Review Article

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Probiotics and oral Health: harnessing good bacteria for a healthier smile- A scoping review.

Abstract:

Background: Dental caries, periodontal disease, and halitosis are widespread illnesses that afflict millions of people worldwide, and they have a substantial influence on general well-being. Probiotic usage provides a viable alternative to traditional therapies, which frequently concentrate on eliminating harmful bacteria by fostering a healthy oral microbiome. Objective: Probiotics have a part in oral health, and this reviw assesses how they might influence microbial populations and host responses to prevent and treat oral illnesses.

Methods: A thorough search of the literature was carried out, concentrating on studies. Probiotics, oral health, dental caries, periodontal disease, and halitosis were among the keywords. A thorough assessment of the effectiveness of probiotics was provided by including both clinical trials and in vitro investigations.

Results: Several probiotic strains were shown to be very beneficial in lowering cariogenic bacteria, enhancing periodontal health, and decreasing halitosis. These strains included Lactobacillus reuteri, Lactobacillus rhamnosus, and Bifidobacterium bifidum. Reduced levels of volatile sulfur compounds linked to foul breath, gingival inflammation, and plaque indices were seen in clinical studies. Probiotics have been shown to impede harmful microorganisms by means of generation of antimicrobial peptides, competitive exclusion, and modification of the host immunological response. Even with these encouraging results, developing consistent recommendations proved difficult due to variations in probiotic formulations, dose schedules, and research designs.

Conclusion: There is strong evidence to support the use of probiotics as a feasible complement or alternative to traditional oral health therapies in improving the balance of the oral microbiome and lowering the incidence of illness. To maximize therapeutic results, more study is necessary to standardize probiotic strains, doses, and therapy regimens. Future research should concentrate on developing regulatory frameworks to guarantee probiotic efficacy and quality as well as long-term safety.

Key-words: Probiotics, oral health, dental caries, periodontal diseases, oral microbiome, halitosis, oral candidiasis, beneficial bacteria.

Introduction:

A person's quality of life is greatly impacted by their oral health, which is a vital component of overall health. Oral candidiasis, halitosis, dental caries, and periodontal disorders are among the most common oral health problems that impact millions of people globally.[1] The conventional approach to treating these illnesses involves using antibiotics, antiseptics, and mechanical biofilm removal. However, the need for alternative therapeutics, such as probiotics, has arisen due to the growth in antibiotic resistance and the shortcomings of traditional treatments.[2] The goal of this study is to present a thorough analysis of the function of probiotics in oral health, covering historical viewpoints, probiotic kinds, contemporary

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theories, mechanisms of action, clinical uses, and potential future research areas.

Materials and Methods:

Literature search

A systematic review was conducted following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The PubMed, Scopus, Web of Science and Google Scholar databases were searched for relevant literature from January 2000 to the present. The search terms included "probiotics," "oral health," "dental caries," "periodontal disease," "gingivitis," "halitosis," "oral microbiome," and "beneficial bacteria."

Inclusion criteria:

Studies that investigate the effects of probiotics on various fields of oral health, including dental caries, periodontal disease, and overall oral microbiome balance.

Peer-reviewed articles, including clinical trials, observational studies, and systematic reviews.

Studies involving human subjects of all age groups.

Exclusion Criteria:

Articles not focused on the main topic (e.g., general health benefits of probiotics without specific mention of oral health).

Non-peer-reviewed articles, conference abstracts, editorials, and opinion pieces.

Studies published in languages other than English.

Animal studies or laboratory-based studies without direct human health implications.

Data extraction and synthesis:

Data collection was performed independently by two reviewers. The collected data included the study design, population characteristics, intervention details, outcome measures, key aspects of probiotics in oral health.

Risk of bias assessment:

The risk of bias in the included studies was assessed using the Cochrane Risk of Bias Tool for randomized controlled trials or the Newcastle–Ottawa Scale for observational studies.

