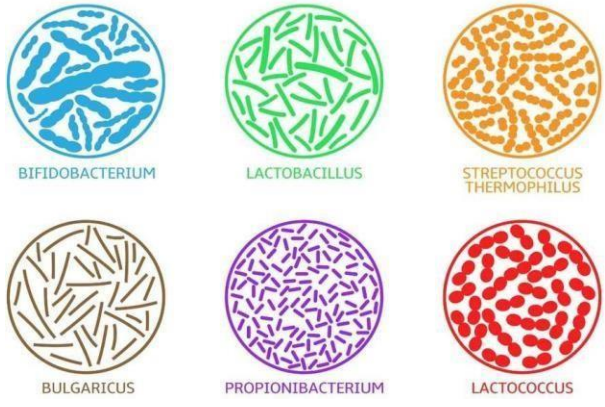

Figure 2: Probiotic Bacterial Strains

Host Modulation:

Probiotics possess the capacity to impact host immunity, exerting their effects both systemically and locally. The identification of "oral lymphoid foci" in interdental papillae in recent studies indicates the occurrence of local immune regulation within the oral cavity, extending beyond the mucosa of the gastrointestinal tract. Probiotics have been shown to activate dendritic cells, influencing T-helper cell responses and modulating immunity. These actions contribute to the control of pathogen-induced inflammation, highlighting the potential of probiotics in promoting immune homeostasis and health, particularly in the context of oral immune regulation.

Probiotics in Halitosis Management:

Halitosis, commonly known as bad breath, frequently originates in the oropharynx, with factors such as tongue coating, gingivitis, periodontitis, and tonsillitis playing key roles. The primary culprits behind bad breath are volatile sulfur compounds (VSCs) produced by specific bacteria, including F. nucleatum, P. gingivalis, P. intermedia, and T. denticola. Weissella cibaria has demonstrated effective inhibition of VSC production, and its capacity to coaggregate with other periopathogens can significantly reduce secondary biofilm colonization. This dual action contributes significantly to the reduction of VSC synthesis, making Weissella cibaria a promising candidate for addressing halitosis.[19]

Prebiotics:

Prebiotics refer to non-digestible oligosaccharides that have the capacity to influence the growth of beneficial commensal bacteria in the gut, thereby providing advantages to the host. When prebiotics are combined with probiotics, this synergistic approach is known as synbiotics. By combining prebiotics with probiotics, synbiotics aim to enhance and promote the growth and activity of beneficial microorganisms in the gastrointestinal tract, contributing to overall gut health and well-being.

Probiotics Availability:

Fermented vegetables like turnips and cabbage are traditional in Northern European cuisine. Kombucha, a fermented tea, enjoys popularity in Russia and China, while Japan favors probiotic beverages such as water kefir (Tibicos) and water crystals. Ginger beer, created from a symbiotic bacterial and yeast culture, is a known beverage. Morocco is famous for its lemons pickled in a probiotic-rich manner. Coconut kefir, derived from fresh coconut water, is another probiotic beverage. Sour pickles, which promote the growth of Lactobacillus, are distinct from vinegar pickles and serve as a source of probiotics.

Dairy products also contribute significantly to probiotic intake. In India, the commercially available "BION," combining pro- and pre-biotics, includes 0.48 billion Lactobacillus bifidum, Streptococcus thermophilus, and 0.10 billion Saccharomyces boulardii spores, along with 300 mg fructo-oligosaccharides. It is recommended as a single daily dose before morning meals.

Notably, there are no substantial safety concerns associated with probiotic organisms, as they have been deemed safe (GRAS) by the Food and Drug Administration (FDA).

Probiotic microbe selection criterion.

- Longevity
- High cell viability, resistance to low pH and acids
- Capable of interacting with or sending signals to immune cells
- Adhesion to eliminate the flushing effect
- Must be of human origin
- Processing resistance
- Have an impact on local metabolic activity

There have been reported cases of bacteremia and fungemia in individuals with compromised immune systems, particularly those with gastrointestinal illness and chronic diseases. An

instance of Lactobacillus endocarditis was noted in a patient who underwent dental treatment while being treated with Lacticaseibacillus rhamnosus.

These observations highlight the importance of caution and consideration, especially in individuals with weakened immune systems or underlying health conditions, when using probiotics or undergoing dental procedures that may introduce bacteria into the bloodstream. It underscores the need for healthcare professionals to assess the risks and benefits of probiotic use on a case-by-case basis, particularly in individuals with compromised immune function.[14] While probiotics are generally considered safe for consumption, there have been isolated reports of adverse effects. In one case, a liver abscess was recorded in an individual taking Lactobacillus rhamnosus GG. Additionally, in some instances, probiotic immune system stimulation has been associated with potential complications, particularly in individuals with autoimmune disorders, where it may exacerbate degeneration.

Furthermore, concerns have been raised about the possibility of probiotics conveying antibiotic resistance, impacting the effectiveness of antibiotic treatments. This emphasizes the importance of using probiotics judiciously, particularly in individuals with underlying health conditions and consulting with healthcare professionals to evaluate the potential risks and benefits based on individual health circumstances.[20] Therefore, it becomes apparent that the meticulous choice of a probiotic strain tailored to a specific disease is crucial. Equally important are the methods and timing of administration, along with considering the age of the individual consuming probiotics.

Probiotics Dosage:

A unanimous agreement on the minimum quantity of microorganisms required for a positive impact has not been reached. Probiotics and prebiotics come in various forms, such as powder sachets, gelatin capsules, or solutions. Probiotics and prebiotics are available in powder sachets, gelatin capsules, or solutions.

Dosage and Safety:

The optimal dosage of probiotics remains debatable, and they are available in various forms, such as powder sachets, gelatin capsules, or solutions. Preparations like "BION" are commercially available, containing specific probiotic strains and prebiotics for daily consumption. While probiotic organisms have generally been recognized as safe (GRAS) by the FDA, it is essential to carefully select the appropriate strain for specific health conditions and consider factors like delivery methods and patient age.

Conclusion:

Probiotics present an exciting opportunity in the field of healthcare, offering an alternative to traditional antibiotics and contributing to the fight against antimicrobial resistance. Strong periodontal health is integral to overall well-being, and probiotics show promise as safe and effective solutions for periodontal health improvement.

However, further research is necessary to determine the optimal probiotic strains, delivery methods, and their efficacy in addressing various oral health issues. Therefore, while exploring probiotics in the context of periodontal health is still in its early stages, it holds considerable potential for treating periodontal diseases.

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