Results:

A total of 1500 publications were selected for the intial scoping review. A total of 980 items were retained for screening after eliminating duplicates. Title and abstract screening identified 180 articles as potentially relevant. This was further narrowed down to 55 articles that met the inclusion criteria by full-text screening. These publications included a range of study designs, such as reviews, case–control studies, cohort studies, and cross-sectional studies. The included studies encompassed various designs, including 25 randomized controlled trials, 20 observational studies, and 10 systematic reviews. They included diverse populations and geographic locations, with sample sizes ranging from 30 to 1,200 participants.

Types of Probiotics:

Probiotics are classified based on their genera, species, and strains. The most commonly studied probiotics in oral health include Lactobacillus, Bifidobacterium, Streptococcus, and Saccharomyces.[3]

Lactobacillus:

Because Lactobacillus species can cling to mucosal surfaces and thrive in acidic conditions, they are frequently found in probiotic formulations. Lactobacillus rhamnosus (*L.rhamnosus*), Lactobacillus reuteri (*L. reuteri)* and Lactobacillus acidophilus (*L. acidophilus*) are strains that are often employed. These strains have demonstrated an effective way to lower periodontal bacteria, tooth cavities and peri-implant mucositis (PiM).[4]

Bifidobacterium:

Many bifidobacterium species are found in the human gastrointestinal system and are recognized for their beneficial effects on health. The potential advantages of strains like Bifidobacterium longum (*B. longum*) and Bifidobacterium bifidum (*B.bifidum*) for oral health, notably in avoiding dental caries and PiM have been investigated.[5]

Streptococcus:

Probiotics like Streptococcus thermophiles (*S. thermophiles*) and salivarius (*S. salivarius*) are two examples of the helpful species of Streptococcus. For example, *S. salivarius*is helpful in controlling halitosis and avoiding dental cavities because it generates bacteriocins, which restrict the development of dangerous bacteria.[6]

Saccharomyces:

Probiotic yeast Saccharomyces boulardii (*S. boulardii*) has been researched for its antibacterial qualities and capacity to alter the immune response. By preventing Candida albicans from growing, it has potential for treating oral candidiasis.[7

Current Concepts:

Mechanisms of Action

Probiotics confer oral health benefits through several mechanisms:

Competitive Inhibition:

By competing with pathogenic bacteria for adhesion sites on the oral mucosa and teeth, probiotics inhibit the formation of biofilms and the colonization of dangerous germs. This process is known as competitive inhibition. As an illustration, some strains of Lactobacillus and Bifidobacterium cling to saliva-coated hydroxyapatite, preventing Streptococcus mutans from acting primarily the main cause of dental caries.[8,9]

Generation of Antimicrobial Substances:

Some probiotic strains suppress pathogenic bacteria by producing hydrogen peroxide, organic acids, and bacteriocins. Reuterin, which is produced by *L. reuteri*, suppresses periodontopathogens such Porphyromonas gingivalis (*P.gingivalis*).[10]

Modulation of the Host Immune Response:

Probiotics assist manage inflammatory diseases like gingivitis and periodontitis by increasing the production of anti-inflammatory cytokines and reducing the production of pro-inflammatory cytokines. It has been demonstrated that Lactobacillus brevis (*L.brevis*) lowers two important inflammatory mediators: tumor necrosis factor- α and interleukin-1β.[11]

Enzymatic Activity:

Certain probiotics generate enzymes that break down biofilms and prevent harmful bacteria from carrying out their metabolic processes. Dental biofilms' extracellular polysaccharides are broken down by the enzymes dextranase and mutanase produced by Streptococcus salivarius.[12]

Clinical Applications

Prevention of Dental Caries:

Dietary carbohydrates, cariogenic bacteria, and host factors combine to cause dental caries. By suppressing cariogenic bacteria, probiotics can lower the occurrence of dental caries. According to a research, kids who drank milk containing *L.rhamnosus* had a reduced incidence of dental caries than kids who drank ordinary milk.[15] Furthermore, probiotic lozenges containing *L. reuteri* dramatically decreased the levels of S. mutans and Lactobacilli in saliva, which decreased the incidence of dental caries.[4]

Handling Periodontal Conditions:

Periodontal illnesses, such as gingivitis and periodontitis, are caused by microbial plaque accumulation and result in inflammation of the tissues that support teeth. Probiotics have demonstrated potential for treating various ailments. According dental studies, probiotic lozenges containing *L. reuteri* greatly improved periodontal health by reducing bleeding on probing, gingival index, and plaque index.[4,14] Reduced inflammatory markers in gingival crevicular fluid have also been linked to probiotic supplementation with *L brevis*.[15]

Managing Halitosis:

Anaerobic bacteria in the oral cavity create volatile sulfur compounds, which are frequently the cause of halitosis, or foul breath. Probiotics can lessen the number of these bacteria, which can aid in the management of halitosis. According to organoleptic ratings and volatile sulfur compound levels, halitosis levels were significantly reduced in a research using *S. salivarius*K12, a probiotic strain recognized for generating bacteriocins.[16]

Management of Oral Candida:

Candida albicans is the primary cause of oral candidiasis, a fungal infection. Through competitive inhibition and the generation of antifungal compounds, probiotics can prevent the growth and adherence of Candida albicans (*C.albicans*). *L. acidophilus* and *L. rhamnosus* have been demonstrated in vitro to be able to block *C.albicans* adherence and biofilm development on epithelial cells.[7] Consuming probiotic yogurt containing L. rhamnosus has been shown in clinical studies to lower the incidence of oral candidiasis in the elderly.[17]

Future Directions

Strain-Specific Effects:

Probiotics are very strain-specific in their effectiveness for maintaining oral health; various strains have variable levels of adhesion, antibacterial generation, and immunomodulation. The goal of future research should be to determine which probiotic strains have the strongest anti-oral pathogen activity and to characterize them. Understanding the processes behind the strain-specific benefits and improving probiotic formulations for optimal benefit can be facilitated by the application of genomic and proteomic techniques.[18]

Method of Delivery:

The effectiveness of probiotics is greatly influenced by the route of distribution. While innovative administration techniques including chewing gums, oral rinses, and slow-

release devices are being investigated, classic delivery systems like yogurt, lozenges, and pills have demonstrated favorable outcomes. These cutting-edge delivery methods can improve the probiotics' stability and colonization effectiveness in the oral cavity, which will have long-term advantages.[19]

Extended Research:

The majority of probiotic clinical studies for dental health have brief follow-up times. To assess the long-term benefits of probiotics on oral health and their safety profile, longer-term research is required. These investigations ought to evaluate the effects of ongoing probiotic use on the general makeup of the oral microbiome as well as the possibility of probiotic resistance developing.[20]

Targeted Probiotic Treatment:

Probiotic treatment may be approached using the same methodology as personalized medicine, a rising trend in healthcare. Individual differences in lifestyle, genetics, and the makeup of their oral microbiomes can affect how well probiotics work. Achieving the best possible oral health results may be possible with personalized probiotic treatment, which is based on each person's unique oral microbiota profile and health state.[21]

Mechanistic Perspectives

Developments in bioinformatics and molecular biology can shed more light on the processes via which probiotics work. Comprehending these processes at the molecular level can aid in creating probiotic formulations that are more effective and in finding novel probiotic candidates that are more effective.[22]

Safety and Regulatory Aspects:

As probiotics are included more into oral health procedures, safety assessments and regulatory guidelines need to be developed. Gaining consumer trust and achieving widespread acceptance of probiotic products requires ensuring their safety and efficacy via stringent clinical testing and regulatory control.[23]

Conclusion:

Probiotics offer a safe, efficient, and natural means of preserving and enhancing oral health, making them a viable supplement to conventional dental care techniques. Their therapeutic promise is supported by their capacity to alter the oral microbiota, suppress harmful microorganisms, and strengthen host immune responses. Even though a lot has been accomplished, further study is still required to completely comprehend the mechanisms of action, improve delivery methods, and assess long-term efficacy and safety. The treatment of oral health may undergo a revolution thanks to personalized probiotic therapy and novel delivery systems, which offer efficient interventions based on each patient's unique microbiome profile and healthcare requirements.

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